Tubercles in cattle carcasses and risk behaviours for zoonotic tuberculosis transmission among workers in a municipal slaughterhouse

Akwoba J. OGUGUA[1]*, Ikechukwu J. ONUNKWO[1],
Innocent O. NWANKWO[1], Leonard E. GUGU[1],
Rose C. BASIL-EJIDIKE[2], John A. NWANTA[1]

[1]*University of Nigeria, Nsukka, Department of Veterinary Public Health and Preventive Medicine, Nigeria;*
*ogugua.akwoba@unn.edu.ng (*corresponding author); joseph.onunkwo@unn.edu.ng; innocent.nwankwo@unn.edu.ng;*
ozonelayer3366@gmail.com; john.nwanta@unn.edu.ng
[2]*College of Veterinary Surgeons, Public Heath Specialty, Nigeria (CVSN), Nigeria; roseejidike@yahoo.com*

Abstract

Prevalence of zoonotic tuberculosis in livestock in Nigeria contributes substantially to TB incidence among the population at risk. This study sought for tubercles in cattle carcasses and assessed knowledge and risk behaviours for zoonotic tuberculosis transmission among workers in Ikpa slaughter, Nsukka, Nigeria. Tubercle samples collected during meat inspection of 420 cattle carcasses were subjected to Ziehl Neelson stain. Questionnaire was issued to 50 slaughterhouse workers and data generated analysed with STATA 12 at $p<\alpha$ (0.05). The results showed 0.71% (3/420) prevalence of tubercles that translated to 0.79% (3/382), 0.81% (3/372), 0.79% (2/379) among the males, adults and White Fulani breeds, respectively. Among the respondents, 64% (32/50) had good knowledge of the disease. Knowledge of ZTB was significantly associated with level of education (P<0.05). Practices that expose to zoonotic tuberculosis infection were found among 48% of the participants. Practices that expose to the infection was found to be significantly associated with the level of education (P<0.05). Tubercles were prevalent in cattle carcasses in Ikpa slaughterhouse. Workers in the place need in-depth enlightenment on ZTB and its modes of transmission to reduce human exposure to the disease.

Keywords: Ikpa slaughter; knowledge; Nigeria; practices; tubercles; zoonotic tuberculosis

Introduction

In the cattle, resistance to *Mycobacterium* infection results in the formation of granuloma and cessation of progressive growth of the organism. The causative agent of bovine tuberculosis, *M. bovis*, is zoonotic and its granuloma can be a source of infection to humans when ingested (Akalu, 2017). The granuloma or tubercle is therefore targeted during meat inspection due to its role in zoonotic tuberculosis (ZTB) transmission and the associated public health importance. During standard meat inspection, tuberculous granuloma is subjected to Ziehl Neelsen stain. When found positive, the judgement for the cattle carcass is total condemnation

(Herenda *et al.*, 2011) and subsequent compensation of the owner to protect consumers. However, in poor resource countries like Nigeria, trimming of affected parts and subsequent thorough cooking of the rest of the carcass is allowed when the disease is not generalized and the lymph nodes are not affected (Herenda *et al.*, 2011; Awah-Ndukum *et al.*, 2012). Bovine TB therefore, is of economic importance by affecting meat production and international trade negatively. To the butcher, there is loss due to downgrading of meat or outright condemnation. To reduce the economic burden, butchers are supposed to be adequately compensated. However, this is not done resulting in butchers not complying with meat inspectors (Hambolu *et al.*, 2013) and other measures put in place to control ZTB in slaughterhouses in Nigeria. Presence of bovine TB in cattle carcasses in the slaughterhouses therefore portends grave public health risks given the high HIV and TB prevalence in the country coupled with abattoir activities with high exposure potentials common among slaughterhouse personnel.

Practices that expose workers and consumers to zoonotic diseases in abattoirs have been recorded in many studies in Nigeria (Sa'idu *et al.*, 2015; Shiaka *et al.*, 2015; Adesokan *et al.*, 2016; Njoga *et al.*, 2018). Some of these practices include consumption of tuberculous and raw meat (Hambolu *et al.*, 2013; Anyanwu *et al.*, 2019), selling infected meat to consumers (Agada, 2015) and not using personal protective equipment (PPE) (Sa'idu *et al.*, 2015; Ayoola *et al.*, 2017; Agada *et al.*, 2019). In addition, many abattoirs do not or employ unqualified meat inspectors. On top of all this is that government does little or nothing to protect meat consumers but considers slaughterhouses only as sources of revenues while not enforcing meat hygiene laws (Agada *et al.*, 2019). Moreover, there is general lack of amenities that could contribute to hygiene practices in Nigerian slaughterhouses. In addition, inadequate knowledge of ZTB common among the occupationally exposed in the country results in developing attitudes and engaging in practices that expose to the disease. According to Smits and Cutler (2004), lack of knowledge is an inhibition and prevents the acceptance of control measures in population at risk contributing to incidence of ZTB in the community. Being that reports on the presence of tubercles in cattle carcasses and level of knowledge of ZTB among workers in Ikpa slaughterhouse is scarce, it becomes important to assess the level of knowledge and activities of the workers as it concerns exposure to the disease. This will provide evidence for the need to put in place control measures. Controlling ZTB transmission in slaughterhouse will go a long way in contributing to stopping the spread of tuberculosis as being advocated by the WHO.

Materials and Methods

Study area
The study was conducted in Ikpa slaughterhouse, Nsukka, Enugu state, Nigeria earlier described (Njoga *et al.*, 2019).

Study design, population and sample selection
The study adopted the cross-sectional design approach which involved cattle carcasses and workers at Ikpa slaughterhouse, Nsukka, Nigeria. Meat inspection was conducted on the cattle carcasses and a survey of the knowledge and practices of the workers between May to August, 2018. The slaughterhouse has very little in terms of amenities like well laid plan and tap water that could be of use in maintaining good hygiene. All slaughter activities are conducted on the floor of slaughterhouse. The slaughterhouse is always overcrowded and the butchers use machetes freely while cutting bones or tough tissues. The butchers process infected animals with no regard to the use of PPE and engage in many practices that could expose them to zoonotic diseases.

In sampling, Nsukka was selected through balloting from the list of the three senatorial zones in the state while Ikpa slaughterhouse was chosen for having the highest number of workers and slaughter activities in the senatorial district. The carcasses were selected by systematic random sampling of one in every three while 30%

of the workers were selected by balloting using the list of workers in the slaughterhouse. Individuals who were not in the list as workers in the slaughterhouse or less than 18 years of age were excluded. The purpose of the study was explained to the participants and that they could decline to participate with no resultant penalty. A pretested semi-structured interviewer administered standardized ZTB questionnaire (Agada, 2015) was administered to consenting respondents.

Sample collection

The Ikpa slaughterhouse was visited three times in a week for a period of three months, and meat inspection systematically conducted following standard methods (Herenda *et al.*, 2011). Specimen(s) suspected to be tubercles with the typical granulomatous lesions were collected into polythene bags and transported to the Department of Veterinary Public Health and Preventive Medicine, University of Nigeria Nsukka laboratory where the acid-fast stain was conducted.

Ziehl-Neelsen (ZN) stain, questionnaire administration and scoring

In ZN, Mycobacteria retain basic dye after treatment with acid-alcohol solution and this was done according to standard methods (Shrestha *et al.*, 2005).

Scores were awarded based on the accuracy of the respondent's answers ranging from zero to one for each incorrectly and correctly answered questions respectively. Overall scores of 11 and 14 were given for ZTB questions on knowledge and practices for each respondent, respectively. A respondent was classified as knowledgeable at the score of six or above, and engaging in (poor) practices that expose to ZTB transmission for below seven.

Data analysis

Data generated were analysed using the STATA 12 (StataCorp 4905 Lakeway Drive, College Station, Texas 77845, USA). Frequencies and percentages were calculated where appropriate. The chi-square analysis was used to determine relationships between variables (presence of tubercles) and factors (age, sex, breed) of cattle carcasses. In the questionnaire study, it was also used to assess the relationship between variables (knowledge and practices) and a range of factors (including occupation, age, sex, educational levels, experience). The p-values less than α (0.05) were considered significant.

Results

Characteristics of cattle slaughtered and presence of tubercles in cattle carcasses examined at Ikpa slaughterhouse

Out of the total of 420 cattle examined most were bulls (90.95%), adults (88.57) and of the White Fulani (90.24%) breed (Table 1). Out of the 420 cattle carcasses examined, tubercles were found in 0.71%. None of the parameters considered was found to be significantly associated (p > 0.05) with the presence of tubercles (Table 2).

Demographic characteristics of the respondents

A total of 50 persons comprising 31 (62%) of butchers and 19 (38%) of workers who were engaged in other duties in the slaughterhouse participated in the study. A greater proportion of them (52%) were young within the age group of 18-39 years, males (92%) and had post-primary education (60%). A higher proportion 60% of the respondents had more than 3 years' experience of working in the slaughterhouse (Table 3).

Table 1. Characteristics of cattle slaughtered in Ikpa slaughterhouse

Variable	Characteristics	Number of animals slaughtered (n = 420)	Percentage (%)
Sex	Male	382	90.95
	Female	38	9.05
Age	Adult (> 2 yrs)	372	88.57
	Young (<2 yrs)	48	11.43
Breed	White Fulani	379	90.24
	Red Bororo	35	8.33
	Ndama	6	1.43

Table 2. Occurrence of tuberculous lesions in cattle slaughtered at Ikpa slaughterhouse

Variable	Characteristics	Positive (%)	Negative (%)	Chi-square	P-value
Sex	Male	3 (0.79)	379 (99.21)		
	Female	0 (0.00)	38 (100)	0.188	0.665
Age	Adult	3 (0.81)	369 (99.19)		
	Young	0 (0.00)	68 (100)	0.353	0.552
Breed	White Fulani	3 (0.79)	376(99.21)		
	Others	0 (0.00)	41 (1000	0.204	0.652

Table 3. Demographic characteristics of the respondents at Ikpa slaughterhouse

Variable	Characteristics	Frequency (%)
Occupation	Butchers	31 (62)
	Others	19 (38)
Age	Young	26 (52)
	Adult	24 (48)
Gender	Male	46 (92)
	Female	4 (8)
Level of education	Little education	20 (40)
	Well educated	30 (60)
Level of experience	Few years of experience	20 (40)
	Well experienced	30 (60)

Knowledge of ZTB among abattoir workers at Ikpa slaughterhouse

Almost 65% of the participants were knowledgeable about the disease with the proportion among butchers (65.2%) being slightly higher than among those in other occupations (63.16%). On ZTB knowledge related questions, 54% knew that ZTB affects man; 44 and 24% knew that it can be transmitted through ingestion (contaminated milk and meat) and inhalation, respectively, while 32% did not know how. On ZTB prevention related question, 70% knew that ZTB transmission from cattle to man is preventable. Additionally, only 38% knew that ZTB in man is curable. However, while 74% knew it is best cured with modern medicine, others indicated traditional medicine (22%) and prayer (4%). Chi-square analysis indicated knowledge of ZTB to be significantly (p = 0.02) associated with only the level of education (Table 4).

Factors associated with practices that expose to ZTB among abattoir workers at Ikpa slaughterhouse

As regards practices that expose to ZTB, about half of the respondents (48%) demonstrated poor practices as it concerns the disease. A significantly higher number of those with primary education and less (70%) engaged in practices that expose to the disease than those with post primary education (33.3%). Less than half (46%) of the respondents had history and evidence of BCG vaccination, the others practiced self-medication (32%), use of herbs (18%) and prayer (4%) on the issue of self-prevention from getting infected with ZTB. On how they handled cattle carcasses with tubercles, 44% sell it to the public, 38% allowed

condemnation, 12% take them home for consumption while others (6%) gave no response. On co-habitation with livestock, 24% had them in their homes while 76% didn't. Responding to the question of having regular check-up, 60% didn't while 40% did. Again, the majority of the respondents (82%) indicated not eating while handling animals against 18% that did eat. Practices that expose to ZTB was significantly (p = 0.011) associated with education but not with the other factors considered (Table 5).

Table 4. Factors influencing levels of knowledge about ZTB among workers in Ikpa slaughterhouse

Variable	Characteristics	Good (%) n=32 (64)	Poor (%) n = 18 (36)	Chi-square	p-value
Occupation	Butchers	20 (64.52)	11 (35.48)		
	Others	12 (63.16)	7 (36.84)	0.009	0.923
Age	Young	16 (61.54)	10 (38.46)		
	Old	16 (66.67)	8 (33.33)	0.143	0.706
Gender	Male	29 (63.04)	17 (36.96)		
	Female	3 (75.00)	1 (25.00)	0.228	0.633
Level of education	Low	9 (45.00)	11 (55.00)		
	High	23 (76.67)	7 (23.33)	5.223	0.020
Level of experience	Few years of experience	14 (70.00)	6 (30.00)		
	Well experienced	18 (60.00)	12 (40.00)	0.521	0.470

Table 5. Factors influencing behaviours that expose to ZTB among workers in Ikpa slaughterhouse

Variable	Characteristics	Good (%) 26 (52)	Poor (%) 24 (48)	Chi-square	P-value
Occupation	Butchers	16 (51.61)	15 (48.39)		
	Others	10 (52.63)	9 (47.37)	0.005	0.944
Age	Young	12 (46.15)	14 (53.85)		
	Old	14 (58.33)	10 (41.67)	0.742	0.389
Gender	Male	23 (50.00)	23 (50.00)		
	Female	3 (75.00)	1 (25.00)	0.922	0.337
Level of education	Low	6 (30.00)	14 (70.00)		
	High	20 (66.67)	10 (33.33)	6.464	0.011
Level of experience	Few years of experience	9 (45.00)	11 (55.00)		
	Well experienced	17 (56.67)	13 (43.33)	0.654	0.419

Discussion

The study found tubercles to be prevalent among the carcasses of slaughter cattle examined. This prevalence may not be unconnected to the absence of policy being pursued actively to control ZTB in livestock in Nigeria (Ejeh *et al.*, 2013). In addition, uncontrolled movement of livestock from neighboring countries where the disease is prevalent (Egbe *et al.*, 2013) is a common practice in Nigeria (Ogundipe, 2001). Prevalence of the disease in slaughter cattle represents economic loss to the butchers due to carcass condemnation (Ejeh *et al.*, 2014; Sa'idu *et al.*, 2015). It is of public health importance to the workers and meat consumers given that meat inspection is poorly conducted in Nigeria (Ejeh *et al.*, 2013), leaving the consumers at the mercy of unscrupulous butchers whose major interests are in the making of profits. In fact, this study found that 44% of the respondents sell carcasses with tubercles to consumers just as earlier recorded in other studies in Nigeria (Hambolu *et al.*, 2013; Adesokan *et al.*, 2018). Furthermore, the Ikpa Slaughterhouses like others in Nigeria are known for being overcrowded (Agada *et al.*, 2019) which is a factor in the transmission of ZTB (Agada,

2015). Moreover, the free use of machetes for the cutting of Mycobacteria infected carcasses in the slaughterhouse can easily give rise to airborne droplets containing the organism which results in acquiring of the infection through inhalation (Thoen *et al.*, 2006).

The study found more than 50% of the respondents to be knowledgeable about ZTB although with gaps. The level of knowledge of ZTB in this study is comparable to that recorded in Gusau (Ismaila *et al.*, 2015) and Nigeria (Adesokan *et al.*, 2018) but higher than what was reported among livestock keepers in Jigawa State, Nigeria (Ibrahim *et al.*, 2012) and livestock workers in Lafia (Agada *et al.*, 2019). Knowledge of ZTB among the respondents may be due to the fact that tubercles in carcasses are always targeted for condemnation by meat inspectors and the reason given to them is to protect them and the consumers from getting infected with bovine TB. Such condemnations, whether whole or partial, results to losses in revenue to the butchers. This loss is more pronounced because butchers are not compensated for meat condemnation in slaughterhouses in Nigeria (Ejeh *et al.*, 2014). It is therefore not surprising that butchers know about ZTB more than those in other occupations since presence of tubercles in meat carcasses deprives butchers of their source of livelihood. The fact that many respondents engaged in practices that expose to ZTB infection could as well be attributed to same economic reasons given that losses due to meat condemnation (wholly borne by the butchers) is huge. Ejeh *et al.* (2014), recorded $18183.8 loss due to condemnation as a result of tubercles in carcasses in one abattoir in one year in Nigeria. Therefore, many butchers would rather sell infected tissues to consumers than loss their sources of livelihood. Another major cause of poor practices may be attributed to the fact that tuberculosis is chronic and because infected individuals do not show immediate signs of the disease, many butchers do not consider ZTB to be severe enough (Hambolu *et al.*, 2013). Belief in non-severity results in not taking personal protective measures against ZTB but engage in practices that expose to ZTB like eating tuberculous tissues (Hambolu *et al.*, 2013) or possibly contaminated raw meat to convince customers of its palatability (Iheanacho *et al.*, 2012). In addition, there is always the belief that the heat of cooking kills all the infectious organisms in the meat in Nigeria but this reduces rather than eliminate all hazards (Iheanacho *et al.*, 2012). Moreover, poor and unhygienic handling of tuberculous meat in homes and food vendor kitchens can contaminate ready to eat food. Unhygienic handling is common among food vendors in Nigeria (Ogah *et al.*, 2015) and disease outbreaks have been traced to ready to eat food sources (Hassanain *et al.*, 2013; Fletcher *et al.*, 2015).

The study recorded an association between level of education and knowledge of ZTB; also, between education and practices that expose to the disease. While those with high level of education were knowledgeable about the disease, those with lower level of education engaged more in TB exposing practices. This is in consonance with the findings of Adesokan *et al.* (2018) on ZTB among livestock workers in Nigeria as well as other studies among members of a rural community on TB in Edo State (Tobin *et al.*, 2013), and among hospital workers in Nigeria (Ogoina *et al.*, 2015), members of a community on TB transmission in Tanzania (Ismail *and* Josephat, 2014), among TB patients about TB transmission in Bangladesh (Tasnim *et al.*, 2012), in a community in Ethiopia on TB (Tolossa *et al.*, 2014). The association of higher educational level with knowledge of the disease may not be unconnected to the fact that education improves one's ability to learn and acquire health knowledge; enables a healthy life style so that lack of education is regarded as sickness (Hahn *and* Truman, 2015). Thus "Universal Primary Education" is core strategy of the United Nations' development programme.

Conclusions

Tuberculous granuloma cases were detected among cattle inspected in Ikpa Slaughter. Most of the workers were knowledgeable about ZTB but practices that expose to the disease is rampant among them. There is need for frequent enlightenment campaign to be organized for workers at Ikpa slaughterhouse. Meat inspection in the place should be done more thoroughly and compensation paid for condemnation of ZTB

cattle carcasses. Workers in the slaughterhouse should be screened for TB and those having the disease recommended for treatment. There should be further studies to culture, isolate and identify the Mycobacterium species responsible for the tubercles present in cattle carcasses in the slaughterhouse.

Authors' Contributions

OAJ, OJI, NJA - designed the study; GLE, BRC - collected the data, OAJ analyzed the data, drafted and wrote the manuscript, NIO revised the manuscript.
All authors read and approved the final manuscript.

Ethical approval (for researches involving animals or humans)

Ethical approval for this study was obtained from the Anambra State Ministry of Health Ethics Committee with number MH/AWK/M/321/344. Oral informed consent was obtained from all questionnaire participants.

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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