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Evaluation of knowledge, attitudes and practices on avian influenza among live bird market workers in Kaduna Metropolis, Nigeria

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Abstract

Highly pathogenic avian influenza (HPAI) is of public health significance due to its potential to infect humans and cause a pandemic. The study was therefore carried out to assess knowledge, attitude and practice (KAP) on avian influenza and biosecurity among poultry workers (poultry sellers and poultry processors) in Live Bird Markets (LBMs) in Kaduna Metropolis, Nigeria. Structured questionnaires were administered to 100 poultry workers at the LBMs in a cross-sectional study to determine their level of knowledge, attitudes and practices concerning avian influenza and biosecurity measures in the LBMs. The majority of the people (54%) who worked in the LBMs were between the ages 21-40 years, they had the highest acceptable knowledge scores (77.8%) and the acceptable attitude scores (18.5%). Most of the poultry workers (72%) agreed that they were safe from AI infection even without proper protective equipment when handling poultry, 16 % disagreed, while 12% were not sure or did not know. This poses a potential danger of the spread of avaian influenza (AI) in humans and animals in the study area. Poultry sellers and processors in the LBM had high level of knowledge but low level of attitudes and practices, signifying high potential of acquiring AI infection. Poultry workers should be properly trained on personal hygiene, provided with appropriate personal protective equipment and be encouraged to use these protective wears while at work to reduce economic and public health risk.

Keywords: Attitudes, Avian influenza, Biosecurity, Knowledge, Pandemic, Practices

Introduction

Avian influenza is an acute and highly infectious viral disease of birds caused by influenza A viruses (IAVs) of the genus Alphainfluenzavirus, family *Orthomyxoviridae*. It is a segmented, negative-sense RNA virus with genome encoding 10 core proteins and a variable number of accessory proteins (Peacock *et al.,* 2019; Kalonda *et al.,* 2020). Influenza A viruses are commonly characterized by their combinations of surface proteins, haemagglutinin (HA) and neuraminidase (NA), giving rise to different subtypes designated, for example, as H1N1, H3N2; H5N6,

H5N8; or H9N2 (Shittu *et al.,* 2020; Kabantiyok *et al.,* 2021; Laleye *et al.,* 2021).

Influenza surveillance among humans and animals in Nigeria is poor due to its weak public health infrastructure and agriculture assistance programs. This lack of animal and health control measures, along with inadequate risk perception among poultry workers likely help to facilitate HPAI virus spread (Fatiregun & Saani, 2008). Significant public health concerns also surround zoonotic H5N1 viruses. Total of 862 laboratory-confirmed human infection, including at least 455 fatalities, have been reported to the World Health Organization since the reemergence of H5N1 viruses in 2003 (WHO, 2018).

Anybody in direct contact with sick or dead poultry is at risk of getting infected with AIV (WHO, 2006). Handling and slaughtering live infected chickens pose one of the biggest risks of viral exposure. Children, LBM employees, animal health service providers, poultry producers, keepers, and sellers, as well as disease control officers and animal health professionals, are among those most at risk for contracting avian influenza. "People who are in close touch with sick poultry, such as backyard flock owners and poultry employees in wet markets or live animal markets, currently pose the greatest health risk" (WHO, 2006; MacMahon *et al.,* 2008; Delgado-Hernández *et al.,* 2021). Anyone who handles or works with AI-infected poultry or in environments contaminated with the secretions or excretions of AI-infected birds is at risk of exposure and potential infection (Halpin, 2005).

For pandemics to be successfully controlled and outbreaks prevented, the public must have effective knowledge, attitudes and practices (KAPs) aimed at specific diseases (Delgado-Hernández *et al.,* 2021). Sutanto (2013) reported that LBM workers had no detailed understanding of avian influenza, had a less perceived risk of experiencing avian influenza, and had a low compliance with precautionary behaviours. As a result, biosecurity in the LBMs is woefully inadequate, increasing the threat of outbreak of HPAI in poultry and perhaps in humans as well.

A recent serosurvey study on Serosurvey for H5, H7 and H9 avian influenza viruses in local chickens in live bird markets within Kaduna metropolis, Nigeria found a low seroprevalence of 1.7% for avian influenza which still signifies the potential for spread within the LBM (Bakam *et al.,* 2023). Therefore, the current study was conducted to evaluate the knowledge, attitudes, and practices of those who work in live bird markets in Kaduna Metropolis, Nigeria – a major trade centre and a vital transportation link to surrounding agricultural areas and neighbouring states.

Materials and Methods

Study design

A cross-sectional study was carried out for a period of two months starting from 1st April to 19th June, 2017 in five live bird markets amongst poultry sellers and poultry processors in Kaduna Metropolis, Nigeria.

Study sites

Kaduna metropolis is made up of four Local Government Areas (LGAs): Kaduna North, Kaduna South, Igabi, and Chikun. These areas, which serve as the study locations, are centrally located in northern Nigeria. It serves as a key economic hub in the region, functioning as a trade centre and a vital transportation link to surrounding agricultural areas and neighbouring states (Evwiekpaefe *et al.,* 2019). The LBMs selected in Kaduna North Local Government Area (LGA) are as follows: Kawo LBM (Longitude 7°27/3.47 E, Latitude 10°34/35.45 N), Sheik Abubakar Gumi LBM (Longitude 7°25/34.55 E, Latitude 10°31/6.48 N) and Sokoto Road LBM (Longitude 7°26/2.42 E, Latitude 10°31/52.82 N). In Kaduna South LGA, Railway Station LBM (Longitude 7°25/5.46 E, Latitude 10°29/40.93 N) was sampled. Moreso, Sabon Tasha LBM (Longitude 7°31/42.35 E, Latitude 10°26/4.09 N) was sampled in Chikun LGA.

Inclusion criteria for human sampling for questionnaire

Participants were considered eligible if they provided informed consent to participate in the study, represented any age category of poultry sellers or processors, and had a minimum of six months of continuous engagement in poultry-related activities within the live bird market (LBM). Eligible individuals included those working exclusively as poultry sellers, exclusively as poultry processors, or in combined roles encompassing both activities.

Exclusion criteria for human sampling for questionnaire

Individuals were excluded if they declined to provide informed consent, had less than six months of continuous experience in poultry-related activities within the live bird market (LBM), or were no longer actively engaged in selling or processing poultry at the time of recruitment. Or other poultry workers (cleaners, suppliers, transporters).

Tools for data assembling

Structured questionnaires were administered in all the selected Live Bird Markets within Kaduna metropolis. Convenient sampling technique was used for the selection of the LBMs while purposive sampling technique was used for selecting respondents. Questionnaires were administered to consenting local chicken sellers and processors in each of the LBMs. The questionnaires sought to gather information on the local chicken processors and sellers' knowledge, attitudes, practices and trade within the live bird markets, readiness to disclose AI outbreak, sources of birds, handling of sick birds and methods of disposal of poultry wastes, sick and dead birds. Responses were graded accordingly and information collated was used to categorize the LBMs based on risk scoring.

A pilot study was conducted to assess the clarity of the questions, time allocation and instructions. Questionnaire format was adopted from published questionnaire by Sutanto (2013) and modified to better suit the objectives of this research. After validation, 100 questionnaires were administered within the study area using face to face interview. Since most of the target participants could neither read nor understand English, the questions were read out in the local dialect (Hausa) and responses were noted accordingly. Prior to questionnaire administration, the leadership of the Workers Union for each sampling site was approached and permission was sought for the questionnaire administration. A letter of consent was given to respondents. The questionnaire had six questions on general information, eight questions on knowledge, 10 questions on attitudes and 10 questions on practices. The questions on attitudes required "Agree" "Do not agree" and "Do not know" responses while questions on practices required "All the time" "Sometime" and "Never" responses. A marking scheme containing expected correct answers was prepared and used to mark and score the responses. Undecided were considered wrong response/answer. For each correct and incorrect answer one and zero points were assigned respectively. A higher score (6-10) indicated greater level of knowledge, positive attitudes or acceptable practices. The questionnaires were divided into four parts. The demographic information of the respondents contained in the first part includes (Name, sex, age, occupation, level of education, etc.). Information about the knowledge of avian influenza includes questions about means of transmission, clinical signs, and disposal of waste in the live bird market, prevention and control. Questions about attitude of respondents towards avian influenza included; attitudes concerning the importance of avian influenza to their businesses, touching sick birds, safety from avian influenza, reporting suspected cases to animal health authority. Questions on practices of respondents towards avian influenza includes; practice of the use of personal protective equipment, disinfection, reporting suspected cases to animal health authority, handling people in poultry related jobs having avian influenza related symptoms in humans and transportation of chickens.

Informed consent was obtained from each participant who agreed to participate.

Data analysis

Data obtained from questionnaire were analysed by descriptive statistics using the Statistical Package for Social Science (SPSS) version 20. The frequency, mean, standard error of mean and Chi square values were calculated. Values of $p < 0.05$ were considered significant. Odds ratios and 95% confidence intervals (CI) were calculated to measure strength and statistical significance of associations between variable data.

The level of knowledge, attitude and practice (KAP) of the respondents was assessed by marking responses using a marking scheme of correct answers. Scores from KAP were categorized as follows: 0-2 (poor), 3-5 (fair), 6-8 (good) and 9-10 (very good). To perform inferential statistical analysis, several independent and dependent variables were re-categorized as follows: Less knowledge if the total score was 0-5, Good knowledge if the total score was 6-10; Negative attitude if the total score was 0-5, Positive attitude if the total score was 6-10; Inappropriate if the total score was 0-5, Good practice if the total score was 6-10.

Results

The sociodemographic characteristics of respondents in this study are shown in Table 1. All of the study participants were men. The majority (54%) were between the ages of 21-40 years, 14% were between the ages <20 years, while 26% were aged between 41-60 years and 6% were aged 61 years and above. Of the 100 LBM workers that participated in this study, (64%) were poultry sellers while 36% were poultry processors. About 34% of the LBM workers had other forms of education (that is Islamic and traditional) or were illiterate. A few workers (12%) had a primary school education and 38% had completed secondary school. Those who had tertiary education were 16 %

and only 1% out of the 16% had a university education the rest had college background. Their job experience duration was divided into 4 categories: 4% of the workers had job experience of < 1 year, 36% had job experience of between 1-5 years, while 14% had job experience of 6-10 years and 46% had experience of >10 years. Majority (90%) of the live bird market workers had more than one poultry supplier while only 10% of the LBM workers had one poultry supplier.

Eight questions with various responses were designed to elicit participant's knowledge in three key areas, prevention, clinical signs and transmission. Table 2 shows participant's responses to some selected questions. A large proportion of participants 76 (76%) knew about avian influenza while 24 (24%) indicated that they did not know about it. Participant's knowledge about prevention of AI was good. Only 58 participants (58%) knew that AI could be prevented. Fewer participants were able to respond correctly to questions on the signs of avian influenza. In terms of transmission, only 44 participants (44%) correctly identified contact with infected birds as a mode of avian influenza (AI) spread. A very small proportion of study participants indicated the likelihood of AI infection in their poultry.

Table 2: Assessment of knowledge of respondents on Avian Influenza

Knowledge	Number	Percentage
Do you know what Avian Influenza (AI) is?		
Yes	76	76
No	24	24
Which animals are susceptible to avian influenza virus infection?		
Chickens	8	8
Poultry	70	70
Mammal	0	0
Do not know	22	22
Where did you find the information on AI?		
Media	36	36
Farmers	20	20
Others	32	32
Family and friends	12	12
What is the likelihood of AI infection in your poultry?		
Likely	0	0
Unlikely	80	80
Very likely	12	12
Very Unlikely	2	2
Can AI be prevented?		
Yes	58	58
No	6	6
Not sure	16	16
Don’t know	20	20
What could one do to prevent AI in poultry?		
Vaccination	36	36
Do nothing	12	12
Do not know	32	32
Others	20	20
How does AI spread among poultry?		
Contact with another infected birds	44	44
Do not know	30	30
Free roaming poultry	2	2
Others	24	24
Could you explain the signs of AI in poultry?		
Sudden onset of illness or death	12	12
Do not know	24	24
Swollen and puffy eyes	28	28
Others	36	36

Thirty-six participants (36%) accurately identified vaccination as a preventive measure against AI in poultry. The general characteristics of respondents in association with knowledge scores as seen in Table 3. The result showed that respondents in the age category of between 21-40 years of age had the higher knowledge of 77.8%. Those who had tertiary and other forms of education had higher acceptable scores of 75% and 76.5% respectively than respondents with primary and secondary education. Work experience showed no statistically significant difference, with those who have worked in the LBM for less than a year having the highest acceptable categorized knowledge scores of 4 (100%) followed by the category of 1-5 years 28 (78%).

Table 4 presents the respondents' attitudes toward AI. A majority (88%) acknowledged that AI-related challenges have a considerable impact on their businesses. Conversely, 8% were unaware of the importance of seeking medical attention promptly when experiencing symptoms like sore throat, chills, high fever, or breathing difficulty." As shown in Table 5, respondents aged between 21 and 40 years recorded the highest proportion of unacceptable attitude scores at 81%. Participants with tertiary and primary education showed higher levels of acceptable attitudes 37% and 50%,

Table 3: Association of demographic variables of workers with knowledge scores in live bird markets in Kaduna Metropolis

Variables	<50%	>50%	95% CI on OR	P-value
Gender				
Male	32(32)	68(68)		
Female	0(0)	0(0)		
Age (years)				
< 20	6(42.9)	8(57.1)	2.667(0.361-19.712)	0.329
21-40	12(22.2)	42(77.8)	7(1.140-42.971)	0.019
41-60	10(38.5)	16(61.5)	3.2(0.492-20.810)	0.209
61 and above	4(66.7)	2(33.3)	1	
Occupation				
Poultry seller	20(31.2)	44(68.8)	1.1(0.460-2.629)	0.837
Poultry processor	12(33.3)	24(66.7)		
Education				
Primary	6(50.0)	6(50.0)	0.308(0.077-1.224)	
Secondary	14(36.8)	24(63.2)	0.528(0.188-1.479)	
Tertiary	4(25.0)	12(75.0)	0.923(0.232-3.675)	
Others	8(23.5)	26(76.5)	1	
Work Experience (years)				
< 1	0(0)	4(100.0)		
1-5	8(22.2)	28(77.8)	2.25(0.841-6.018)	0.102
6-10	6(42.8)	8(57.2)	0.857(0.255-2.882)	0.805
>10	18(39.1)	28(60.9)	1	
Suppliers				
1	2(20.0)	8(80.0)	2(0.399-10.009)	0.391
>1	30(33.3)	60(66.7)		

Table 4: Assessment of attitude of respondents towards avian influenza

Attitude	Agree	Do not agree	Do not know
Avian Influenza challenges are significant to my business	88	12	0
My sales are unaffected by AI problems	66	26	8
Touching sick poultry can expose humans to AI	12	74	14
Contaminated equipment such as cages, boots and clothes can spread AI	20	68	12
Even without the proper equipment to handle poultry, I believe I am immune to AI infection	72	16	12
You have to notify the animal health authority if your chickens suddenly die or become sick over several days from an unidentified reason	48	32	20
If people in poultry related jobs have clinical signs of high fever, shivering, sore throat or difficulty in breathing, they should see a doctor as soon as possible	68	24	8
Individuals who handle poultry or goods related to chicken are more susceptible to contracting AI	10	76	14
I am pleased with the efforts being made by the government to control AI	54	32	14
You benefit from government initiatives to control AI	52	40	8

respectively, compared to those with secondary or other forms of education. In terms of work experience, individuals who had worked in the Live Bird Market (LBM) for over 10 years had the highes acceptable attitude scores at 30%, followed by those with 6 to 10 years of experience at 14%.

Table 6 illustrates the practices of Live Bird Market (LBM) workers regarding avian influenza. Findings indicate that 84% reported using soap or disinfectant to clean their hands and equipment, and 72% disinfected vehicles both before and after transporting poultry.

However, 38% admitted they would not report sudden, unexplained deaths of chickens during transport to animal health authorities.

Table 7 evaluates the relationship between respondents' general demographic characteristics and their practice scores.

Participants under the age of 20 demonstrated the highest rate of acceptable practices at 57.1%. Regarding occupation, 34 out of 64 poultry sellers (53.1%) exhibited poor practices related to avian influenza, while the remaining 30 (46.9%) demonstrated good practices. In terms of work experience, individuals with over 10 years at the Live Bird Market (LBM) had the highest proportion of acceptable practices at 56.6% (26 individuals), followed by those with less than one year of experience, of whom 50% (2 individuals) had acceptable practices.

Discussion

Poultry traders, suppliers, processors, farmers, customers, and distributors are all linked through a complex network known as the Live Bird Market (LBM). Additionally, LBMs have a supply chain that gathers birds from various sources before slaughtering or selling them live to customers at a daily or weekly market. Sales of numerous species, including pigeons, guinea hens, ducks, chickens, and a variety of wild birds, take place in the same location. In the event of an outbreak, it would be challenging to identify a bird's origin due to the complex, unregulated, and poorly managed aspect of the poultry industry. This has contributed to why it is now difficult to regulate, control and prevent HPAI.

In this study, poultry vendors collect birds from various locations and transport them together in a single vehicle to the market. This mixing of birds increases the likelihood of exposure to and spread of highly pathogenic avian influenza (HPAI), whether at the farms, during transport, or at the market itself.

Paul *et al.* (2010) and Paul *et al.* (2011) also observed that the movement of live poultry and poultry products along highway routes was also identified as a potential factor in the dissemination of HPAI through the road network, particularly when infected birds are.

Also, the period of waiting before disposing or selling the birds brought from different locations may result in spread of infections including HPAI.

Based on administered questionnaire, all the poultry workers in the live bird markets were men; this is probably because in this part of the Country

Table 5: Association of demographic variables of workers with attitude scores in live bird markets in Kaduna Metropolis

Variables	<50%	>50%	95% CI on OR	P-value
Gender				
Male	82(82)	18(18)		
Female	0(0)	0(0)		
Age (years)				
< 20	14(100.0)	0(0)		
21-40	44(81.5)	10(18.5)	0.5(0.174-1.505)	0.219
41-60	18(69.2)	8(30.8)	1	
61 and above	6(100.0)	0(0)		
Occupation				
Poultry seller	48(75.0)	16(25.0)	5.667(1.221-26.281)	0.015
Poultry processor	34(94.4)	2(5.6)		
Education				
Primary	6(50.0)	6(50.0)	7.5(1.609-34.955)	0.006
Secondary	36(94.7)	2(5.3)	0.417(0.071-2.435)	0.319
Tertiary	10(62.5)	6(37.5)	4.5(1.052-19.253)	0.034
Others	30(88.2)	4(11.8)	1	
Work Experience (years)				
< 1	4(100.0)	0(0)		
1-5	34(94.4)	2(5.6)	0.135(0.028-0.639)	0.005
6-10	12(85.7)	2(14.3)	0.381(0.075-1.932)	0.232
>10	32(69.6)	14(30.4)	1	
Suppliers				
1	10(100.0)	0(0)		0.118
>1	72(80.0)	18(20.0)		

Table 6: Practice of respondents towards Avian Influenza at the live bird markets in Kaduna Metropolis

Practice	Response	Number	Percentage (%)
When handling live birds, feathers, or during slaughtering of birds, do you wear the appropriate personal protection equipment (mask, gloves)?	All the time	24	24
	Sometime	46	46
	Never	30	30
Do you use PPE before having contacts with sick or dead birds?	All the time	44	44
	Sometime	26	26
	Never	30	30
After work, do you wash your hands and the equipment you used?	All the time	78	78
	Sometime	18	18
	Never	4	4
Do you use soap or disinfectant to clean your hands and equipment?	All the time	84	84
	Sometime	18	18
	Never	4	4
Do you disinfect cars both before and after using them to move poultry?	All the time	72	72
	Sometime	20	20
	Never	8	8
Do you use same vehicle to transport chickens and other poultry?	All the time	22	22
	Sometime	30	30
	Never	48	48
Do you use same vehicle to transport humans and poultry?	All the time	14	14
	Sometime	40	40
	Never	46	46
Is there an annual health check for workers who have contact with poultry?	All the time	40	40
	Sometime	30	30
	Never	30	30
If people in poultry related jobs have clinical signs of high fever, shivering, sore throat or difficulty with breathing, do you report it?	All the time	48	48
	Sometime	30	30
	Never	22	22
Do you notify animal health authority of sudden unexplained deaths among chickens during transportation?	All the time	30	30
	Sometime	32	32
	Never	38	38

(Northern Nigeria), poultry selling and processing in live bird markets are mostly a male dominated occupation. According to the questionnaire that was given out, all of the poultry workers at the live bird markets were men. This is most likely due to the fact that selling and processing poultry in live bird markets is mostly a male-dominated profession in this region of the country (Northern Nigeria).

The majority of those that worked at the LBMs were between the ages of 21 and 40, and they had favorable views and awareness about AI. This is most likely because individuals in this age group are in the peak of youth and will be physically capable of pursuing these types of occupations. Because they frequently access the media, it is not unexpected that they have better understanding of and attitudes concerning biosecurity measures and avian influenza.

Based on workers' job experience, those who had worked for more than 10 years had less knowledge related to avian influenza compared to those who had job experience of less than a year. This may be because the majority of those who may have only recently begun their businesses had already learned about the live bird market and poultry diseases before beginning such a business. This is in agreement with Sutanto (2013) where 97% of the LBM workers who had job experience of more 10 years had less knowledge related to HPAI and biosecurity measures while only 37% of the LBM workers who had job experience of less 10 years had more knowledge related to HPAI and biosecurity.

Processing of poultry takes place in most of the markets under unhygienic conditions. This study shows the poor personal hygiene of the LBM workers and the unwillingness of the poultry processors to wear protective clothing, nose mask and gloves when working.

They believe that no harm can come to them by mere touching of these birds. However, for decades, some live bird markets have been recognized as potential

Table 7: Association of demographic variables of workers with practice scores in live bird markets in Kaduna Metropolis

Variables	<50%	>50%	95% CI on OR	P-value
Gender				
Male	54(54)	46(46)		
Female	0(0)	0(0)		
Age (years)				
< 20	6(42.9)	8(57.1)	0.643(0.174-2.382)	0.507
21-40	28(51.8)	26(48.2)	0.959(0.582-1.579)	0.867
41-60	14(53.8)	12(46.2)	1	
61 and above	6(100.0)	0(0)		
Occupation				
Poultry seller	34(53.1)	30(46.9)	1.103(0.486-2.506)	0.815
Poultry processor	20(55.5)	16(44.4)		
Education				
Primary	6(50.0)	6(50.0)	1.429(0.381-5.357)	0.596
Secondary	24(63.2)	14(36.8)	0.833(0.323-2.153)	0.706
Tertiary	4(25.0)	12(75)	4.286(1.143-16.071)	0.026
Others	20(58.8)	14(41.2)	1	
Work Experience (years)				
< 1	2(50.0)	2(50.0)	0.769(0.099-5.945)	0.801
1-5	24(66.7)	12(33.3)	0.385(0.156-0.951)	0.037
6-10	8(57.1)	6(42.9)	0.577(0.172-1.932)	0.369
>10	20(43.5)	26(56.5)	1	
Suppliers				
1	2(20.0)	8(80.0)	5.474(1.099-27.247)	0.023
>1	52(57.8)	38(42.2)		

sources of disease emergence e.g. highly pathogenic avian influenza. This is due to the fact that variety of species are presented to consumers in a state where they are able to defecate, cough and effectively spread potential pathogens to surrounding animals and humans (Brown, 2004). Most of the live bird market workers agreed that AI can be prevented, this could be as a result of their knowledge of diseases such Newcastle Disease (ND) and Infectious Bursal Disease (IBD) that are preventable by vaccination. Fatiregun & Saani (2008) also reported that majority agreed avian influenza is a serious and preventable disease.

This study shows that most of the respondents had unacceptable attitude towards avian influenza and biosecurity measures. This may be because of their beliefs and misconceptions that they cannot be infected with avian influenza virus. Those who have been in the business for more years, who are probably more influential but least knowledgeable based on the findings here may be the ones influencing others driving them to resistance so public education through a variety of media is necessary.

Those with tertiary education are usually more exposed to a certain level of greater knowledge concerning various topics and it showed in the way they practiced biosecurity in their day-to-day activities in the LBMs in this study. Durosinlorun (2010), also reported a similar result, individuals with higher educational status would have access to other sources of information that can improve knowledge of HPAI other than governments public enlightenment campaign.

When there is an outbreak in the area, the large number of respondents who stated they will abide by the advice of the animal health authority may be a sign that the majority of them are aware of the harm that going against the advice of the animal health authority will do to their enterprises. This shows that they are more concerned about their businesses and not their health as individuals.

This study reveals that most of the respondents have heard of AI, are aware of the animals it affects, clinical signs, what to do with poultry suspected to have AI and how to dispose waste from the LBMs, but majority had higher unacceptable practices. This agrees with Ilonze (2010), who reported that respondents had a high knowledge of signs of AI infection in birds, awareness of AI signs, symptoms and preventive measures was high but the use of

prescribed AI preventive measures was rather low and the Knowledge of AI human risk was low.

Although LBM workers had high level of knowledge on AI, this KAP study found that they also exhibited negative attitudes and inappropriate practices. Sutanto (2013), on the other hand, showed that despite the information provided, LBM workers had no detailed understanding of avian influenza, and had low compliance with precautionary behaviours.

In conclusion, live Bird Markets workers had high level of knowledge on AI but negative attitudes and inappropriate practices, signifying high potential for the spread of AI.

The limitations of study was first, the language and literacy posed significant barriers. Many participants had limited formal education, making it difficult to understand survey questions. Even with translation into Hausa, certain technical or scientific terms may not have been fully understood, which could have affected the quality of responses.

Secondly, issues of trust and respondent willingness to participate was considered. Poultry sellers and processors are usually skeptical of outsiders asking questions, particularly if they fear the information could lead to government-imposed restrictions or market closures. This mistrust made some of them hesitant to participate or encourage them to give answers they thought were expected rather than truthful.

In addition, time constraints within the market environment further complicated data collection. The fast-paced, commercial nature of live bird markets means that many participants were unwilling to engage in lengthy interviews or were easily distracted by business activities. This could have affected both the depth and accuracy of responses.

Lastly, sampling limitations may arise due to the informal and often transient nature of market operations. Many traders were not formally registered and only present on certain days, making it difficult to ensure a representative sample. Security challenges in some areas of Kaduna also presented logistical barriers to accessing certain markets safely and consistently.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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