

Backyard Poultry Mortality Associated with Highly Pathogenic Avian Influenza (HPAI) H5N1 outbreaks in Nigeria

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Abstract: Backyard poultry farms infected with highly pathogenic avian influenza (HPAI) H5N1 virus in Nigeria between 2006 and 2008 were investigated for morbidity, mortality and Pathology. Affected farms raised local chickens, duck, turkey, guinea fowl and geese and were already confirmed to be infected with HPAI virus by virus isolation and reverse transcriptase polymerase chain reaction at the National Veterinary Research Institute, Vom Nigeria. Backyard local chickens recorded the highest number of death with 89.4% of the total flock size while the duck had the highest mortality rate at 87.1%. Mortality rate was least in guinea fowls (20.55%), and above average in geese (54.64%). For Pathology, submitted carcasses comprised of sixty (60) chickens, twenty-nine (29) ducks, thirty-seven (37) turkeys, fourteen (14) guinea fowls and twelve (12) geese which were examined for gross morphological changes and histopathology. Though lesions sparingly occurred in these village poultry, main pathologic findings were associated with the nervous, circulatory, respiratory, and gastro-intestinal systems and occasionally lesions were general unspecific and multi-systemic. It was observed that mortality rate was highest in duck, then chicken and turkey compared to guinea fowl and geese while lesions were milder and mortality were acute in these flocks.

Key words: backyard poultry, morbidity, mortality, pathology

I. Introduction

Highly Pathogenic Avian Influenza (HPAI) is an acute, generalized, fatal disease in chickens and turkeys however, other gallinaceous birds such as ducks, guinea fowls, geese, quails, ratites, passerine bird, flamingos, herons and raptors [1] are also susceptible to HPAI. HPAI is caused by avian influenza viruses (AIVs) that are extremely virulent, causing up to 100% mortality [2] in domestic chickens. Nigeria experienced an outbreak of HPAI H5N1 virus in both commercial and local poultry populations during January 2006 [3] as an extension of the global outbreaks. It was anticipated that the confirmation of the first outbreak of HPAI on the African continent could have multiple consequences [4] if it spread further to wild and domestic birds. This is because, it is common practice to keep rural poultry in free-range, multispecies, multiage holdings that have low biosecurity levels thus exposing them to many at-risk contacts, and they could act as the epidemiologic link between the wild reservoir of AI viruses [5] and industrial poultry. This was evident in Nigeria as new cases of HPAI (H5N1) were detected during the surveillance activities [6] at the live bird markets in July 2008 in Gombe city, Gombe state after a 9-month period of influenza outbreak. Rural poultry sector of Africa has the scavenging indigenous domestic fowl (*Gallus domesticus*) as the predominant species [7], which in most African countries have no regular health control programme [7], may or may not have shelter, and scavenge for most of their nutritional needs. In fact, village chickens have been reported to act as potential reservoirs and carriers of infections to themselves and to the more susceptible exotic breeds [8] in commercial poultry farms. This is demonstrated by the episodes of mortality that characterized the first outbreak of HPAI in Nigeria in a farm that had predominantly commercial birds with a small stocks that included turkeys, geese and ostriches as reported [4,9] and this may have preceded the national catastrophe of AI outbreaks. Also, it is queried that the epidemic of AI might have spread from Jigawa state to Kano state [10] because from December 2005 to January 2006, history revealed that local poultry in Jigawa state have been dying as a result of a disease that was more devastating than the annual epidemic of Newcastle disease [10], usually experienced during the cold, windy harmattan period. In the north of Nigeria, Jigawa and Yobe states are home to the Hadejia- Nguru wetlands, characterized by permanent and seasonal lakes and a numerous population [11] of migratory and residential waterfowl. This area also sustains a large backyard poultry population and the highest concentration of domestic ducks [11], reared under free-range conditions, providing opportunities for contact between wild birds and backyard poultry. During these HPAI outbreaks in backyard poultry in Nigeria, production losses were recorded and several attempts were made to determine the losses in terms of number of poultry, monetary [12] and social value as a result of the disease burden in Nigeria. These attempts have been at some point in the course of the disease [12] or aimed at north-western region of the country [10] or in part [13] due to some identified constraints. Also there exist no overall, detailed clinical and pathological record of the findings on a case by case basis for all the outbreaks as seen from different state and regions of the countries which could highlight

the disease mechanism and the factors involved in the spread of the disease. This study is set to achieve the determination of the losses on a state by state basis and the total losses recorded during the overall course of the disease as well as the trends in the lesions observed during HPAI outbreaks in backyard poultry in Nigeria.

II. Materials and Methods

Data: All the data on state, location, farm flock size, morbidity and mortality records used in this study were supplied in questionnaires directly by clients who reported and submitted carcasses of local chicken, duck, turkey, guinea fowl and geese for post-mortem examination and avian influenza diagnosis at the National Veterinary Research Institute's (NVRI) Central Diagnostic Laboratory, Vom.

Carcasses: A total of one hundred and fifty-two (152) carcasses comprised of 60 chicken, 29 duck, 37 turkey, 14 guinea fowl and 12 geese from eighty (80) farms in sixteen (16) states and the Federal Capital Territory, Abuja were examined. These carcasses were submitted directly by clients for post-mortem examination and avian influenza diagnosis and were selected based on laboratory confirmation of HPAI H5N1 virus infection by virus isolation and reverse transcriptase polymerase chain reaction at the NVRI laboratory.

Clinical signs and Pathology: Carcasses of the backyard birds that died after natural infection with HPAI were submitted for pathologic examination. Following postmortem examination of the carcasses, samples of liver, heart, spleen, kidney, lung, trachea, proventriculus, gizzard, duodenum, ileum, cecum, and brain were removed and fixed in 10% buffered formalin. All tissue samples were then embedded in paraffin, sectioned at 5 µm, mounted on clean glass slides and stained with hematoxylin and eosin (HE) stains for histopathologic examination using low and high powered field of Carl Zeiss® or Nikon® binocular microscope.

III. Results

Data set distribution

The HPAI outbreaks and virus detection in Nigeria spanned between 2006 and 2008, during this period, a total of fifteen (15) states (Kano, Jigawa, Kaduna, Katsina, Zamfara, Adamawa, Bauchi, Yobe, Bornu, Benue, Nasarawa, Plateau, Taraba, Lagos and Edo) and the Federal Capital Territory, Abuja in five geographical regions of Nigeria had confirmed HPAI H5N1 outbreaks in backyard chicken, duck, turkey, guinea fowl and geese (Table1). A total of eleven thousand, five hundred and forty-six (11,546) backyard local chicken, duck, turkey, guinea fowl and geese were reported dead of a total flock size of fourteen thousand, five hundred and twelve (14,512) backyard poultry.

Table 1. Backyard poultry losses in HPAI infection in Nigerian states and region

Region	State	flock size	No. dead	Backyard poultry type
North West	Kano	22	13	Geese, turkey
	Jigawa	9343	9062	Chicken, duck, turkey, guinea fowl
	Kaduna	425	179	Chicken, duck, turkey, geese
	Katsina	127	127	Chicken, duck, turkey, guinea fowl, geese
	Zamfara	1	1	Chicken
Regional subtotal		9918	9382	
North East	Adamawa	250	37	Chicken, guinea fowl, mixed
	Bauchi	737	451	Chicken, duck, turkey, guinea fowl
	Yobe	6	6	Chicken, duck
	Bornu	50	29	Chicken
Regional subtotal		1043	523	
North Central	Benue	500	500	Chicken
	Abuja	40	37	Chicken, geese
	Nasarawa	2298	509	Chicken, duck, turkey
	Plateau	50	6	Chicken, duck
	Taraba	103	89	Chicken, duck, turkey
Regional subtotal		2991	1141	
South West	Lagos	60	High	Chicken
Regional subtotal		60	High	
South South	Edo	500	500	Duck, turkey
Regional subtotal		500	500	
	Total	14512	11546	

Mortality

Mortality rate (Table 2), was highest in ducks (87.1%), and followed by local chicken (82.13%) and turkey (80.59%). Geese had a mortality rate of 54.64% and the lowest mortality rate was observed in guinea fowl (20.55%). The difference of the total flock size and the total number dead (2,966) was stamped-out (Table 2) as a result of the Nigerian government policy on the control of the spread of the disease. Backyard local chickens recorded the highest number of dead with 89.4% of the total flock size affected in 37 farms and 10,657 (92.30%) were reported dead, while the duck had the highest mortality rate at 87.1%. Turkey was next, of which 505 (3.47%) were affected and 407 (3.52%) were reported dead. The duck (table 2) was next of which 356 (2.45%) were affected and 310 (2.68%) was reported dead. 579 (3.98%) guinea fowls were affected and 119 (1.03) was reported dead. The least affected was geese of which 97 (0.66%) was affected and 53 (0.45%) was reported dead.

Table 2. Mortality rates in HPAI infected backyard poultry species in Nigeria

Backyard Poultry	No. farms	Flock size	No. dead	Stamped out	Mortality rate (%)
Chicken	37	12975	10657	2318	82.13
Duck	15	356	310	46	87.1
Turkey	14	505	407	98	80.59
Guinea fowl	8	579	119	460	20.55
Geese	6	97	53	44	54.64
Total	80	14512	11546	2966	79.56

Clinical signs and Pathology

Main clinical sign reported in backyard poultry is sudden death, which occurred in 72.9% of turkeys, 58.6% in ducks, 57.1% of guinea fowls and 35% of local chickens and in 8.3% of geese. Signs were rarely observed and reported in these poultry species, as they were seen to die suddenly without premonitory signs although paralysis, ataxia and torticollis, dyspnea, coughing, sneezing and diarrhea were occasionally seen and reported. Main pathologic findings were observed in the nervous, circulatory, respiratory, musculoskeletal and intestinal systems and occasionally lesions are multi-systemic. Lesions observed in the circulatory system included cyanosis of comb and wattle, comb and wattle edema, facial and subcutaneous edema. Within the respiratory system, there were nasal discharges, airsacculitis and pneumonia. While petechiation to ecchymoses of the proventricular, and intestinal mucosal with resultant enteritis in the intestinal system were observed. There were inflammatory, degenerative and necrotic lesions in the musculoskeletal system.

Local Chicken: lesions of the circulatory system (cyanosis of comb and wattle with occasional facial edema) were exhibited by 24 (40%) chickens (Table 3). While only 5 (8.3%) showed nervous lesions of neuronal and purkinje cell necrosis of the cerebrum and cerebellum respectively. Respiratory lesions of nasal exudation, airsacculitis and pneumonia were evident in 19 (31.6%). Enteric petechiation and ecchymoses was observed in 21 (35%) of the carcasses. Only 17 (28.3%) had muscular hemorrhages with necrosis, and or myositis. Twenty-one (35%) of the local chickens died suddenly or were from flocks with high mortality.

Duck: Sixteen of the ducks (55.1%) exhibited one or more lesions of the circulatory system, while only four (13.7%) showed nervous lesions of neuronal and purkinje cell necrosis of cerebrum and cerebellum respectively (Table 3). There was nasal exudation, airsacculitis and pneumonia in 16 (55.1%). Enteric petechiation and ecchymoses was observed in 10 (34.4%) of the carcasses and only one (3.4%) had muscular hemorrhages with necrosis, and or myositis. Seventeen ducks (58.6%) died suddenly or were from flocks with high mortality.

Turkey: circulatory lesion was most common in the infected turkeys. Thirty of the turkeys (81%) exhibited one or more signs and lesions of the circulatory system, while respiratory lesions of nasal exudation, airsacculitis and pneumonia was evident in seventeen (45.9%). This is followed by enteric petechiation and ecchymoses observed in 13 (35.1%) of the carcasses. Nervous lesion was less common (Table 3).

Guinea fowl: Enteric petechiation and ecchymoses was the most common lesion observed in 6 (42.8%) of the carcasses. Three guinea fowls (21.4%) exhibited lesions of the circulatory system and only one (7.1%) showed nervous lesion of neuronal and purkinje cell necrosis of cerebrum and cerebellum respectively. Eight guinea fowls (57.1%) had history of sudden death and exhibited multisystemic lesions (Table 3).

Geese: respiratory lesion of nasal exudation, airsacculitis and pneumonia were evident in ten (83.3%) geese. Seven (58.3%) showed nervous lesions of neuronal and purkinje cell necrosis of cerebrum and cerebellum respectively. Enteric petechiation and ecchymoses was observed in 4 (33.3%) of the carcasses.

Table 3. Systemic lesion in HPAI infection in backyard poultry species in Nigeria

Bird type	Percentage of carcasses with HPAI lesion						
	No. of carcasses examined	Circulatory	Nervous	Respiratory	GIT diarrhea	Musculo-skeletal	multisystemic
Backyard chicken	60	40%	8.3%	31.6%	35%	28.3%	35%
Duck	29	55.1%	13.7%	55.1%	34.4%	3.4%	58.6%
Turkey	37	81%	2.7%	45.9%	35.1%	8.1%	72.9%
Guinea fowl	14	21.4%	7.1%	28.5%	42.8%	28.5%	57.1%
Geese	12	16.6%	58.3%	83.3%	33.3%	-	8.3%
Total	152	-	-	-	-	-	-

IV. Discussion

It was observed that of the 36 states in the 6 geographical regions of Nigeria, 15 states in 5 geographical regions excluding south-eastern region reported outbreak of highly pathogenic avian influenza virus in backyard poultry flocks. The northwestern region was observed to report the highest number of mortalities in backyard poultry in the country. The mortality figure of 9,382 represents 81.25% of the total number of backyard poultry that was reported dead as a result of HPAI in this study. In a northwestern regional [10] avian influenza investigation, this region also show very high number of affected poultry flocks, apart from the fact that it was in this region the first outbreak of HPAI in Nigeria was reported [4, 14] in a farm that had predominantly commercial birds [9, 15] with a small stocks that included turkeys, geese and ostriches. The total number of bird losses as a result of natural HPAI death and stamping out policy in this region which stands at 9,918 was the highest only followed by the North central region where backyard poultry losses totaled 2,991 and the number that died as a result of HPAI when the reporting was done was 1,141 being 9.88%. The finding of high mortality in the North western states [9, 10] is consistent with earlier reports. In the north-western regional analysis by [10], which excluded bird losses in one north-western state of Sokoto, four hundred and eighty thousand, three hundred and seventy-eight (480, 378) birds were reported as being lost as a result of HPAI incursions and stamping-out. This figure did not separate between the various sectors of poultry production systems, as it included backyard flocks and commercial flock. The North-eastern states had a mortality of 523 (4.52%) being the total number of backyard poultry that died as a result of HPAI, while the total number of bird loss as a result of natural death and stamping out policy in this region was 1043. One state each from the south-west (Lagos) and the south-south (Edo) reported confirmed HPAI infection in backyard poultry with bird losses of 60 and 500 respectively. Lagos state is a commercial and industrial nerve center of the country, therefore backyard poultry farming rarely exist, and this is the reason for the low reporting of HPAI infection, although the mortality figure was not given. In the backyard poultry, otherwise classified as the sector 4 of poultry production systems practiced in Nigeria [16], the domestic local chicken was most hit by the highly pathogenic avian influenza outbreaks experienced by the Nigerian village poultry households. With a total flock size of 14,512 lost in 80 backyard farms having confirmed outbreaks, the backyard domestic local chicken suffered a major economic loss and devastation with death and stamping-out in 12,975 chickens representing a mortality rate of 89.4% which is the highest for any species. This corroborates the dominance of the scavenging indigenous domestic fowl (*Gallus domesticus*) species in the rural poultry sector [7, 17] of Africa. Although the commercial poultry production system suffered the greatest losses [18] during the HPAI outbreaks in Nigeria, the losses suffered by the backyard poultry is important because these birds are kept by the rural poor and often serve as means of livelihood. It was also observed that as at the time of reporting by livestock owners and farmers, the presence of disease as evident by high death rate 2-3 days post onset of disease, the duck had the highest mortality rate of 87.1% and the guinea fowl had the least mortality rate of 20.55%. The other mortality rates recorded were: 82.13 % in domestic chicken, 80.59% in turkey and 54.64% in geese. The overall clinical signs reported and the necropsy findings in the 152 carcasses examined of which 60 were backyard domestic chicken, 29 were duck, and 37 were turkey and 14 guinea fowl and 12 geese revealed sudden death as the most observed clinical finding in turkeys (72.9%), and in decreasing order in duck, guinea fowl, local chicken and geese. This corroborates our earlier observation in local chickens during early HPAI outbreaks in Nigeria where acute mortalities were observed but with little or no premonitory signs and with or without gross lesions [3] in affected backyard local chickens. This study also revealed lesion of the respiratory system, as the most common gross finding in geese (83.3%) while more than half of the necropsied geese showed lesions of the nervous system (Table 3). Other most common lesions observed included circulatory disturbance and muscular hemorrhages in local chicken, and circulatory disturbance and respiratory lesions in domestic ducks. The data presented in this work are based on reported, submitted and confirmed HPAI cases. This did not included unreported cases and HPAI negative cases. It is hoped that in the future, factors responsible for some of the unresolved findings will be looked into.

V. Conclusion

This study was able to document the bird losses in HPAI infected backyard poultry in Nigeria on a state by state and region by region cases, hitherto which has not been carried out. It also showed highest percentage dead of 89.4% observed in the domestic chicken which is the highest for any species, while mortality rate was highest in ducks.

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