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Assessment of Abattoir Workers' Knowledge, Perceptions and Preventive Preparedness during COVID-19 Pandemic in North-central Nigeria: The Health Belief Model

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ABSTRACT

Abattoirs have been risk points for the transmission of SARS-CoV-2 with far-reaching implications. We assessed abattoir workers' knowledge and risk perceptions in line with the Health Belief Model premise, and preventive preparedness towards the COVID-19 pandemic, as well as identified factors associated with its spread at slaughterhouses. A structured questionnaire-based cross-sectional study was conducted on randomly selected workers (n=660) in 11 conveniently selected abattoirs in North-central Nigeria, between January and December 2021. Statistical analysis was performed at a 95% confidence level using OpenEpi 3.1. The majority (96.1%, n=634) of selected workers participated. Most workers (88.9%) were males, and 56.5% were married. Only 24.6% had tertiary education and 48.4% were butchers. Only 33.4% of the workers mentioned that COVID-19 can affect animals, while all (100.0%) reported that it can affect humans. Few of the workers practice handshake avoidance (46.1%), handwashing with soap and water (26.5%), use of hand sanitizer (21.3%), physical distancing (16.6%), and PPE (28.5%) as preventive measures, while the majority use face masks (76.8%). Age, gender, formal education, and occupation were significantly associated with knowledge, perceptions, and preventive practices toward COVID-19. Lack of physical distancing was more likely (OR=6.36; 95% CI: 3.76–10.76) to influence COVID-19 spread, while lack of PPE was 12 times more likely (OR=12.53; 95% CI: 8.01–19.63) to influence the spread of the disease in slaughterhouses. The study highlighted overall poor knowledge, perceptions, and preventive practices regarding the COVID-19 pandemic amongst surveyed workers. Application of the 'One Health' approach mitigation would assure food safety, food security, public and environmental health.

Keywords: Abattoir workers; COVID-19 pandemic; Health Belief Model; Preventive practices; Slaughterhouse; Zoonosis

INTRODUCTION

A pneumonia-like disease of unidentified cause occurred in Wuhan, Hubei province, China on December 12, 2019 (Lu *et al*., 2020). The causal agent of the disease was later identified to belong to the virus family, Coronaviridae family, which the World Health Organization (WHO) named the "2019-novel coronavirus (2019-nCoV)" on January 20, 2020, and later entitled the "Coronavirus disease 2019 (COVID-19)" on February 11, 2020, (Gralinski and Menachery, 2020). The International Committee on Taxonomy of Viruses (ICTV) subsequently designated this emerging virus as the "severe acute respiratory-syndrome coronavirus 2 (SARS-CoV-2)" (Gorbalenya *et al*., 2020). However, the WHO on March 11, 2020, pronounced the occurring outbreaks as a pandemic, severely affecting mankind in terms of economic losses, fear, sickness, and death (Zheng, 2020; WHO, 2020a). COVID-19 is an emerging infectious disease in humans and animals (O'Connor *et al*., 2020; FAO, 2020). The disease in humans is commonly characterized by difficulty breathing, dry cough, fatigue, fever, loss of smell and taste, runny nose, sore throat, diarrhea, and death (Yang *et al*., 2020; Zhou *et al*., 2020). The pandemic has affected millions of people worldwide, causing thousands of deaths (Zhou *et al*., 2020).

The precise animal origin of SARS-CoV-2 remains unknown but possible speculations rooted it in bats because of the shared similarity with the SARS-CoV that caused the 2002–

2003 pandemic (Zhou *et al*., 2020). Many animal species could serve as the intermediate hosts of the virus (McNamara *et al.,* 2020). SARS-CoV-2 has a high genetic similarity with other Betacoronavirus – severe acute respiratory syndrome-coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV), which are zoonotic in nature and have been associated with high mortalities in humans in the last two decades (Wei *et al*., 2020; Zhang *et al*., 2020). At present, no report exists on the emergence of SARS-CoV-2 from any zoonotic spill over event after exposure; its spread has been mainly associated with human-to-human transmissions through coughs, sneezes, droplets of saliva or discharge of an infected person; and contacts with contaminated objects or surfaces in specific settings, such as slaughterhouses (WHO, 2020b). However, zoonotic and reverse zoonotic events of SARS-CoV-2 with impacts on global health have been reported (Munir *et al.*, 2020).

Slaughterhouses are a major risk for infectious diseases, with far-reaching transmission implications that require intensive public health interventions (Dyal *et al*., 2020; Middleton *et al*., 2020; Odetokun *et al*., 2020). Although animal-mediated transmission of SARS-CoV-2 at slaughterhouses has not been reported, a study has found a high percentage of slaughtered camels in Doha, Qatar to be carriers of MERS with slaughterhouses identified as "epicentres" for outbreaks due to MERS in high-risk areas for human exposure (Farag *et al.*, 2015). There are also reports of asymptomatic occurrences of SARS-CoV-2 infections among slaughterhouse workers in Germany, France, and the Netherlands. In Germany and France alone, over 90 and 100 infections were confirmed in a few slaughterhouses, respectively (Pig Progress, 2020). Slaughterhouses have been shut down across the United States (US) after thousands of cases were confirmed. Furthermore, above 5,000 meat and poultry workers were confirmed to be SARS-CoV-2 positive resulting in the closure of slaughterhouses across the United States (Dyal *et al*., 2020). Also, the COVID-19 pandemic situation reported among slaughterhouse workers in 19 states in the US include 4,913 cases and 20 deaths among 130,000 workers in 115 slaughter facilities (Dyal *et al*., 2020).

Basic infection control and prevention measures that include handwashing, self-quarantine, physical distancing, and cleaning and disinfecting surfaces have been emphasized as the global response to COVID-19 pandemic mitigation in many contexts (WHO, 2020c). For effective disease control and prevention, compliance with preventive behaviours is essential, which in turn hinges on people's knowledge and risk perceptions toward diseases (Alhaji *et al*., 2017). Threats affecting the health and livelihood of people influence their behaviour towards diseases (Brug *et al*., 2009; Leppin and Aro, 2009). Knowledge, risk perceptions, and preventive preparedness regarding the COVID-19 pandemic in Nigeria are critical to identifying challenging factors for potential target interventions among occupational groups at high risk of the disease.

The objectives of this study were: to assess knowledge, risk perceptions, and preventive preparedness regarding the COVID-19 pandemic amongst the abattoir workers, who are potentially exposed occupational groups, in Nigeria post waves of the pandemic. We hypothesized that the socio-cultural factors of the workers cannot influence the emergence and transmission of the COVID-19 pandemic at slaughterhouses. This study was conducted around the premise of the Health Belief Model (HBM), which proposes that people are most likely to take preventive measures if they perceive the threat of a health risk to be serious and feel personally susceptible (Laranjo, 2016).

MATERIALS AND METHODS

Study Area

The study was carried out in Kwara and Niger States as well as the Federal Capital Territory (Abuja) in the North-Central Nigeria. This region is occupied by the savannah vegetation that is favourable for livestock production (Bourn *et al*., 1994). Environmental temperature ranges from 16 to 39 °C (mean: 23 °C). There is a single rainy season spanning from April to October, with a mean annual rainfall of 1600 mm. The surveyed slaughterhouses were located at Minna, Bida, Kontagora, Suleja, and New-Bussa in Niger State; Gwagwalada, Deidei, and Karu in the Federal Capital Territory Abuja; as well as in Ipata, Oja-tuntun, and Akerebiata in Kwara State (https://en.wikipedia.org/wiki/North_Central_(Nigeria).

Study Design and Population

Using a structured questionnaire-based cross-sectional research design, the study was conducted in conveniently selected slaughterhouses in North-central Nigeria from June 2020 to June 2021, after the COVID-19 pandemic lockdown was lifted in May 2020.

The study population consisted of animal health meat inspectors, sanitary officials, livestock suppliers, butchers, and meat sellers, termed abattoir workers, who work in slaughterhouses for daily socio-economic and public health activities. Inclusion criteria were that the participants must be at least 20 years old at any of the selected slaughterhouses during the questionnaire administration. Visitors to the slaughterhouses and workers not present at the time questionnaire was being administered were excluded.

Health Belief Model Concept

The Health Belief Model (HBM) conceptualizes two types of health beliefs that make behavioural responses to disease threats positively or negatively attractive. These are threat perceptions of disease and evaluation of the effectiveness of behaviours to mitigate or prevent the threat (Sheeran and Abraham, 1996). Two constructs of HBM were used in this study: perceived susceptibility and perceived severity constructs. Perceived susceptibility is the risk perception of contracting a disease, while perceived severity is the perception of the seriousness associated with contracting the disease. However, these variables are determined by the likelihood of the individual following a health-related action, which also have their effect modified by demographic variables, social pressure, and personality (Jantz and Becker, 1984).

Sample Size and Sampling Methods

The number of respondents that were recruited for this study was computed using the Open-Source Epidemiologic Statistics for Public Health (OpenEpi) 3.1 software for percentage frequency in a finite population (Dean *et al*., 2012). In this study, the assumed expected proportion of 50%

was applied with 4% margin of error at a 95% confidence interval; and a sample size of 600 was obtained. Since the desired effect was less than 1% for a cross-sectional study at a single-level probability sampling, a contingency of 10% was included to control for non-response, and the size was attuned to 660 respondents.

A multi-stage sampling technique was organized. Firstly, a non-probability sampling that combined both convenient and purposive sampling techniques was applied to choose 11 slaughterhouses across the study area. They were the main slaughterhouses with an estimated average daily population of 860 workers that transact meat processing socio-economic and public health activities. Secondly, 660 workers were proportionately recruited using a probability sampling approach of the stratified sampling procedure, in which workers were stratified by activities: meat inspectors, butchers, and the environmental health workers.

Questionnaire, Pre-testing, and Consent

A structured questionnaire was used in this survey and created based on experts' opinions and literature. It comprised mainly close-ended questions, to enhance data management and response precision (Thrusfield, 2009). The questionnaire was divided into four sections. The first section consisted of six questions centered on socio-demographic features of age, gender, marital status, occupation, and formal educational level; while the second section was on knowledge about COVID-19 and consisted of 11 questions, among which were sociocultural factors that could influence COVID-19 occurrence and spread at slaughterhouses. The third section had seven questions on risk perceptions about routes for COVID-19 transmission, and the final section had nine questions on preventive preparedness measures practiced against COVID-19 emergence and its spread at slaughterhouses in Nigeria.

A supervised interviewer-administered questionnaire that involved 18 trained enumerators was conducted. Data were collected in the pre-testing and main survey. Study objectives were explained to the participants and researchers opted to collect data based on verbal consent because the participants were unwilling to put their signatures on the consent form. Participation in the study was voluntary, and confidential, and the respondents had the chance to withdraw at any point without bias following the Helsinki Declaration guide (WMADH, 2001).

Data Management and Statistical Analysis

The data obtained were summarized into Microsoft Excel 7 spreadsheet (Microsoft Corporation, Redmond, WA, USA) and cleaned. Descriptive and analytic statistics were used. As for the descriptive statistics, results were expressed in frequencies and proportions, while analytic statistics were used to model the relationship between potential predictors and outcomes, respectively. To assess the association of the hypothesized factors that influenced COVID-19 pandemic transmission, which constituted the independent (explanatory) variables, binary outcome variables were created from these explanatory determinants to obtain dependent (outcome) variables. An exclusive scoring procedure was devised for the dependent responses. Each participant was allocated a response mark in a range of 0–10 points that showed the stringency of responses to questions. For further analysis, the score range was classified into "poor" or "satisfactory" to produce categorical variables. Response scores that were assessed to be within 0–5 and 6–10 points were deemed as "poor" and "satisfactory" influence, respectively.

To evaluate the association between the potential predictors and outcome variables, we first applied a univariable model using the Chi-square test (Dohoo *et al*., 2012). In the final model, we utilized the likelihood backward multivariable logistic regression model to control for confounders and effect modifications. The goodness of fit for the final model was assessed with the Hosmer and Lemeshow test and found to be good. All statistical analysis was carried out with the Epi-Info 3.5.3 (CDC, Atlanta, USA) and a $p<0.05$ was judged significant.

Ethical Statement

The Research Ethics Committee, Niger State Ministry of Livestock and Fisheries, Nigeria approved the study protocol (Ref. MLF/NGS/05/2020). Verbal informed consent was acceptable and approved by the Ethics Committee to be used on the respondents.

RESULTS

Demographic Characteristics of Respondents

Out of the 660 abattoir workers selected for the survey, 634 (96.1%) responded. The average age of the respondents was 40.6±12.6 SD years, and the majority (21.1%, n=134) were within 40–49 years. Most of the workers (88.9%, n=563) were males, and 56.5% were married. Only 24.6% of the respondents possessed tertiary education (Figure 1). Furthermore, 48.42% (n=307) of the workers were butchers (Figure 2).

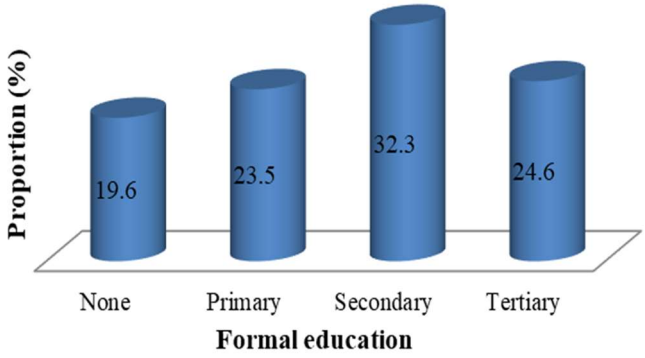

Figure 1: Formal Education Status of Abattoir Workers at Slaughterhouses in North-central Nigeria

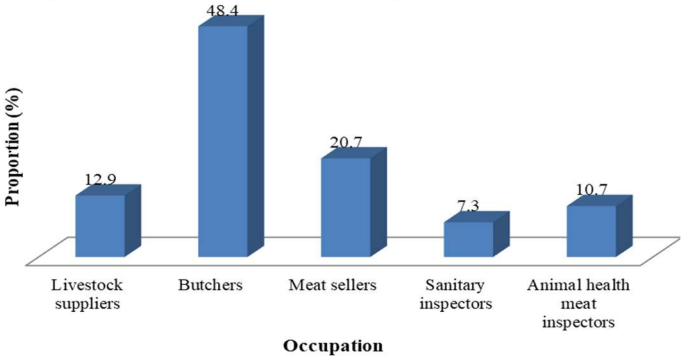

Figure 2: Occupation of Abattoir Workers at Slaughterhouses in North-central Nigeria

Knowledge about the COVID-19 Pandemic among Abattoir Workers

All participants (100.0%, n=634) indicated to have heard about the COVID-19 pandemic. About one-third (35.5%, n=220) of them got the index information from radio, 24.5% (n=153) through friends, and only 6.4% (n=40) were first informed by the veterinary and public health authorities (Figure 3).

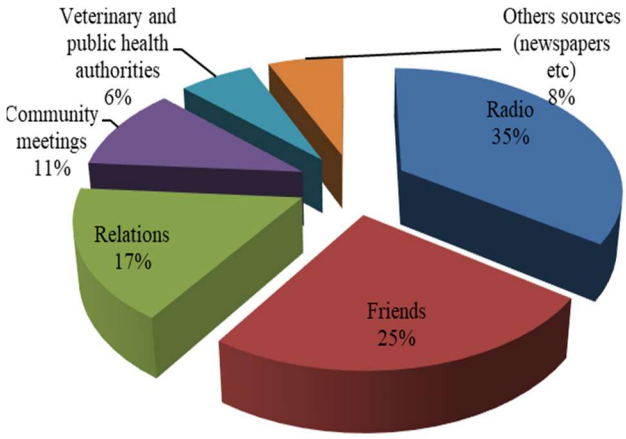

Figure 3: Sources of Index Information about COVID19 Pandemic to Abattoir Workers at Slaughterhouses in North-central Nigeria

One-third (33.4%, n=212) of the workers mentioned that COVID-19 can affect animals, while all (100.0%, n=634) reported that COVID-19 can affect humans. However, less than one-third (28.1%, n=178) indicated that the disease is transmissible from animals to humans (zoonotic). Less than one-third (31.4%, n=199) knew its clinical symptoms in humans to be high fever, difficulty breathing, dry cough, loss of taste and smell, congested nose, and death; while 14.7% (n=93) knew that the disease can lead to death in humans. All participants (100.0%, n=634) mentioned outbreaks of the COVID-19 pandemic to have occurred in Nigeria, but none mentioned to have ever contracted the disease. Only 4.1% (n=26) mentioned that suspected cases of COVID-19 have occurred in their abattoirs (Table 1).

Risk Perceptions Towards COVID-19 Pandemic Transmission at Slaughterhouses

Respondents perceived contact with contaminated animals and products, consumption of raw and undercooked meat, as well as environmental contaminations with effluents and aerosols, and people sharing the same shelter at the slaughterhouse premises to be significant risk routes for the spread of the COVID-19 pandemic at the slaughterhouses (Table 2). Less than one-quarter of the respondents mentioned all activities under contacts and consumption to be high-risk routes for the transmission of the disease. Overall, less than half of the respondents perceived activities in the environment, that is, people sharing the same shelter at slaughterhouse premises (29.0%, n=184), and the contaminated environment with effluents and aerosols (43.8%, n=278) to be high-risk routes for COVID-19 pandemic spread at the slaughterhouses.

Preventive Preparedness Towards COVID-19 Pandemic

More than two-thirds of the workers practiced the use of face masks (76.8%, n=487), and thorough cooking of meat before consumption (78.4%, n=497). Avoidance of handshakes was practiced by less than half of the workers (46.1%, n=292). Other preventive measures of handwashing with soap and water, use of hand sanitizer, application of physical distancing, use of Phyto-medical approach, use of personal protective equipment (PPE), and fumigation of the environment with disinfectants were practiced by less than one-third of the workers as preventive measures against COVID-19 in slaughterhouses (Table 3).

Sociocultural Factors that Influenced COVID-19 Pandemic Spread at Slaughterhouses

Lack of physical distancing, poor housing conditions, poor sanitation, common transportation to and from slaughterhouses, lack of or inadequate PPE, and season were more likely to significantly ($p<0.05$) influence COVID-19 pandemic transmission at slaughterhouses. On multivariable logistic regression, lack of physical distancing was more likely (OR=6.36; 95% CI: 3.76–10.76) to satisfactorily influenced the COVID-19 pandemic spread in slaughterhouses. Common transportation to and from slaughterhouses was four times more likely (OR=4.07; 95% CI: 2.92–5.68) to satisfactorily influenced COVID-19 pandemic spread, while lack of or inadequate PPE was thirteen times more likely (OR=12.53; 95% CI: 8.01–19.63) to satisfactorily influenced COVID-19 pandemic transmission in slaughterhouses. However, the season (cool rainy) was less likely (OR=0.61; 95% CI: 0.43–0.87) to satisfactorily influenced the spread of the COVID-19 pandemic in slaughterhouses (Table 4).

Table 1: Abattoir Workers' Knowledge about the COVID-19 Pandemic at Slaughterhouses in North-central Nigeria

Variable	Frequency(n)	Proportion (%)	95% CI
COVID-19 can affect animals	212	33.4	29.85,37.18
It is transmissible from animals to humans (zoonotic)	178	28.1	24.68, 31.67
COVID-19 can affect humans	634	100.0	31.67, 100.00
Clinical symptoms in humans are high fever, difficulty breathing, cough, loss of taste and smell, congested nose	199	31.4	27.86, 35.08
COVID-19 can lead to death in humans	93	14.7	12.07,17.59
Outbreaks of COVID-19 have occurred in Nigeria	634	100.0	31.67, 100.00
Ever contracted COVID-19	0	0.0	0.00
People have contracted COVID-19 in this abattoir	26	4.1	2.75, 5.87

n=Number of participants that gave 'Yes' responses; CI - Confidence interval

Table 2: Abattoir Workers' Risk Perceptions on COVID-19 Pandemic Transmission at Slaughterhouses in North-central Nigeria

Risk Route	Low risk n (%)	Moderate risk n (%)	High risk n (%)	Chi-square	P-value
Direct or indirect contacts					
Contacts with fetuses	446 (70.3)	129 (20.4)	59 (9.3)	33.59	0.001*
Contacts with blood and bodily fluids of slaughtered animals	370 (58.3)	183 (28.9)	81 (12.8)		
Contacts with life animals	415 (65.5)	142 (22.4)	77 (12.1)		
Contacts with fomites	398 (62.8)	187 (29.5)	49 (7.7)		
Consumption					
Eating raw meat	443 (69.9)	117 (18.5)	74 (11.6)	44.89	<0.001*
Eating undercooked meat	376 (59.3)	217 (34.2)	41 (6.5)		
Environment					
People share same shelter at slaughterhouse premises	348 (54.9)	102 (16.1)	184 (29.0)	125.5	<0.001*
Contaminated environment with effluents and aerosols	155 (24.4)	201 (31.8)	278 (43.8)		

Low risk (< 35%); Moderate risk (35-65%); High risk (> 66%); *Significant at p<0.05

Table 3: Preventive Preparedness Practiced by Abattoir Workers against COVID-19 Pandemic Spread at Slaughterhouses in North-central Nigeria

Practice	**Frequency (n)**	**Proportion (%)**	**95% CI**
Hand washing with soap and water	168	26.5	23.17, 30.04
Use of hand sanitizer	135	21.3	18.24, 24.61
Use of face masks	487	76.8	73.41, 79.98
Application of physical distancing	105	16.6	13.82, 19.61
Avoidance of hand shaking	292	46.1	42.20, 49.95
Use of the Phyto-medical approach	163	25.7	22.42, 29.22
Thorough cooking of meat before consumption	497	78.4	75.06, 81.46
Use of personal protective equipment (PPE)	181	28.5	25.13, 32.16
Fumigation of an environment with disinfectants	23	3.6	2.37, 5.31

n – Number of participants that gave 'Yes' responses; CI - Confidence interval

Table 4: Multivariate Logistic Regressions of Factors that Influence COVID-19 Pandemic Transmission at Slaughterhouses in North-central Nigeria

Factor	**Poor influence (%)**	**Satisfactory influence (%)**	**Odds ratio (OR)**	**95% CI**	**P-value**
Lack of physical distancing					
No	309 (58.4)	220 (41.6)	1.00**		
Yes	19 (18.1)	86 (81.9)	6.36	3.76, 10.76	<0.001*
Poor housing conditions					
No	225 (48.1)	243 (51.9)	1.00		
Yes	34 (20.5)	132 (79.5)	3.60	2.37, 5.46	<0.001*
Poor sanitation					
No	218 (60.9)	140 (39.1)	1.00		
Yes	128 (46.4)	148 (53.6)	1.80	1.31, 2.47	0.001*
Common transportation to and from slaughterhouse					
No	233 (66.9)	115 (33.1)	1.00		
Yes	95 (33.2)	191 (66.8)	4.07	2.92, 5.68	<0.001*
Lack of or inadequate PPE					
No	116 (50.9)	112 (49.1)	1.00		
Yes	31 (7.6)	375 (92.4)	12.53	8.01, 19.63	<0.001*
Season (cool rainy)					
No	154 (64.7)	84 (35.3)	1.00		
Yes	297 (75.0)	99 (25.0)	0.61	0.43, 0.87	0.006*

*Statistically significant at p < 0.05; **Reference

DISCUSSION

Efforts made to contain the COVID-19 pandemic in Nigeria have not only posed an enormous One Health challenge but have severely affected the economy. Understanding knowledge and preventive preparedness regarding the disease amongst occupational groups is necessary because it

will provide valuable clues towards the development of health interventions to the people.

This survey found sources of index information about the COVID-19 pandemic to the abattoir workers to be from veterinary health officials, relatives, and radio. These diverse information channels highlighted the importance of these communication sources on information dissemination regarding emerging and re-emerging diseases to vulnerable groups to enrich their knowledge and risk perceptions as well as preventive preparedness towards diseases. We observed poor knowledge responses among the majority of workers on the clinical symptoms of the disease in humans. We found less than one-third of the workers with knowledge about the clinical symptoms of the disease in humans, which were mentioned include high fever, difficulty breathing, dry cough, loss of taste and smell, congested nose, and death. The clinical presentation of COVID-19 symptoms which has been reported include fever, fatigue, dry cough, malaise, and difficulty breathing (Abdelhafz *et al*., 2020).

All participants in this study mentioned having heard about the COVID-19 pandemic and indicated that its outbreaks have occurred in Nigeria and other parts of the world, yet only a few of them responded positively to its epidemiology. This could be due to a lack of targeted sensitization during slaughterhouse health education awareness program at slaughterhouses. This finding is in contrast with the results of previous studies that indicated high COVID-19 knowledge among the populations in Egypt and Kenya (Abdelhafz *et al*., 2020; Austrian *et al*., 2020).

The study found all workers mentioned that the COVID-19 pandemic can affect humans, but only 33.4% of them indicated that it can affect animals, and only a few of them (28.1%) knew it to be zoonotic. These findings implied that workers possessed variable knowledge about the COVID-19 pandemic at slaughterhouses. However, there is still no evidence of the zoonotic nature of the disease (FAO, 2020). Health education of workers on the COVID-19 pandemic through mass media, especially radio, is essential for effective social change toward the adoption of physical distancing and the use of PPE during slaughterhouse operations. The workers should have more access to obtain information on slaughterhouse hygiene and sanitation through the mass media channels such as radio and the internet (Alhaji *et al*., 2015). Regular infection control, occupational safety, and health training should be provided for all workers tailored to literacy levels and preferred languages as previously reported (Alhaji and Baiwa, 2015; Dyal *et al*., 2020).

In the present study, only a few workers significantly perceived the COVID-19 pandemic to be high-risk, even concerning the contaminated environments with faeces and aerosols. The survey also found low perceptions of the workers on the high-risk status of contacts with blood and bodily fluids of slaughtered animals as well as contacts with fomites. The virus thrives in lower temperatures, metallic surfaces, aerosols of dust and faeces, and water use that carry materials over surfaces in slaughterhouses (van Doremalen *et al*., 2020). Crowded environments and difficult social distancing, and the possibility of airborne fasten spread of COVID-19 in such environments (Zhang *et al*., 2020). The detection of SARS-CoV-2 viral RNA in the airborne dust contaminated with faecal matter in mink farms indicates the possibility of animal-to-animal and animal-to-human transmissions of SARS-CoV-2 via dust and/or droplets (Sharuna *et al.*, 2021).

We found preventive preparedness measures of using face masks (76.8%) and thorough cooking of meat before consumption to be practiced amongst a high proportion (78.4%) of workers. However, a low proportion of them practice avoidance of handshake, hand washing with soap and water, use of hand sanitizer, application of physical distancing, use of PPE, and fumigation of the environment with disinfectants as measures against COVID-19 pandemic spread in the slaughterhouses. These findings highlighted the poor potential practices against transmission of the disease in slaughterhouses. The adequate practice of these measures is important, especially in crowded settings like slaughterhouses, which have a high risk for COVID-19 and other respiratory disease transmission (Dyal *et al*., 2020, Odetokun *et al*., 2020). To shield workers from various hazards in slaughterhouses, the preferred methods are to remove exposure sources and institute efficient sanitation and hygienic operations, and physical distancing of at least two meters apart (Dyal *et al*., 2020; Odetokun *et al*., 2020). Cloth face coverings in public settings potentially help to prevent infectious disease transmission and should complement physical distancing (Shaw *et al*., 2019). Facemasks should be worn always by every abattoir worker because the maintenance of physical distancing may be challenging. Regular use of facemasks and distance separation are potential preventive measures against COVID-19 for slaughterhouse workers (Steinberg *et al.*, 2020).

Slaughterhouses have been reported to be favourable environments for COVID-19 transmission (Durand-Moreau *et al*., 2020; Dyal *et al*., 2020), due to some of the factors identified in this survey. The study found lack of physical distancing, poor housing conditions, poor sanitation, common transportation to and from slaughterhouses, lack of or inadequate PPE, and season to be significant factors that can influence the spread of COVID-19 at slaughterhouses. Overcrowded accommodation and transportation in overcrowded buses, as well as poor hygiene measures, facilitate COVID-19 spread (Durand-Moreau *et al*., 2020; Dyal *et al*., 2020).

We found low proportions of the respondents with high-risk perceptions towards the disease. From the applied HBM constructs of perceived susceptibility and perceived severity, our findings can be inferred that very few workers at the slaughterhouses perceived to be susceptible to COVID-19 pandemic risk and also perceived that contracting the disease may not lead to severe health consequences. Therefore, only a few of them were active in the practice of preventive measures against the disease. It is noteworthy that adequate knowledge about health threats promotes perceptions of their risks, as previously reported (Jantz and Becker, 1984). We could say that HBM constructs during the COVID-19 pandemic are low amongst the workers at the slaughterhouse, but can be comprehended easily by the workers if well-sensitized.

However, there is a need to intensify efforts to bridge the knowledge and perception as well as preventive practices gaps on the disease through health education programs and

the development of health communications that centre on the identification of transmission pathways and preventive actions of physical distancing, use of PPE, handwashing, and disinfection using multiple channels like pamphlets, radio and community meetings. Furthermore, the surveillance and monitoring of SARS-CoV-2 in animals including livestock, companion, pet, and zoo animals and their handlers should be carried out along One Health approach mitigation strategies, and preventive and control strategies to contain the disease and its zoonotic impacts, the mechanisms of which remains unclear (Dhama *et al*. 2013; Bhatia 2020; Leroy *et al*. 2020; McNamara *et al*. 2020; Murdoch and French 2020).

The strength of this investigation is that it has concentrated on the area with a dearth of information about occupational workers at risk of the COVID-19 pandemic in developing countries, such as Nigeria. Its major limitation was the use of only a questionnaire tool for data gathering. However, this tool was pre-tested for quality control. Furthermore, we utilized a cross-sectional study that does not show a causal relationship, though establishes associations on effects of socio-cultural factors. There was a lack of full adjustments for occupational clustering during the probability sampling design. We expect the use of measures of the location to be valuable enough to accommodate all likely deficiencies in the confidence intervals. The outcomes of this survey are expected to be contributions towards COVID-19 health education promotion and preventive strategy among occupationally exposed groups in developing countries.

Conclusions

This study forms part of preliminary information on COVID-19 emergence and spread, and constitutes contributions that will support health intervention on the disease at slaughterhouses. It highlighted overall low knowledge and risk perceptions, and preventive preparedness regarding the COVID-19 pandemic among surveyed workers. These challenging gaps, call for health education of these vulnerable groups on the practice of adequate preventive measures. Taking the perceived risk routes for the disease spread into consideration will assist in the development of COVID-19 surveillance at slaughterhouses. Reform of factors that influence COVID-19 spread through the 'One Health' approach concept will ensure food security, and public and environmental health.

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Conflict of Interests

The authors have no conflict of interest to declare.

Authors' Contributions

NBA and MBA conceived, designed and conducted the research, and drafting of the manuscript. AMA and AHU participated in data collection. AMA, WDN, IAO and MKI designed and supervised the drafting of the manuscript. FOF supervised the research. All authors have read and approved the final manuscript.

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