

Environmental Conditions of Abattoirs and Slaughter Sites and Perceived Risk of Zoonoses in the Tamale Metropolis of Ghana

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ABSTRACT

Abattoirs and slaughter sites are integral to the food production cycle; hence, their environmental factors and hygiene status must be optimal to produce wholesome meat for human consumption. These facilities face numerous challenges, including poor waste disposal, inadequate hygiene and sanitary facilities, and the spread of infections. This study assessed the environmental conditions of abattoir and slaughter sites and the risk of zoonotic diseases in the Tamale Metropolis of Ghana. A cross-sectional descriptive research study was utilized to carry out this study. A total of 245 abattoir and slaughter site workers in the Tamale Metropolis were included in this study. Descriptive statistics and chi-square tests were used to compare the variables in this study, and statistical significance was computed at a p-value <0.05. The study found that dumping animal waste on the environment was the most practiced method of waste disposal at both the abattoir and slaughter sites. About 86.44% of respondents at the abattoir indicated adequate hygiene and sanitary facilities available compared to 26.47% at the slaughter sites (p-value <0.001). Toilet facilities were likelier to be present at the abattoir than at the slaughter sites (p-value < 0.001). The abattoir was more likely to have availability of portable water than the slaughter site (p-value < 0.001). Each worker had had at least an episode of zoonotic disease-related symptoms during their operations. Coughing (p-value=0.002) and vomiting (p-value=0.019) were more common among the abattoir workers than those at the slaughter sites. The study revealed generally poor animal waste disposal at both the abattoir and the slaughter sites. It also found that the slaughter sites had inadequate hygiene and sanitary facilities. There was a marginally higher occurrence of perceived zoonotic disease-related symptoms at the abattoir, particularly cough and vomiting, than at the slaughter site. This is attributed to the enclosed nature of the abattoir compared to the slaughter sites, which are open to the environment.

Keywords: Abattoir, Infection, Slaughter site, Zoonoses.

INTRODUCTION

Abattoirs are integral to the food production cycle, serving as facilities where animals are slaughtered and prepared for consumption (**Rodarte** *et al.*, 2023). These establishments vary widely in their infrastructure, use of personal protective equipment, sanitation procedures, and regulatory compliance (**Ibrahim** *et al.*, 2021). The main objective of abattoir operations is to recover safe meat components for human consumption. However, the process generates significant organic and inorganic waste, contributing to environmental pollution (**Fearon** *et al.*, 2014; Richard *et al.*, 2015). In many developing countries, the

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unhygienic conditions prevalent in abattoirs are further exacerbated partly due to poor inspection methods and inadequate slaughter practices (Fasanmi *et al.*, 2018).

The risks associated with abattoirs extend beyond environmental concerns; they pose significant public health threats. Humans can contract diseases through direct contact with infected animals or contaminated food products (**Komba** *et al.*, 2012). The prevalence of zoonotic diseases is heightened in slaughter facilities, where workers frequently interact with animals and their byproducts (**Rodarte** *et al.*, 2023). This necessitates stringent regulations to protect workers from occupational hazards and to ensure better sanitation practices (**Cook** *et al.*, **2017**). Informal "backyard" slaughtering operations further complicate the situation by operating outside regulatory frameworks, increasing the risk of pathogen transmission due to poor hygiene standards (**Cook** *et al.*, **2017**).

Zoonotic diseases are a significant concern as they can threaten animal health and productivity while impacting the livelihoods of those dependent on livestock (**Pieracci** *et al.*, **2016; Agu** *et al.*, **2021**). Practical strategies for controlling risks in meat production and improving food safety are essential for preventing disease outbreaks (**Agu** *et al.*, **2021**). Despite the critical need for optimal food safety measures in abattoirs, many facilities still fail to meet adequate hygiene standards (**Agu** *et al.*, **2021**).

This research aimed to study the environmental conditions at abattoir and slaughter sites and the associated risks of perceived zoonotic infections in the Tamale Metropolitan District. Addressing these challenges is vital for improving public health outcomes and ensuring sustainable meat production practices. By understanding the interplay between environmental factors and disease transmission in abattoirs and slaughter sites, targeted interventions can be developed to enhance biosafety measures and bio-surveillance strategies.

MATERIALS AND METHODS

Location

Tamale is the capital of the Tamale Metropolitan District, one of the sixteen districts that comprise Ghana's Northern Region. It is the only Metropolitan District in the entire northern belt of Ghana: Upper East, Upper West, Northern, North East, and Savannah regions. With its advantageous location between latitudes 9.16° and 9.34° North and longitudes 0.36° and 0.57° West and its elevation of about 180 meters above sea level, Tamale has the potential to develop into a significant hub for the sale of locally produced goods from the agricultural and commercial sectors in and around the region's other districts, including those from the southern part of the nation. The city is in the middle of the region, and it borders the Mion District to the east, the Sagnarigu Municipality to the north and west, the East Gonja to the south, and the Central Gonja to the southwest.

Study design and population

A cross-sectional descriptive research design was carried out. The study population included all the workers at the Tamale abattoir, the Tamale-Tolon Road slaughter site, and the Tamale-Salaga Road slaughter site. The study covered the period from 8th January 2024 to 1st March 2024. These individuals were directly involved in handling animals and operating at the abattoir and the slaughter sites.

Sample size sampling technique

Using Cochran's formula: $n = Z^2 * p(1-p) / e^2$, where n is the required sample size, Z is the Z-score (1.96) for 95% confidence, where p is the zoonotic disease prevalence (50%), and e is the margin of error (0.05). The p-value is unknown, so 50% was used for a maximum sample size. Using these values, the minimum sample size of the metropolis was 196. However, 245 workers from the various sites considered in this study were interviewed throughout the study, thus serving as the sample size.

Data collection procedure

A questionnaire generated using various relevant literature as a guide was formatted on a Google Form to aid data collection. The questionnaire was pretested for clarity, consistency, and response-friendliness and corrected for duplication and overlapping questions. Respondents were voluntarily engaged oneon-one to respond to the questions. The components of the questionnaire consisted of the demographic participants characteristics of the study and environmental characteristics of the sites, which included questions on the methods of animal waste disposal, the presence of sanitary facilities at the sites, and workers' health components. Questions were asked in English for respondents who could comprehend English or translated into the respondents' preferred language with the help of a translator.

Data analysis

Data generated on the Google Form was exported to the IBM Statistical Package for Social Science (SPSS) software version 25.0. The responses from the questionnaire were coded before analysis. The data was analysed using descriptive statistical tools and presented in tables. The dependent and independent variables were compared using the Chi-Square Test in all cases, and the significant levels between the compared variables were pegged at p<0.05.

Ethical consideration

The Institutional Review Board of the University for Development (UDS/RIB/277/24) granted approval for this study, and the heads of the abattoir and the various slaughter sites approved site permission. Data was collected anonymously and confidentially throughout the study period.

RESULTS

Socio-demographic characteristics of the respondents

A total of 245 abattoir and slaughter site workers participated in this study. The mean age of the study participants was 35.32 years, with a standard deviation of 9.21 years. The slaughter site workers had a mean age of 35.07, with a standard deviation of 8.41, and those of the abattoir had a mean age of 35.58 years, with a standard deviation of 10.02. The study participants were males, and over two-thirds, 195 representing 79.6%, were between 18 and 42 years old. Among the participants, 44 (18%) were single by marital status, with 29 (24.6%) of them working at the abattoir and 15 (11.8%) working at the slaughter sites. About 151 participants, representing 61.63%, attained some formal education, ranging from basic, junior high school, senior high school and tertiary levels. About 38.37% (94/245) had no formal education. Of those who attained formal education, 60.63% (77/127) worked at the slaughter sites, and 62.71% (74/118) worked at the abattoir. About 39.37% (50/127) of slaughter site workers had no formal education, while the corresponding value for abattoir workers was 37.29% (44/118). About 156 (63.7%) of the 245 study participants had 1–10 years of experience working at the abattoir or slaughter sites, out of which 66.9% (79/118) worked at the abattoir while 60.6% (77/127) worked at the slaughter sites (**Table 1**).

General demography		Slaughter site		Abattoir		
Age (years)	Ν	%	Ν	%	Ν	%
18-29	68	27.8	32	25.2	36	30.5
30-35	69	28.2	44	34.6	25	21.2
36-42	58	23.7	31	24.4	27	22.9
43-63	50	20.4	20	15.7	30	25.4
Total	245	100	127	100	118	100
Marital Status						
Married	201	82	112	88.2	89	75.4
Single	44	18	15	11.8	29	24.6
Total	245	100	127	100	118	100
Level of education						
Level of education Formal education	151	61.63	77	60.63	74	62.71
Level of education Formal education No formal education	151 94	61.63 38.37	77 50	60.63 39.37	74 44	62.71 37.29
Level of education Formal education No formal education Total	151 94 245	61.63 38.37 100	77 50 127	60.63 39.37 100	74 44 118	62.71 37.29 100
Level of educationFormal educationNo formaleducationTotalDuration of work (g)	151 94 245 years)	61.63 38.37 100	77 50 127	60.63 39.37 100	74 44 118	62.71 37.29 100
Level of educationFormal educationNo formaleducationTotalDuration of work (2)110	151 94 245 years) 156	61.63 38.37 100 63.7	77 50 127 77	60.63 39.37 100 60.6	74 44 118 79	62.71 37.29 100 66.9
Level of education Formal education No formal education Total Duration of work (2) 110 1120	151 94 245 years) 156 72	61.63 38.37 100 63.7 29.4	77 50 127 77 45	60.63 39.37 100 60.6 35.4	74 44 118 79 27	62.71 37.29 100 66.9 22.9
Level of education Formal education No formal education Total Duration of work (2) 110 1120 21-30	151 94 245 years) 156 72 16	61.63 38.37 100 63.7 29.4 6.5	77 50 127 77 45 5	60.63 39.37 100 60.6 35.4 3.9	74 44 118 79 27 11	62.71 37.29 100 66.9 22.9 9.3
Level of education Formal education No formal education Total Duration of work (2) 110 1120 21-30 31-40	151 94 245 years) 156 72 16 1	61.63 38.37 100 63.7 29.4 6.5 0.4	77 50 127 77 45 5 0	60.63 39.37 100 60.6 35.4 3.9 0	74 44 118 79 27 11 1	62.71 37.29 100 66.9 22.9 9.3 0.8

Table 1: Demographic characteristics of the study participants

Assessment of animalwaste disposal modes at the abattoir and slaughter sites

The different methods of abattoir and slaughter site waste disposal, as evaluated by the study, found that dumping waste into the environment was the most practiced across the various work areas, accounting for 41.0% of the waste disposal methods. About 39.0% of the respondents practiced open burning of the waste, whilst commercial waste collection and composting accounted for 8.4% and 11.1% of the disposal methods, respectively; only 0.3% used incineration. About 42.8%, representing 111 respondents from abattoir workers, practiced dumping waste on the environment compared to 125 respondents from the slaughter sites who practiced dumping. Open burning was the second most practiced method at the abattoir, accounting for 41.0% (111) of respondents, while the slaughter sites recorded 37.5% (120) of respondents. Composting and commercial waste collection were the least practiced methods, representing 15.6% and 7.2% at the slaughter site and 6.3% and 10.0% at the abattoir (**Table 2**).

Samuel Tamanyian Suuk, et al.....

	All Responses		Slaughter site		Abattoir	
Waste disposal methods	Frequency	Percent %	Frequency	Percent %	Frequency	Percent %
Incineration furnace	2	0.3	2	0.6	0	0.0
Open burning	231	39.0	120	37.5	111	41.0
Composting	67	11.3	50	15.6	17	6.3
Dumping on the environment	241	41.0	125	39.1	116	42.8
Commercial waste collection	50	8.4	23	7.2	27	10.0
Total	591	100.0	320	100.0	271	100.0

Table 2: Modes of waste disposal at the abattoir and slaughter sites

Hygienic and sanitary facilities at the abattoir and slaughter sites

The study established that 102 (86.44%) respondents who worked at the abattoir indicated the availability of adequate hygiene and sanitation facilities. In contrast, only 26 (20.47%) respondents from the slaughter sites indicated such facilities were present. The abattoir was more likely to have adequate sanitation and hygienic facilities (p-value of <0.001) compared to the slaughter sites, as about 101 (79.52%) slaughter site respondents indicated a lack of adequate hygienic facilities. The hygiene and sanitary facilities at the abattoir included a drainage system of 84.75% (100) compared to 19.69% (25) respondents at slaughter sites (p-value <0.001). Also, 102 (86.44%) respondents from the abattoir reported water availability, while 26 (20.47%) slaughter site respondents indicated the same. At the abattoir, 92 (77.97%) respondents answered that toilet facilities were available, against only 2 (1.57%) respondents at the slaughter sites (**Table 3**).

Hygienic and sanitation facilities	Abattoir, n(%)	Slaughter site, n(%)	p-value
Drainage system			
No	18 (15%)	102 (80.31%)	
Yes	100 (84.75%)	25 (19.69%)	< 0.001
Total	118 (100%)	127 (100%)	
Toilet facilities			
No	26 (22.03%)	125 (98.43%)	
Yes	92 (77.97%)	2 (1.57%)	< 0.001
Total	118 (100%)	127 (100%)	
Availability water			
No	16 (13.56%)	101 (79.53%)	
Yes	102 (86.44%)	26 (20.47%)	< 0.001
Total	118 (100%)	127 (100%)	
Presence of adequate hygiene and sanitation facilities			
No	16 (13.56%)	101 (79.52%)	
Yes	102 (86.44%)	26 (20.47%)	< 0.001
Total	118 (100%)	127 (100%)	

Table 3: Hygienic and sanitary facilities available at the abattoir and slaughter sites

Occurrences of zoonotic-related signs and symptoms in the various work areas

Generally, each worker had experienced one or more of these zoonotic-related signs/symptoms within the past month prior to interaction with respondents. The study established that general malaise was the most common and frequent zoonotic symptom experienced by the workers in the various work areas. About 62 (52.54%) respondents experienced general malaise at the abattoir compared to 79 (62.20%) respondents at the slaughter site. The most common zoonotic-related symptom experienced at the abattoir was fever, with 60 (50.58%) respondents

Environmental Conditions of Abattoirs

having experienced this zoonotic-related symptom, against 77 (60.63%) respondents from the slaughter sites. Cough was the third most common zoonotic-related symptom at the abattoir (p-value=0.002), with 49 (41.53%) respondents experiencing it compared to 29 (22.83%) respondents from the slaughter sites. Additionally, 42 (35.59%) abattoir workers reported having experienced vomiting during their operations (p-value=0.019) compared to 28 (22.05%) workers from the slaughter sites. The study also established that 31 (26.27%) of respondents from the abattoir reported having had diarrhoea during their operation during the study, while 25 (19.69%) of the slaughter site workers reported having had diarrhoea. Also, the study found that 36 (30.51%) respondents from the abattoir had skin rash compared to 30 (23.62%) respondents from the slaughter site who reported to have had skin rash (**Table 4**).

Sign/Symptom		Abattoir	Slaughter site	p-value
Fever	No	58 (49.15%)	50 (39.37%)	
	Yes	60 (50.85%)	77 (60.63%)	0.123
Total		118	127	
Cough	No	69 (58.47%)	98 (77.17%)	
	Yes	49 (41.53%)	29 (22.83%)	0.002
Total		118	127	
Diarrhoea	No	87 (73.73%)	102 (80.31%)	
	Yes	31 (26.27%)	25 (19.69%)	0.22
Total		118	127	
Skin Rash	No	82 (69.49%)	97 (76.38)	
	Yes	36 (30.51%)	30 (23.62)	0.225
Total		118	127	
General Malaise	No	56 (47.46%)	48 (37.80%)	
	Yes	62 (52.54%)	79 (62.20%)	0.126
Total		118	127	
Vomiting	No	76 (64.41%)	99 (77.95%)	
	Yes	42 (35.59%)	28 (22.05%)	0.019
Total		118	127	

Table 4: Occurrences of zoonotic-related signs/symptoms among workers at the abattoir and slaughter sites within the past month prior to the study

DISCUSSION

Results obtained from the research indicated that out of the 245 abattoir and slaughter site workers interviewed, 55.0% were between the ages of 18-35 years, which is in concordance with a study done in Kaduna State, Nigeria, which found that 75% of abattoir workers were between the ages of 25-35 and 25% were between the ages of 18-25 years, which agrees with the 27.8% between 18-35 years as established by this study (Gali et al., 2020). Furthermore, 30% of abattoir workers were found to have had formal education (Gali et al., 2020). However, this study found that 61.63% of the abattoir and slaughter site workers had attained formal education, significantly higher than reported. In an Ethiopian study, 47.7% of abattoir workers were single, and 52.3% were married (Ashuro et al., 2023). This observation deviates from our study, which established that 82% of the respondents were married and 18% were single. These variations could be due to geographical and cultural variances between the study locations.

From the study, 39% practiced burning as a method of waste disposal, similar to a study done in Nigeria, where 33.3% of the abattoirs used open burning (**Otto, 2022**). However, another study in Nigeria reported that 9.0% of respondents used burning to dispose of animal wastes at the abattoir and slaughter sites (**Agu** *et al.*, **2021**). It was found that open dumping of waste in the environment was the most common method practiced at these facilities, accounting for 41% of the methods used to dispose of waste, and this is lower than 66.7% and 83.5% reported elsewhere (**Agu** *et al.*, **2021**; **Otto, 2022**).

It was established in a study done in Nigeria that most abattoirs and slaughter sites lacked operating facilities, such as a lack of sewage and waste disposal systems and a lack of potable water and toilet facilities for staff and workers (Gali *et al.*, 2020). According to other studies, about 60% of slaughter sites had access to toilet facilities (Cook *et al.*, 2017). However, this study found that 86.44% of abattoir workers had adequate hygiene and sanitation facilities, whereas only 20.47% of slaughter site workers had similar facilities present. About 79.52% of the slaughter site respondents had no adequate hygienic facilities present. This observation could negatively impact their hygienic practices and the quality of meat products for public consumption.

Generally, each of the 245 respondents in this study reported having had one or more signs/symptoms that were likely zoonotic-related within the past month during their operations, as reported by the respondents during the study period. Nonspecific symptoms such as vague abdominal pain, nausea, vomiting, diarrhoea and weight loss can occur due to zoonotic infections (Komba *et al.*, 2012). In this study, signs/symptoms include fever, cough, diarrhoea, skin rash, general malaise and vomiting among the abattoir and slaughter site workers.

The abattoir workers studied reported that 60 (50.85%) had a fever, 49 (41.53%) had a cough, 31 (26.27%) had diarrhoea, 36 (30.51%) had skin rashes, 62 (52.54%) had general malaise, and 42 (35.59%) had vomiting in the last month prior to the study. It was reported by the slaughter site workers that 77 (60.63%)had a fever, 29 (22.83%) had a cough, 25 (19.69%) had diarrhoea, 30 (23.63%) had skin rashes, 79 (37.80%) had general malaise, and 28 (22.05%) had vomiting in the last month prior to the study. A marginal increase in these zoonotic-related symptoms at the abattoir was observed. This could be attributed to the abattoir's enclosed nature, which facilitates the dissemination of infectious pathogens among the workers compared to the open nature of the slaughter sites. These findings agree with a study in Nigeria, which found that fever, headache, profuse sweating, chills, weakness, generalized aching and joint pain are associated with zoonotic infections at the abattoir (Bobu Igawe et al., **2020**). A similar study found that fever, anorexia, chills, headache, myalgia, weakness and cough were associated with zoonotic infections among abattoir workers (Abdul Sattar et al., 2023). These may be attributed to non-use and improper use of personal protective equipment by workers.

CONCLUSION

The study established that most abattoir and slaughter site workers practiced open dumping of animal waste while 39% practiced open burning, thus posing a significant risk to the environment and residents. The study found that the abattoir had adequate hygiene and sanitation facilities compared to the slaughter site. The abattoir had good hygienic and sanitation facilities, while slaughter sites lacked these facilities. Cough and vomiting were significantly associated with the abattoir workers, while slaughter site workers predominantly reported fever and general malaise. This association is attributed to the fact that the abattoir is an enclosed area with significant crowding of workers in the working area and to improper use of personal protective equipment. The slaughter sites are open areas; thus, improved air circulation and reduced crowding reduce the relative risk of some perceived zoonotic infections.

Study limitation

The study relied on self-reporting from workers at slaughter sites and abattoirs, which may result in response bias due to social desirability. Thus, the report on the magnitude of the unhygienic practices at the facilities was limited to the Tamale Metropolis, thereby limiting its applicability in other contexts.

Conflict of interest

The authors declare that there is no conflict of interest

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