



Research Article

Knowledge and Practices Regarding Zoonotic Bovine Tuberculosis among Meat Processors at Slaughter Slabs in Owerri, Southeastern Nigeria

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ABSTRACT

Zoonotic tuberculosis remains a major public health issue in many parts of the world. A study was conducted to evaluate the knowledge and practices of slaughter slab meat processors in Owerri, Southeastern Nigeria, using a structured, closed-ended questionnaire. A total of 100 questionnaires were randomly administered to butchers and meat sellers with their informed consent. The data were analyzed using descriptive statistics, and chi-square tests were used to assess associations, with a p value of $p \leq 0.05$ considered statistically significant. Demographic data showed that all respondents were male; half were butchers, and half were meat sellers. Most respondents were between 26 and 45 years, with 40% between 26 and 35 and 42% between 36 and 45 years old. Regarding education, 40% had primary education, while 42% had secondary education. The study revealed that butchers were more aware of TB than meat sellers ($p < 0.000$). However, most respondents lacked awareness that TB is a zoonotic disease ($p = 0.01$, Table 2). Concerning vaccination, 44% of butchers and 48% of meat sellers had never received the Bacillus Calmette-Guérin (BCG) vaccine ($p = 0.14$). Most butchers (45%) and meat sellers (35%) associated tuberculosis only with animal diseases ($p = 0.01$). There was a moderate level of understanding about tuberculosis among 45% of butchers and 25% of meat sellers. Still, more targeted policies are needed to enhance awareness of zoonotic diseases among meat processors in abattoirs and slaughter slab operations.

Keywords: Butchers; Knowledge; Meat sellers; Practices; Tuberculosis; Zoonotic

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INTRODUCTION

Bovine tuberculosis is a significant infectious disease caused by *Mycobacterium bovis*, a (*M. bovis*) bacterium belonging to the *Mycobacterium tuberculosis* complex (MTBC). The pathogens can infect a wide range of mammalian species, including humans (Ofukwu *et al.*, 2006), cattle (Zanwa *et al.*, 2023), and many wild animals (Michel *et al.*, 2010), posing a substantial zoonotic threat to public health (Szacawa *et al.*, 2025). The primary mode of transmission of tuberculosis in cattle is the inhalation of infected aerosols containing *M. bovis* in close settings with intense contact, such as

slaughterhouses and livestock markets (Desu *et al.*, 2025). Similarly, the spread of the disease in humans has been exacerbated by the consumption of unpasteurized milk (Ofukwu *et al.*, 2008), undercooked meat, and close contact between humans and animals during grazing (Zanwa *et al.*, 2024) and abattoir operations (Adesokan *et al.*, 2018).

Mycobacterium tuberculosis is the most common cause of tuberculosis in humans, with some underdiagnosed cases resulting from *M. bovis* (Damene *et al.*, 2020). The incidence and mortality rate of tuberculosis globally, regionally, and locally

are alarming, with total mortality approximately 1.6 million in 2021, and a global incidence of 10.6 million cases, of which adult males accounted for 6 million cases, while women and children accounted for 3.4 million and 1.2 million cases, respectively (WHO, 2019). Tuberculosis is a major public health problem in Nigeria, as the country is ranked 5th amongst the 22 countries with tuberculosis burden, which collectively bears 80% of the global tuberculosis burden (WHO, 2013). This study aimed to determine the knowledge and practice amongst meat processors towards zoonotic bovine tuberculosis in Owerri, eastern Nigeria.

MATERIALS AND METHODS

Study Area

Owerri serves as the capital of Imo State, located in the southeastern geopolitical zone of Nigeria. The city comprises three Local Government Areas: Owerri

Municipal, Owerri North, and Owerri West. The population was approximately 401,873 in 2006, with projections suggesting it reached around 516,610 by 2015 (National Population Commission, 2006). The total area of Owerri is about 550.848 square kilometers (figure1). Situated in the southern part of Imo State, Owerri lies between longitudes 60°52'35" E and 70°10'26" E, and latitudes 5°32'59" N and 5°16'1" N. The city is primarily drained by the River Nwaorie and River Otamiri, along with their tributaries. Like many Nigerian cities, Owerri experiences two distinct climatic seasons: the dry season from October to March, and the wet season from April to September. Additionally, the harmattan, characterized by cold, dry, dusty winds, occurs annually from December to February. The mean temperature in Owerri ranges from 24°C to 34°C, with relative humidity levels reaching 70% during the dry months and 90% during the wet months.

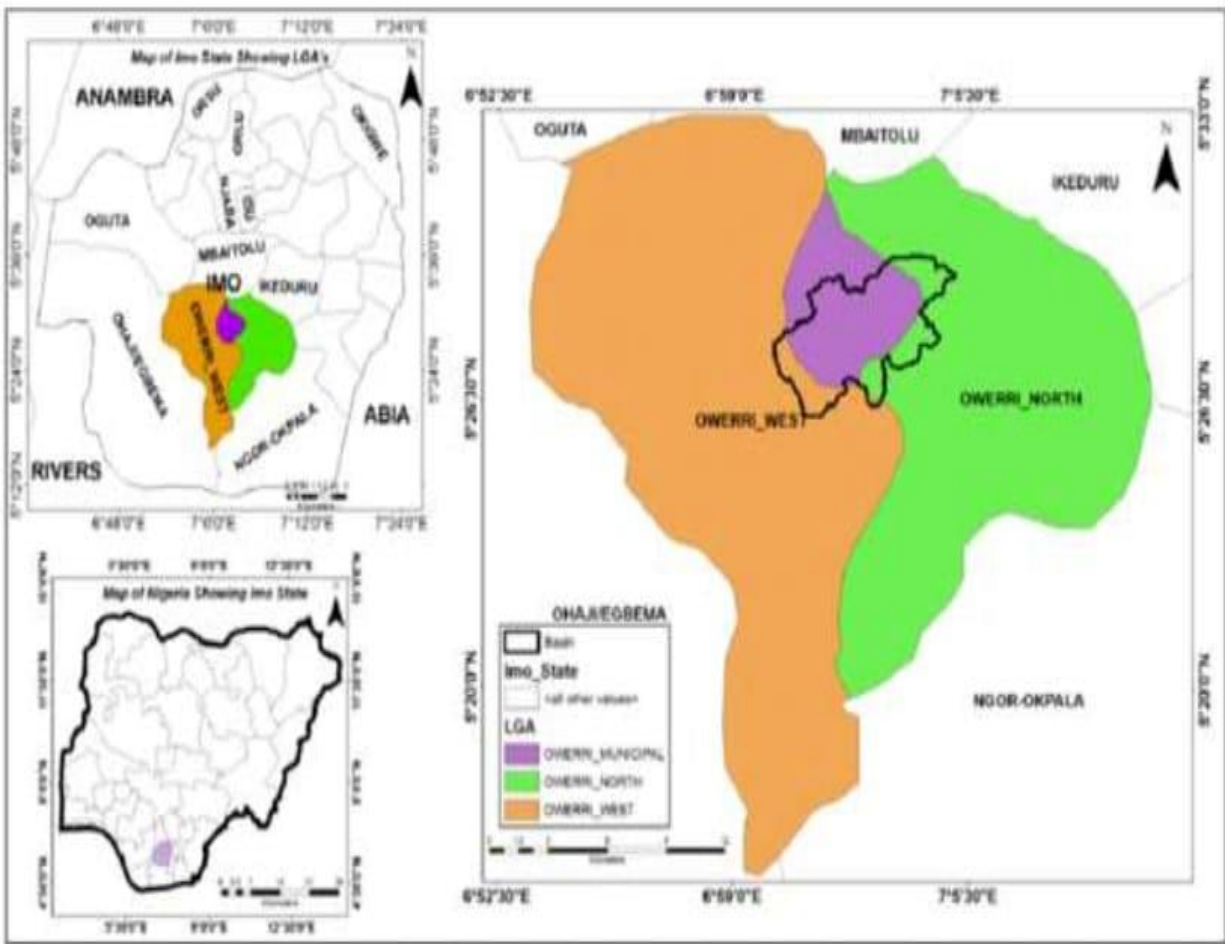


Figure1: Map of Nigeria showing Imo state, states bordering Imo state, and Owerri, the study area (Department of Geography and Urban Planning, Federal University of Technology Owerri)

Study Design

The study design was cross-sectional.

Questionnaire Survey

A total of 100 questionnaires were administered to meat processors at slaughter slabs located in Owerri, following a process of informed consent. The questionnaire was written in English language, as most respondents possessed proficiency in the language. Data were collected on respondents' demographic characteristics, including occupation, age, gender, educational background, and years of experience in the field. Additionally, the questionnaire assessed participants' knowledge and practices regarding zoonotic bovine tuberculosis (ZTB), and responses were collected from various slaughter slabs in Owerri. The study was carried out between Septembers to October 2025.

Data Analysis

Descriptive statistical tables were created, and the data were organized using Microsoft Excel® 2010. The collected data, which consisted of responses from each main area of the questionnaire, were classified, and frequencies were estimated to clarify the variables. The degree of association between the variables was analyzed using the Chi-square test of significance across the various data categories.

RESULTS

Demographic information of the respondents

In this study, the demographic information indicated that 50 butchers and 50 meat sellers participated in the survey; all respondents were male. Respondents were grouped by age: 18-25-year-olds accounted for 15%, whereas the 26-35- and 36-45-year age groups had the highest participation rates, respectively. Similarly, 10% were aged 46-55 years. However, lower participation was observed among individuals aged 56 years and above, with only 5% participation (Table 1).

Association among butchers and meat sellers about Knowledge of zoonotic tuberculosis in Owerri

In evaluating tuberculosis knowledge among respondents, 45% of butchers had a better understanding than meat sellers (25%), and this difference was significant in the current study, $\chi^2 = 19.048$, $p < 0.000$. Additionally, a significant association is observed among butchers and meat sellers when asked whether coughing is a sign of tuberculosis in animals, 40% of butchers indicated good knowledge of the signs of TB, whereas, only 20% of meat sellers had a better understanding of the signs of the disease in animals, the results are statistically significant, with $\chi^2 = 16.05$, $p < 0.00$, (Table 2).

Table 1: Demographic information of the Butchers and meat sellers

Variables	Frequency	Percentage (%)
Occupation		
Butchers	50	50.0
Meat Sellers	50	50.0
Sex		
Male	100	100.0
Female	0	0.0
Age		
18-25 years	15	15.0
26-35 years	35	35.0
36-45 years	35	35.0
46-55 years	10	10.0
56 years and above	5	5.0
Level of Formal education		
None	10	10.0
Primary	40	40.0
Secondary	42	42.0
Tertiary	8	8.0
Years of Experience		
Less than 5 years	10	10.0
6-10 years	30	30.0
11-15 years	35	35.0
16 years and above	35	35.0

Table 2: Knowledge of zoonotic tuberculosis among butchers and meat sellers in Owerri slaughter slabs (n=100)

Variables		Responses (%)		X ²	p=value
		Yes	No		
Have you heard of TB?	Butchers	45.0	5.0	19.05	0.00
	Meat Sellers	25.0	25.0		
Is TB a highly contagious disease?		18.0	32.0	0.31	0.53
		17.0	33.0		
Is it your responsibility to ensure that the meat you sell is safe from disease?		14.0	36.0	0.48	0.49
		11.0	39.0		
Can TB be transmitted from animals to humans?		35.0	15.0	1.01	0.21
		30.0	20.0		
Do swollen lymph nodes indicate TB in animals?		13.0	37.0	0.76	0.38
		17.0	33.0		
Do you think humans can get TB from the consumption of fermented Milk?		20.0	30.0	2.94	0.86
		12.0	38.0		
Do you think TB is a serious health risk to you?		10.0	40.0	0.23	0.63
		37.0	13.0		
Is weight loss a sign of TB in Slaughter animals?		40.0	10.0	0.58	0.48
		20.0	30.0		
Is coughing a sign of TB in animals?		40.0	10.0	16.7	0.00
		20.0	30.0		
Are you willing to attend a training session on TB prevention?		9.0	41.0	0.25	0.62
		11.0	39.0		

Association among butchers and meat sellers about Practices towards zoonotic tuberculosis in Owerri

Finding in table 2 show a slight association ($\chi^2=2.17$; $p=0.14$) between butchers and meat sellers and poor practices, specifically, not receiving regular vaccination with Bacillus Calmette-Guerin (BCG), with 44% of butchers and 48% of meat sellers having never

been vaccinated. Additionally, the respondents were asked whether TB is a disease that affects animals only. Most butchers and meat sellers are unaware that TB is not a disease affecting animals only; it is transmissible between animals and humans. The results show a strong association ($\chi^2 = 6.25$, $p = 0.01$).

Table 3: Practices among the butchers and meat sellers towards zoonotic tuberculosis in the slaughter slabs operations in Owerri (n=100)

Variables		Responses (%)		X ²	p=value
		Yes	No		
Have you ever been vaccinated with BCG?	Butchers	6.0	44.0	2.17	0.14
	Meat Sellers	2.0	48.0		
Is it possible to get TB by inhaling infected droplets from an animal?		5.0	45.0	0.13	0.72
		14.0	36.0		
Is TB a disease that affects animals only?		45.0	5.0	6.25	0.01
		35.0	15.0		
Is the consumption of raw meat a way to get TB?		45.0	5.0	0.46	0.41
		12.0	38.0		

DISCUSSION

The data presented in this study indicate that meat processors were predominantly male (100%), consistent with reports by Muhammad *et al.* (2022) and Bihon *et al.* (2021), which reported higher

proportions of males at 95.1% and 75.2%, respectively. Similarly, the level of education among respondents indicated that those at the primary and secondary levels predominated, consistent with findings reported by Smita *et al.* (2021) and Bihon *et*

al. (2021). This study shows that a substantial proportion of meat processors are aware of zoonotic tuberculosis, consistent with reports by Adesokan *et al.* (2018), who found that abattoir workers have good knowledge of zoonotic TB, with knowledge gaps among livestock owners and pastoral communities (Zanwa *et al.*, 2023). This study reports lower levels of ZTB knowledge among respondents than those reported by Muhammad *et al.* (2022) and Bihon *et al.* (2021). Additionally, the data presented in this study show that respondents aged between 18-45 were more populated in the study than other age bracket, which aligns with reports by Hajara *et al.* (2022), Bihon *et al.* (2021), and Adesokan *et al.* (2018). The years of experience presented in this study revealed that meat processors with 11-15 years of experience (35%) and 16 years or more (35%) were more. Adesokan *et al.* (2018), whose findings show a higher duration of 68.1% among respondents with experience > 3 years, demonstrate that new entrants are among the susceptible risk group.

In this study, most butchers (45%) and meat sellers (25%) have heard of ZTB, a proportion lower than that reported by Mathewos *et al.* (2024), which showed 73.3% and 26.7%, respectively, among butchers and abattoir personnel, indicating they have good knowledge of ZTB. The study by Muhammad *et al.* (2022) reports a higher awareness of ZTB (105%) among meat processors in Abuja, Nigeria, while studies in Ethiopia by Hamid *et al.* (2024) and Bihon *et al.* (2021) show awareness levels of 98.2% and 97.4%, respectively. The knowledge gap observed in this study could stem from the lack of abattoirs in the area, leading butchers to rely on slaughter slabs with limited or no information on ZTB. Nevertheless, 35% of butchers and 30% of meat sellers are aware that bTB can be transmitted from animals to humans, while 15% and 20% have poor knowledge about the disease and its transmission to humans. In contrast, Adesokan *et al.* (2018) in Southwestern Nigeria reported that abattoir workers were six times more aware of bovine tuberculosis, able to identify its signs on carcasses, and able to recognize human symptoms. Additionally, in India, Smita *et al.* (2021) found that urban populations are generally aware of how bovine tuberculosis can be transmitted from animals to humans, with veterinarians demonstrating greater knowledge of its zoonotic nature. Similarly, Zanwa *et al.* (2023), in Nasarawa State, found limited knowledge among pastoralists about the disease as a zoonosis (Alhaji *et al.*, 2020).

The findings in this study indicated that butchers were more aware of the signs of tuberculosis in animals and agreed that coughing is a sign of bovine tuberculosis. This report aligns with studies by Agada *et al.* (2019), Adesokan *et al.* (2021), and Muhammad *et al.* (2022). In a study by Phiri *et al.* (2025) in Zambia, whose results supported the current study's findings that meat handlers with lower levels of education have less knowledge of ZTB than butchers. In contrast, Agada *et al.* (2019) identify coughing and emaciation as symptoms of tuberculosis in cattle. Damene *et al.* (2020) indicate that bovine tuberculosis lesions could be pulmonary or extrapulmonary. In a previous study, Damene *et al.* (2020) described the lesions as circumscribed, yellowish in the tracheobronchial lymph node; similarly, Samuel *et al.* (2014) reported calcified necrotic granulomatous lesions in the carcasses of bulls.

The result of this study indicated that butchers and meat sellers have poor knowledge of milk serving as a vehicle for the transmission of tuberculosis to humans, this results agrees with Adesokan *et al.* (2018), that there is a knowledge gap among livestock workers consuming unpasteurized milk and meat from infected animals and engaging in direct contact with infected animal through inhalation of infected aerosols could increase the mode of transmission of zoonotic bTB. Additionally, Phiri *et al.* (2025) concur with this study's findings, which report that cattle farmers, veterinarians, and para-veterinarians consumed undercooked meat and unpasteurized milk, even though they knew this could predispose them to ZTB. The high risk of transmission of ZTB could be attributed to the consumption of unpasteurized milk sold by milkmaids, which may contain *Mycobacterium bovis* (Mathewos *et al.*, 2024) and is consistent with findings from Ofukwu *et al.* (2008) in Makurdi, Benue state, Nigeria, whose results show the isolation of *M. bovis* from nono commercially sold milk by milkmaids. Additionally, Agada *et al.* (2018) reported the isolation of non-tuberculous mycobacteria from milk samples traded for human consumption in Ibadan, South-West Nigeria.

This study shows that only a few butchers and meat sellers in Owerri, Nigeria, have received the BCG vaccine against tuberculosis. This is a public health concern because these workers are often involved in slaughtering operations and could have a higher risk of transmitting zoonotic tuberculosis. The current findings align with the results of Odetokun *et al.* (2022), who reported a lower vaccination rate of 6.4%

among respondents who had received the BCG vaccine. Additionally, Dahiru *et al.* (2022) reported that 40.0% of small ruminant butchers in Katsina State, North-West Nigeria, were vaccinated with BCG since birth. This study reveals that awareness of tuberculosis vaccination is limited among respondents, and the importance of vaccination for public health underscores the need for intervention policies, using One Health approaches to educate high-risk groups and prevent the transmission of zoonotic bovine tuberculosis.

In this study significant proportion of respondents agreed that tuberculosis is an animal disease only, the result corroborates with the study by Adesokan *et al.* (2018), whose results revealed that, despite the good knowledge among abattoir workers about zoonotic tuberculosis in animals, they still indulge in practices that risk transmission of the disease, like the consumption of unpasteurized milk, undercooked meat, and lack of protective clothing during slaughter operation. The work of Muhammad *et al.* (2022) reported that, since there is a lack of a national control strategy and the high degree of transmission of zoonotic tuberculosis from animal to human is less clear, the culling of animals with tuberculosis should be done without treatment, since most species of *M. bovis* are resistant to drugs.

Moreover, the study showed that respondents with formal education were more knowledgeable about zoonotic tuberculosis than those with no formal education. This finding is consistent with the results of Mathewos *et al.* (2025), Muhammad *et al.* (2022), and Bihon *et al.* (2021). The overall results of this study revealed that butchers are more aware of bovine tuberculosis than meat sellers, corroborating the findings of Cadmus *et al.* (2010) and Adesokan *et al.* (2018).

CONCLUSION

Even though adequate knowledge of tuberculosis exists among the butchers and meat sellers at 45 % and 25 %, efforts must be implemented through policy development to target occupationally exposed personnel engaging harmoniously in meat processing to better understand the implications of zoonotic diseases in our abattoirs and slaughter slab operations. Knowledge of identifying tuberculous animals before slaughter, assessing carcasses, and, in addition to avoiding practices that could predispose personnel to zoonotic disease, must be instituted as a policy to provide a serve heaven to safeguard public health.

Authors' Contributions

All authors have read, reviewed, edited, and approved the final manuscript.

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Conflict of interest

There are no conflicts of interest among the authors, as every aspect of the manuscript was consistent with their contributions, from the conception of the ideas to the final review and editing.

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