



International Journal on Recent Advancement in
Biotechnology & Nanotechnology
<https://www.eurekajournals.com/biotech.html>
ISSN: 2582-1571

Assessing the Meat Hygiene Knowledge, Self-Reported Practices, and Compliance with Health Standards among Butchers in Clarendon, Jamaica

Shanon Douglas-Francis¹MSc., Marcia Thelwell-Reid¹ PhD., Zandy U. Elliott^{1,2,3} PhD,* DHSc, MPH

¹University of Technology, Jamaica, WI.

²Northern Caribbean University, Mandeville, Jamaica, WI.

³Caribbean Maritime University, Jamaica, WI.

Abstract

This study evaluated the relationship between meat hygiene knowledge, self-reported hygiene practices, and compliance with health standards among butchers in Clarendon, Jamaica. Using a quantitative cross-sectional descriptive-correlation research design and convenience sampling approach, data were collected from 80 licensed butchers through a structured questionnaire. Descriptive statistics, Pearson correlations, and binary logistic regression were employed to analyze the data. Males represented 91.3% of the sample, while females accounted for only 8.8%, indicating a male-dominated industry. A moderate positive correlation was observed between self-reported hygiene practices and compliance with health standards. Binary logistic regression analysis showed that self-reported hygiene practices were a significant predictor of compliance with health standards, whereas meat hygiene knowledge was not statistically significant. The regression analysis also revealed that butchers who reported better hygiene practices were 3.7 times more likely to comply with health standards. The study concludes that practical adherence to hygiene practices has a greater impact on compliance than knowledge alone. These results highlight the need for enhanced training, routine inspections, and behavior-focused interventions to improve food safety.

Keywords: knowledge, hygiene practices, compliance, health standards.

Introduction

In many countries, meat is a vital part of a person's diet (Ali & Alsayeqh, 2022). Meat is an excellent source of high-value proteins, minerals, and vitamins (Ali & Alsayeqh, 2022). Meat harbours numerous pathogenic organisms, and it serves as an excellent growth medium for bacteria if not handled correctly (Ali & Alsayeqh, 2022). Therefore, access to a consistent supply

of hygienic meat is essential. The handling and preparation of meat are crucial in ensuring food safety and public health. A prerequisite for a hygienic meat supply is that butchers possess the correct meat hygiene knowledge and adhere to sanitary meat handling practices. Butchers are the first link in the meat supply chain; therefore, they have direct responsibility for maintaining the quality of meat at every step in the meat supply chain (Bhandari et al., 2022). Failure on the part of a butcher to prevent contamination resulted in potential meat spoilage and also public health and food safety concerns (Bhandari et al., 2022).

Meat hygiene encompasses all conditions and measures necessary to ensure the safety and suitability of meat throughout the entire food chain (Bhandari et al., 2022). Poor or insufficient meat hygiene practices can expose consumers to various pathogens, leading to public health issues. Additionally, inadequate facilities and equipment can contribute to the contamination of meat and meat products (Bhandari et al., 2022). To promote food safety and security worldwide, the World Health Organization (WHO) along with the Food and Agriculture Organization (FAO) have recognized the Codex Alimentarius standards for meat hygiene, which all member states must follow, especially concerning exports (Abdullahi et al., 2016; Food and Agriculture Organization [FAO], 1991). Member countries have implemented laws based on these standards to regulate meat hygiene within their jurisdictions. For instance, in the United States, Title 9 of the Code of Federal Regulations (9 CFR 202.1-3) governs the inspection, certification, and identification of animals permitted for slaughter and processing. The inspection of red meat complies with the Federal Inspection Acts of June 21, 1906 (34 Stat. 671) (March 4, 1907) and the Federal Meat Inspection Act of 1957.

In addition, developing countries also develop laws to govern meat hygiene. For example, in Kenya, laws include Kenya Food Drug and Chemical Substance (Meat Control) Regulation 2009 (Part IV); Public Health Act; and Public Health (Butchers and Slaughterhouses) Rules, 1975. In South Africa, the meat safety system includes two parallel sets of laws, including the Animal Diseases Act, 1984 (Act 35 of 1984), the Meat Safety Act, 2000 (Act 40 of 2000), and relevant chapters of the Act No. 54 of 1972 as amended, the Animal Diseases and Communicable Disease Act. Similarly, Jamaica has also adopted the standards of the WHO and the FAO to aid in meeting meat safety standards governed by the Public Health Act 1985 and regulations such as the Meat Inspection Regulation (1989), the Butchers Regulation (1989), and the Food Handling Regulation (1998, 2000). The Butchers Regulation (1989) in Jamaica stipulates that all butchers must satisfy the requirements to be licensed before they are legally allowed to slaughter food animals. All butchers' licences expire on March 31st annually.

Furthermore, the local Municipal Corporation of each parish is responsible for the licensing of butchers based on the recommendation of the police and the public health department. There is no automatic renewal of a butcher's licence; both renewals and new applicants should go through the same process yearly. Butchers submit an application to the local Municipal Corporation, which is then sent to the police and the public health department. The police are responsible for making recommendations on the character of the applicant, while the public health department conducts inspections to determine if their slaughter facility has met public health standards, and the validity of their food handler's permit. If all the criteria, including a suitable place of sale, are

met, then the local health department makes a recommendation to the Municipal Cooperation for licensing.

Food Safety training of butchers' rest with the public health department, as all butchers must undergo an annual training to obtain a food handler's permit. There are few abattoirs in the country; therefore, butchers construct and use their own slaughterhouses. Butchers may sell their meat at the local markets throughout the parish or at their own meat shops. These meat shops are inspected by the public health department and licensed under the Food Handling Regulation (1989, 2000). Public Health Inspectors carry out meat inspection. Individual health departments develop a training curriculum for the annual training of butchers through guidelines obtained from the FAO international standards. Protocols for obtaining a Food Handlers Permit are adopted from the Food Handlers Training Manual from the Ministry of Health and Wellness (MOHW), Jamaica.

However, Jamaica lacks a standardized training protocol for butchers, which can lead to subjectivity based on the trainer. Butchers in different parishes and regions are exposed to training that is solely based on the trainer's perspective or the lack thereof. Having a standardized butchers' training module would ensure that all butchers in Jamaica have access to the same resources and receive equivalent training. This would positively improve the overall quality and consistency of the information imparted, thereby inevitably enhancing knowledge among butchers.

Statement of the Problem

The study seeks to assess the meat hygiene knowledge, self-reported practices, and compliance with health standards among butchers in Clarendon, Jamaica. Foodborne illnesses remain a global public health concern, with unsafe meat handling practices contributing significantly to disease transmission. According to the World Health Organization (WHO, 2020a) more than 600 million people fall ill annually due to contaminated food, and approximately 420,000 die, with meat-related pathogens such as *Salmonella*, *Listeria*, and *E. coli* being major culprits. In the Caribbean, including Jamaica, foodborne diseases continue to place a burden on national health systems and economies (Caribbean Public Health Agency [CARPHA], 2019).

Jamaica has reported multiple cases of gastroenteritis outbreaks linked to improperly handled meat and poor food hygiene, particularly in rural areas where informal markets are prevalent (Ministry of Health & Wellness [MOHW], 2022). In Clarendon, a parish with both urban and rural communities, the public relies heavily on butchers and meat vendors for their protein needs. However, there is a lack of empirical data on how well these butchers understand and apply hygienic practices aligned with national public health standards. While meat hygiene regulations are outlined in Jamaica's Public Health (Food Handling) Regulations, enforcement and compliance remain inconsistent, particularly in non-regulated slaughter operations (MOHW, 2022).

Although food safety training and public health inspections exist, knowledge alone may not guarantee safe practices. Studies have shown that while meat handlers may be aware of hygiene protocols, this does not always translate to behavior change or full compliance with health

regulations (Aluko et al., 2016; Ko, 2021). Moreover, self-reported practices can differ from actual behaviors, making it crucial to examine not only what butchers know and report, but how well their practices align with national standards.

This study aims to identify areas of strength and weaknesses in the knowledge and practices of butchers in Clarendon to develop specific interventions for improvement, raise awareness among policy makers, industry stakeholders, regulators, and the general public of the importance of butchers' knowledge and practices, thereby enhancing the overall quality and safety of meat products sold to consumers.

Aim of the Study

The aim of this research study was to assess the meat hygiene knowledge, self-reported practices, and compliance with health standards among butchers in Clarendon, Jamaica, to evaluate their contribution to overall food safety and public health outcomes.

Research Questions and Hypotheses

RQ1: Is there a statistically significant relationship between meat hygiene knowledge and compliance with public health standards?

H₀₁: There is no statistically significant relationship between meat hygiene knowledge and compliance with public health standards among butchers in Clarendon.

H_{a1}: There is a statistically significant relationship between meat hygiene knowledge and compliance with public health standards among butchers in Clarendon.

RQ2: Is there a statistically significant relationship between self-reported hygiene practices and compliance with public health standards?

H₀₂: There is no statistically significant relationship between self-reported hygiene practices and compliance with public health standards among butchers in Clarendon.

H_{a2}: There is a statistically significant relationship between self-reported hygiene practices and compliance with public health standards among butchers in Clarendon.

RQ3: Is there a combined effect of meat hygiene knowledge and self-reported practices on compliance with health standards?

H₀₃: Meat hygiene knowledge and self-reported practices do not jointly predict compliance with public health standards among butchers.

H_{a3}: Meat hygiene knowledge and self-reported practices jointly predict compliance with public health standards among butcher.

Significance of the Study

The result of this study could assist in raising awareness among policy makers and regulators at the Ministry of Health and the Ministry of Agriculture and Fisheries to identify the gaps and

develop appropriate guidelines and regulations to capture all aspects of proper meat hygiene practices. These policy guidelines could aid Animal Health Technicians, Veterinarians and Veterinary Public Health Inspectors to have a standardized framework to execute more effective monitoring strategies, embark on capacity building initiatives, targeted training programmes and best practices to improve meat quality in Jamaica.

This study can also aid in highlighting the strength and weaknesses in the knowledge and practices of butchers, which would allow for a more modified training programme. Butchers could also be trained by various methods on meat hygiene practices and the negative impact on their business, the health of the population and the country. Additionally, information gathered from this study aims to establish baseline data for the parish for future reference and research related to butcher knowledge and practices.

Key Definition of Terms

The study identifies key definitions of terms to assess meat hygiene knowledge, self-reported practices, and compliance with health standards among butchers in Clarendon, Jamaica.

Abattoir/ Slaughter House: This is a premise approved and registered by the local Board in Jamaica to be used for the slaughter and dressing of animals of which the meat is intended for human consumption (Food and Agriculture Organization [FAO], 1991).

Butcher: According to the Public Health (Butchers) Regulation (1989), a butcher includes any person who slaughters or causes any animal to be slaughter; or prepares or processes the carcass of any animal or meat for human consumption (FAO, 1991).

Meat Hygiene: Meat hygiene refers to all conditions and measures necessary to ensure safety and suitability of meat at all stages of the food chain (Center for Disease Control and Prevention [CDC], 2011).

Meat: This is the edible part of an animal slaughtered for human food (CDC, 2018).

Slaughter: This is the killing of any animal, using an approved method of stunning and bleeding, of which the meat is intended for human consumption (CDC, 2018).

Zoonosis: A zoonosis is an infectious disease that has transmitted from a non-human animal to humans. Zoonotic infections can spread to humans by direct contact, food, drink, or the environment. They can be bacterial, viral, parasitic, or include unusual agents (World Health Organization [WHO], 2020b).

Limitations of the Study

Despite the valuable insights yielded by this study, several limitations must be acknowledged. First, the data on hygiene practices were self-reported, which introduces the risk of social desirability bias. Participants may have overstated their adherence to safe meat-handling practices in an effort to present themselves more favourably, potentially inflating the level of reported compliance.

The cross-sectional nature of the study further limits the ability to make causal inferences. While associations between hygiene practices and compliance with health standards were observed, the direction of these relationships cannot be definitively established. Longitudinal studies would be required to better understand the temporal dynamics of these associations. Another limitation lies in the geographic scope of the study, which was confined to Clarendon, Jamaica. As such, the findings may not be generalizable to butchers in other regions of the country or in different cultural and regulatory contexts. Factors such as access to training, public health monitoring, and infrastructure could differ significantly across parishes or countries.

Furthermore, the study did not include direct observational or microbiological assessments to validate the reported hygiene practices or compliance outcomes. The absence of objective measures may have limited the accuracy of the findings, especially in relation to actual public health risks. Furthermore, while training and educational background were considered, the study did not explore the depth and quality of these learning experiences. The type and duration of training could have varying effects on hygiene behaviour, which may have influenced the study's outcomes if more detailed information had been collected.

Literature Review

Literature related to this research was reviewed through journal articles and books on similar research conducted by various researchers in both developed and developing countries. The University of Technology, Calvin McCain Library along with Research Gate and other online academic research portals were utilized in the acquisition of journals. Moreover, in reviewing the literature, meat was found to be an excellent source of protein in the human diet and is highly susceptible to microbial contaminations which can cause spoilage and food borne infections in humans (Ponnampalam et al., 2021). Meat is considered the only source that contributes six major nutrients: quality protein, vitamin B12, niacin, zinc, essential fatty acids (eicosatetraenoic acid), and docosahexaenoic acid (Ponnampalam et al., 2021). Meat is a highly perishable food and has sufficient nutrients to support the growth of a wide range of spoilage and pathogenic microorganisms (Subedi et al., 2022).

Nonetheless, the chemical composition of meat facilitates contamination through improper meat hygiene practices. Contamination of meat can occur at any time during slaughtering, processing, handling and storage (Birhanu et al., 2017). It has been documented that dangerous meat handling, processing, and marketing is prominent in low-income countries in the world, of which local butchers play a pivotal role (Manyi-Loh & Lues, 2023). In low-income countries, meat sold in informal settings may be found as a vehicle transmitting some zoonotic diseases. Control and eradication of these diseases are often linked to low standards of food safety and meat hygiene, which mainly occur at informal markets such as those practiced by butchers (Espinosa et al., 2020).

Meat Production and Consumption Worldwide

Meat is an important source of nutrition for many people around the world. Studies have shown that there has been a 204 % increase in the supply of meat from 1960 - 2010 (Basu,

2015). Global demand for meat has been steadily growing over the past 50 years resulting in meat production more than tripling. Currently, the world now slaughters 80 billion animals annually to produces more than 340 million tons of meat each year for human consumption(Ritchie & Roser, 2019). China is the largest meat producer in the world with over 88 million tons annually. The United States of America is the second largest producing country with over 46 million tons yearly. Brazil, on the other hand, is the third largest meat producing country in the world with a little over 29 million tons yearly (Ritchie & Roser, 2019).

On average, it is estimated that a person consumes 43kg of meat in 2014. However, in countries such as the United States and Australia consumption ranged to over 100 kg person, while in India consumption was at 5kg per person on average (Ritchie & Roser, 2019). It can be said that meat consumption is related to income; however, meat consumption in developing countries has been steadily increasing over the years.

The Effect of Bacterial Growth on Meat

The total viable count (TVC) of bacteria expressed as organisms/cm² or as organisms/g on fresh meat or a meat product sets a limit to its shelf-life. Meat “spoil” with TVC at 10⁶/cm² because of off-odours. Slime and discoloration appear at 10⁸/cm²(FAO, 1991). The main factors determining the time taken for the TVC to reach these levels are the initial count due to contamination during slaughtering and processing, further contamination during inspection and storage, temperature, pH and relative humidity. Table 1 illustrates how contamination levels impact shelf life.

Table 1: Level of Contamination Affects Shelf-Life

Initial bacterial count (org./cm²)	Days at 0°C before slime development
100 000	8
10 000	10
1 000	13
100	15
<u>10</u>	<u>18</u>

Source: (FAO, 1991).

After proper meat hygiene practices keeping meat cold is the second most important requirement in order to achieve a desirable shelf-life. Microorganisms rapidly proliferate at elevated temperatures and slime development is a definite visual sign of microbial growth. Bacteria relevant to meat and meat products are divided into three groups according to the temperature range within which they can grow: mesophiles 10- 45°C, psychophiles 0- 28°C and psychographs 10- 45°C, or slow growth at 0- 10°C. Storage temperature nearer to 0°C slows the growth of the spoilage bacteria and the longer the shelf-life(Aljamali et al., 2021).

Foodborne Illness Associated with Meat Hygiene

Meat harbours a number of pathogenic organisms such as *Escherichia coli*, *Salmonella*, *Campylobacter*, *Listeria*, and enteritis-associated parasites, including *Toxoplasma gondii* and *Trichinella spiralis* and serves as an excellent growth medium for bacteria if held at an incorrect

temperature (Aljamali et al., 2021). At temperatures between 5 and 60 °C, bacterial growth may occur with the doubling of population size occurring within 20 to 30 minutes (Aljamali et al., 2021). Although many bacteria are killed during cooking, *Listeria monocytogenes* may remain causing food poisoning, especially in the very young and very old, resulting in complications and even death in these vulnerable individuals (Aljamali et al., 2021).

The transmission of Salmonella and Shiga toxin-producing *Escherichia coli* O157:H7 (STEC) has been linked to the consumption of undercooked beef. This bacterial group has been linked to many cases of hemolytic uremic (HUS) syndrome worldwide (Brusa et al., 2020). Cattle are the main animal reservoir of STEC currently known and around 40.0% of all STEC reported cases worldwide are associated with food, mainly beef (Brusa et al., 2020). Beef can be cross-contaminated with STEC at different stages of the supply chain, from the abattoir to retail and the home environment. Contamination by STEC in intact beef cuts is superficial and can easily be destroyed through cooking. However, ground beef is considered high-risk for STEC due to the potential of contamination spread during the production process.

Meat Hygiene

According to the Food and Drug Administration (FDA), *Code of Hygiene Practices for Meat* CAC/RCP 58-2005, meat hygiene is all conditions and measures necessary to ensure the safety and suitability of meat at all stages of the food chain. It is a collection of practices and procedures that are used to ensure that meat is safe for human consumption. It involves a variety of specific standards and regulatory actions by the appropriate authorities to guarantee that only safe meat enters the food chain. Meat hygiene requirements must be met at all stages of meat production from animal welfare, slaughtering, processing, storage and transportation.

Meat hygiene encompassed many areas of food safety and is not limited to personal hygiene of meat handlers, washing and sanitization of equipment, sanitation of slaughter and processing facilities, proper water and waste water management and overall environmental sanitation. The Food and Drug Administration (FDA) highlights that meat hygiene involves the “farm to fork” mantra where the aim is to adopt best practices to include animal husbandry, ante mortem and post-mortem inspection by trained and certified meat inspectors, proper handling, temperature control and storage (Ko, 2021).

Significance of Meat Hygiene in Public Health

Meat hygiene has significant importance to public health in developing countries as contamination of meat by poor handling practices, inadequate knowledge of butcher, lack of resources and weak regulatory systems can result in catastrophic food borne disease outbreaks especially to vulnerable populations. Meat hygiene is important at all the following stages; animal health, transport, rest and feeding, ante-mortem inspection, stunning, slaughtering, post mortem inspection, hygiene and health of the personnel, abattoir sanitation, and transportation of meat to ensure food safety for consumers. These stages possess high potential for contamination before the meat gets to the consumer.

The Center of Disease Control (2011) estimated that 48 million people get sick, 128,000 hospitalizations, and 3000 deaths occur every year nationwide in the USA from food borne illnesses, most of which are related to the consumption of meat and meat products (CDC, 2011). Various cases of foodborne disease have been reported and documented. For example, in 2012, Alberta Health Services in Canada reported an *Escherichia coli* O157:H7 foodborne disease outbreak connected to the eating of needle-tenderized beef steaks manufactured from a meat facility in Alberta and purchased at a supermarket in Edmonton, Albert. As a result, 4000 tons of beef products were recalled to control the outbreak, thus, making it the largest beef recall in Canadian history (Currie et al., 2019).

Based on another study by Tchatchouang et al. (2020) 1060 persons became ill and 216 died, between 2017 and 2018, in one of the largest recorded *Listeria monocytogenes* ST6 outbreak linked to the consumption of processed meat products from one of the largest food companies in South Africa (Tchatchouang et al., 2020). Enterprise Foods, a subsidiary of Tiger Brands. Even though Africa and even the United States report outbreaks of *Listeria* yearly, this outbreak was the world's deadliest Listeriosis outbreak on record (Tchatchouang et al., 2020). The aftermath of these foodborne disease outbreaks has a greater socioeconomic impact than only the impacted customers. The financial implications to the food sector and economy are also significant, particularly when product recalls, trade restrictions, litigations emerge from a large-scale epidemic (Tchatchouang et al., 2020).

Meat Hygiene Best Practices

Jamaica adopts its meat hygiene standards from international standards such as those of the Food and Agriculture Organization (FAO) and is enforced in Jamaica through the Meat Inspection Regulation, the Butchers Regulation and the Food Handling Regulation. Based on the guideline of the FAO Animal Production and Health Paper 91, all aspects of meat hygiene were covered in the following areas: personal hygiene practices. Hands should be frequently and properly washed under running water to remove visible soil and always after visiting the toilet, smoking, coughing or sneezing, handling money, garbage, soiled or infected material (CDC, 2018). A stainless-steel foot-pedal or knee operated hand washing sinks, without plugs should be conveniently located and accessible to all workers to facilitate frequent hand washing. This sink should also be equipped with hot and cold water, liquid soap, disposable hand towels or hand drying device and a covered no contact garbage bin (CDC, 2018).

Meat handlers should not smoke, eat, scratching their head or other body parts, place fingers in or around the nose or mouth, sneezing or coughing while handling meat. Jewelry of any kind, badges or buttons should not be worn by meat handlers while handling meat. These items that may become loose and can potentially contaminate the product. All clothing worn by meat handlers should be clean, in good condition and made of washable material. Clothing or shoes should be covered by protective clothing while handling meat. Protective clothing such as coats or gowns should be of a light-colour, preferably white so that soil can be easily seen. Hair and beard restraint should be worn at all times by meat handlers while handling meat. Other safety gears such as aprons, wrist guards, mesh gloves, boots, and knife guards must be made of impervious material, clean and in good repair. Any aprons, knives and footwear that become

contaminated during operations should be promptly cleaned in areas or facilities provided for that purpose(CDC, 2018).

Cleaning and sanitization to prevent contamination of meat products during processing a standard cleaning routine of the facility and the equipment should be established. The floors in slaughter facilities should be kept clear of debris at all times. Large pieces of refuse material such as fat, meat particles or hair should be scraped and appropriately disposed. At the end of processing a thorough cleaning of the facility should be done. A thorough hosing down of walls, floors, drains, platforms, equipment and all surfaces with potable water to loosen dirt should be done. The floors, walls and equipment should then be scrubbed using detergent and cleaning apparatus then thoroughly rinsed and sanitized with an appropriate sanitizer which can include hot water at 82°C, an approved chlorine solution or iodine(Caribbean Public Health Agency, 2019).

Hot-water containers, either electric or steam-heated to 82°C, should be available for sanitizing tools that have been contaminated. Meat rails should be cleaned and sanitized every four hours to reduce the risk of contamination. Frequent cleaning is important because in warmer temperatures bacteria multiply rapidly and the risk of product contamination increases(Caribbean Public Health Agency, 2019).

Butchers' Knowledge of Meat Hygiene

Numerous studies have been conducted to assess the knowledge level of butchers in regard to meat hygiene principles. However, there has been no identified study conducted in Jamaica to assess the knowledge or practices of the many butchers in the country. According to Gebeyehu and Tsegaye (2022), butchers have varying levels of knowledge about meat hygiene and food safety where they were found to have had a low level of knowledge in relation to proper meat handling protocols such as storage and temperature control. Similar studies have been conducted in Malaysia that found that butchers had low knowledge in food safety regulation and lack awareness of the public health risks associated with improper meat hygiene practices (Abdullahi et al., 2016). Varying studies have often indicated difference in knowledge levels among butchers that are influenced by socio-demographics such as education, training and experience (Abdullahi et al., 2016; Gebeyehu & Tsegaye, 2022).

Practices of a Butcher

Correct meat hygiene practices are important in prevents contamination of meat. However, sufficient knowledge and positive attitudes stimulates positive practice.(Adesokan & Raji, 2014) It would seem that meat handlers who are younger tend to have better meat hygiene practices. Based on studies, meat handlers younger than 30 years old exercised better meat hygiene practices and were of a better education status. Therefore, it can be seen that education plays an important role in the knowledge and practices of meat handlers; where Adesokan and Raji (2014) compared meat handlers in private and government abattoirs which concluded that with high educational level the meat handlers were three times more likely to obtain good practice level than those without any formal education. The study further stated that meat handlers who had

less work experience were less likely to exercise good meat hygiene practices(Adesokan & Raji, 2014).

On the contrary, studies have presented that good knowledge does not necessarily lead to good hygiene practice(Matchawe et al., 2019). The practice of butchers during cutting and manipulating the carcass not only determines meat contamination at the abattoir, but also the microbiological level of the meat and, as a result, shelf life (Adesokan & Raji, 2014). It is evident that consumers, especially in developing countries, rely heavily on butchers to supply fresh meat from bovine, small ruminants and porcine to meet their dietary needs. However, poor practices by butchers during meat handling pose the risk of contamination. Consequently, meat eaters worldwide, including Jamaica are susceptible to foodborne pathogens (Gebeyehu & Tsegaye, 2022). The various foodborne disease outbreaks associated with meat has put tremendous stress not only on individual households but also on the global economy affecting the rate of disability adjusted life year (DALY) per year (Gebeyehu & Tsegaye, 2022).

Hence, given the serious implications of meat contamination and the resulting consequences of food safety incidents involving meat, it is critical to understand the contributing factors and root causes of these incidents in order to develop risk-mitigation strategies and counter-measures currently and for the future (Currie et al., 2019). According to Gebeyehu and Tsegaye (2022), the lack of knowledge about good meat handling and the improper food handling and hygiene practices of butchers may be attributed to weak enforcement of food safety laws, lack of education and deficiency or ineffective training of food handlers including butchers.

Methodology

This chapter outlines the research methods used to examine the relationship between meat hygiene knowledge, self-reported hygiene practices, and compliance with public health standards among butchers in Clarendon, Jamaica. This research describes the research design, population, sampling procedures, data collection instruments, and analytical techniques employed. The chosen methodology was guided by the study's objective to generate empirical evidence through quantifiable data, allowing for statistical analysis and interpretation of the relationships among the key variables. The approach ensures reliability, validity, and relevance to public health and food safety policy in the Jamaican context.

Study Design

This study employed a quantitative, cross-sectional, correlational research design(Creswell & Creswell, 2017). The quantitative approach allows for objective measurement and statistical analysis of the relationships between variables, including meat hygiene knowledge, self-reported hygiene practices, and compliance with health standards. The cross-sectional nature of the study involved collecting data at a single point in time from a sample of butchers operating in Clarendon, Jamaica.

The descriptive component of the design was used to assess the levels of hygiene knowledge, reported practices, and compliance among participants, while the correlational component explored the statistical relationships between the independent variables (meat hygiene knowledge

and self-reported practices) and the dependent variable (compliance with public health standards). This design is appropriate because it facilitates the identification of patterns and associations among variables without manipulating the study environment. Data was collected using a structured questionnaire for knowledge and self-reported practices, and a standardized observational checklist was used to assess compliance. The results helped determine whether knowledge and reported practices significantly influence adherence to public health guidelines in meat handling.

Study Setting

The study was conducted in Clarendon, one of Jamaica's largest parishes, located in the south-central region of the island. Clarendon is characterized by a mix of urban centers, rural communities, and informal settlements, with a thriving local meat market that includes both licensed and unlicensed butchers. The parish is served by public health departments that oversee food safety regulations; however, the level of enforcement and compliance varies across locations. The selection of Clarendon is based on its diverse butcher population, reported instances of food safety concerns, and its significance in Jamaica's meat supply chain. Data collection had occurred at various butcher shops, meat stalls, and abattoirs operating within the parish.

Population

The study population consisted of licenced butchers in the parish of Clarendon. The target population for this study comprises of butchers operating within the parish of Clarendon, Jamaica, who are actively engaged in the slaughtering, handling, and selling of meat products to the public. This includes individuals working in both formal settings (e.g., registered butcher shops and abattoirs) and informal settings (e.g., community markets).

The population is diverse in terms of age, years of experience, level of training, and adherence to regulatory standards. These individuals play a critical role in the local meat supply chain and are directly responsible for implementing meat hygiene practices that impact public health. The study focuses specifically on butchers who have been in operation for at least six months to ensure that participants have sufficient experience in meat handling and exposure to existing hygiene practices and standards. The parish of Clarendon is divided in four zone namely Zones 1- 4, respectively. Table 2 shows a breakdown of the number of licensed butchers per health zone.

Table 2: Licensed Butchers per Health Zone

Health Zone	Health District	Number of Licensed Butchers
Z1	May Pen East Raymonds Lionel Town Race Course	7
Z2	May Pen West Milk River	57

	Thompson Town	
Z3	Chapleton Rock River Kellits Crofts Hill	8
Z4	Spalding James Hill Frankfield	8
TOTAL		80

Inclusion Criteria

Participants were eligible for inclusion in the study if they met the following criteria. Participants who were actively working as a butcher in Clarendon, Jamaica, at the time of data collection. Participants involved in meat handling, including the slaughtering, cutting, or selling of meat to consumers. Participants were at least 18 years or older, ensuring legal consent for participation in the study. Participants who were to sign an informed consent to voluntarily participate in the study.

Exclusion Criteria

Participants were excluded from the study if they meet any of the following conditions. Individuals who are not directly involved in meat handling: such as shop assistants or administrative staff. Butchers who were operating outside of the parish of Clarendon; as the study is geographically limited to this parish. Individuals who decline to give informed consent or are unwilling to participate voluntarily.

Sample Size and Sampling Technique

The sample size for this study was determined using the Raosoft sample size calculator, which is appropriate for estimating proportions in large populations. Assuming a 95% confidence level, a 5% margin of error, and a 50% response distribution (to maximize variability), the minimum sample size required was approximately 100 participants. However, given the study's logistical constraints and the accessible butcher population in Clarendon, a target sample size of 80 pursued. This adjusted sample size remains acceptable for a correlational study and allows for meaningful statistical analysis while considering feasibility and available resources.

A non-probability convenience sampling method was used to select participants. This technique involves recruiting butchers who are readily accessible, willing to participate, and meet the inclusion criteria. The use of convenience sampling was justified due to the variability in their locations and availability. While this approach limits the generalizability of the findings to the wider butcher population, it was suitable for this studies and public health assessments which focused on identifying practical, context-specific gaps in hygiene knowledge and compliance.

Data Collection Instrument

Face-to-face interview was conducted using a structured interview questionnaire to collect information about the knowledge, practice and compliance of the study population. To eliminate bias and to ensure accuracy of response from the respondents, four research assistants were trained to conduct these face-to-face interviews. This was determined based on the profession of the researcher.

There was no validated pre-existing interview questionnaire schedule of this magnitude for this research interest. As a result, a questionnaire was developed for the interview schedule. The interview schedule and zones were coded (Z1, Z2, Z3, Z4) to represent the four health zones in Clarendon, which was equal to a total of 80 health zones. Close-ended questions were utilized to enable easy comprehension of questions and facilitate more accurate data analysis. The interview schedule was validated by veterinary public health specialists from the University of Technology, Jamaica. Pre-testing was conducted on sixteen (16) conveniently selected butchers in the parish of St. James, Jamaica, which was 20% of the sample size. There were no changes to the instrument as the questions were clear and the respondents had no challenge in responding.

The interview schedule was comprised of three sections: Demographic data comprising of questions such as, “What is your educational level?” Possible responses included whether respondents completed, primary, high school, college/vocational training or no formal education. The meat hygiene knowledge participants were asked a series of questions based on meat hygiene and safety such as, “Wearing jewellery while working (watches, earrings, and rings) increased the risk of meat contamination.” Possible response options included respondents choosing if they agree, disagree or do not know. The self-reported meat hygiene practices participants were asked about their current meat hygiene and safety practices, such as, “I cover all cuts or bruises on my hands before handling meat.” Possible response options included respondents choosing never, sometimes or always.

Data Collection Approach

Participants were contacted by phone, where they were informed about the study and asked for their participation. The consent form was read over the phone, and participants had 24 hours to verbally express their willingness to participate in the research study. A follow-up contact was made at the end of the 24-hour to check on participants' willingness to voluntarily participate after which the interview date was scheduled.

On the date of the interview, the consent form was read aloud to the participants, and consent was obtained once again where participants signed the consent form to affirm their approval to participate. Participants were not forced into providing consent and were notified that they can withdraw their participation in the study at any moment. After the participant signed the consent form, questions were read aloud during the interview, with responders having one minute to answer each question. Therefore, completion of the interview took approximately 45 minutes per respondent.

Key Output Variables

Knowledge and practice were considered as the two independent variables and compliance as the dependent variable in the research study. Meat hygiene knowledge scoring system was adapted from Ashuro et al. (2023) where all knowledge-related questions were summarized into a single variable, which had categories, Agree = 1, Disagree = 2, and Do not know = 0. For self-reported practice questions, a scoring system adopted from research (Paudel et al., 2013) where responses never = 0, sometimes = 1 and always = 2 points. Compliance with health standards responses were labeled “0” for noncompliance with health standards and “1” for compliance with health standards for was labeled.

Independent Variables

Meat hygiene knowledge level

This is an independent variable measured by a structured questionnaire consisting of multiple-choice questions assessing knowledge of safe meat handling, storage, cross-contamination prevention, and sanitation. Responses were recorded as categories, Agree = 1, Disagree = 2, and Do not know = 0.

Self-reported practices

Self-reported practice was also an independent variable, this variable captures butchers’ reported behaviors related to handwashing, equipment sanitation, protective clothing use, and meat storage. Responses was recorded using a Likert scale (e.g., always, sometimes, never), with higher scores indicating better reported practices.

Dependent Variable

Compliance with public health standards

Compliance with public health standards was the dependent variable, which reflects the extent to which butchers adhere to national food safety regulations and meat hygiene standards. Compliance was assessed using a standardized observational checklist administered by the researcher, focusing on facility cleanliness, temperature, protective gear usage, pest control, meat storage conditions, and visible hygiene practices.

Ethical Consideration

Ethical approval was sought from the Ethics Committee at the University of Technology. All participants were informed of the aim and significance of the research. The procedure of obtaining data was explained to each participant so as to reduce anxiety. Participation in the research study was voluntary. Participants were not coerced and may withdraw at any time. Signed consent was obtained from each study participants using the University of Technology consent form. Personal information was kept confidential, and their anonymity of participants to protect their identity as names was not recorded or linked to interview schedules. All interview

schedules were coded and numbered, for example, Z1, so as to eliminate any possibility of linking participants to responses given.

To eliminate associating interview schedules with any participants, research assistants was required to deliver signed consent forms and completed interview schedules daily to the researcher which was stored in a locked filing cabinet. Data was also stored on a password accessed computer that can only be accessed by the researcher. Back up data was also stored on a flash drive, which was also secure in the filing cabinet accessible only to the researcher. This flash drive was stored in a locked filing cabinet. At the end of the research, all interview schedules were shredded by the use of an electrical shredder and disposed of. Despite these limitations, the study expected to provide valuable insights into key gaps in hygiene knowledge, practices, and compliance that can inform targeted interventions and policy enhancements in Jamaica's meat safety industry.

Data Analysis and Results

Data obtained was coded, entered into Microsoft Excel and saved as *sav file* and imported into Statistical Package for the Social Sciences (SPSS) Version 29 software for further analysis. To understand the demographic characteristics of the study population, descriptive statistics was conducted for measures of central tendency (mean) and measures of dispersion (range, standard deviation) for each variable. To determine if there is an association between meat hygiene knowledge and practice, the researcher used Pearson's correlation coefficient between the knowledge and practice scores to determine the degree of association. A binary logistic regression was used to determine how meat hygiene knowledge and self-reported hygiene practice predicts the independent variables against and the dependent variable, compliance with health standards. For all statistical analysis $p < 0.05$ was observed.

Descriptive Findings

The sample consisted of 80 butchers from Clarendon, Jamaica. The majority of participants were male, representing 91.3% of the sample ($n = 73$), while females accounted for only 8.8% ($n = 7$). This gender imbalance reflects the male-dominated nature of the butchery industry in the region. The age of participants ranged from 18 to 80 years. The largest proportion of butchers (28.7%) fell within the 50- 57 age group ($n = 23$), followed by those aged 42- 49 years (17.5%, $n = 14$) and 58- 65 years (16.3%, $n = 13$). The 26- 33 age group accounted for 13.8% ($n = 11$), while 10% ($n = 8$) were aged 34- 41 years. A smaller proportion of participants were in the oldest category, 66- 80 years (7.5%, $n = 6$). Very few participants were under 25, with just 1.3% ($n = 1$) aged 18- 25 and 4.9% ($n = 3$). Currently, the data shows that the butchery workforce in Clarendon is largely composed of middle-aged and older individuals, with a notably small representation of young adults under 25 years of age.

All participants in the study (100%, $n = 80$) reported having a valid butcher's license. This uniformity indicates that the sample exclusively comprised licensed practitioners, thereby ensuring that all respondents met the formal regulatory requirement for legal meat handling and sale in Clarendon. This also strengthens the reliability of subsequent analyses, as participants are

assumed to have some baseline exposure to regulated meat hygiene standards. All 80 participants (100%) reported possession of a valid food handler's permit. This indicates full compliance with public health regulations requiring individuals involved in food preparation and handling to be certified. The universal presence of this permit among respondents suggests a workforce that is formally recognized by the public health system and presumed to have received foundational training in hygiene and food safety practices.

The participants displayed a wide range of experience in the butchery profession. The majority (58.8%, $n = 47$) reported between 20 and 25 years of experience. Smaller proportions were seen in the 1- 5 years (15.0%, $n = 12$), 5- 10 years (14.9%, $n = 11$), and 11- 20 years (11.3%, $n = 9$) categories. The data indicate that most butchers in Clarendon have substantial experience in the field, with over half having worked for two decades or more. This could reflect both the stability of the occupation and the long-term engagement of individuals in the trade.

The educational levels among the butchers in Clarendon varied, with the majority having completed high school (58.8%, $n = 47$). This was followed by those who attained primary-level education (18.7%, $n = 15$) and a smaller group with college or vocational training (12.5%, $n = 10$). Notably, 10% of the participants ($n = 8$) reported having no formal education.

These findings suggest that while most butchers have received at least a high school education, a significant portion still operates with only basic or no formal educational training. This has implications for the design and delivery of hygiene training programs, which may need to be tailored to accommodate varying literacy and comprehension levels. The majority of butchers (58.8%, $n = 47$) reported that they were trained by their parents, highlighting the influence of informal, generational knowledge transfer in the profession.

Other modes of training included on-the-job experience (17.5%, $n = 14$), and self-taught (13.8%, $n = 11$), indicating that a notable portion of participants acquired their skills outside of formal institutions. A smaller group (6.3%, $n = 5$) reported receiving formal training through HEART Trust/NTA, Jamaica's national vocational training institution. A few additional responses (3.8%, $n = 3$) referenced similar informal learning experiences, also listed as "By parent(s)." These findings underscore that while most butchers learn through informal channels, a minority have accessed structured vocational training, which may influence hygiene knowledge and compliance practices. Figure 1 and Figure 2 show sample percentages of males and females and trained butchers in Clarendon.

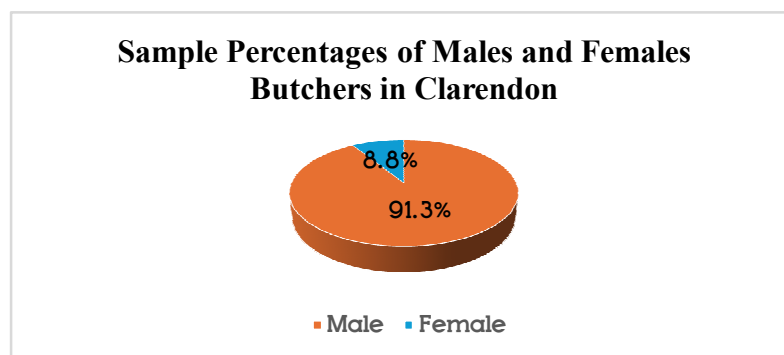


Figure 1: Sample Percentage for Males and Females Butchers in Clarendon

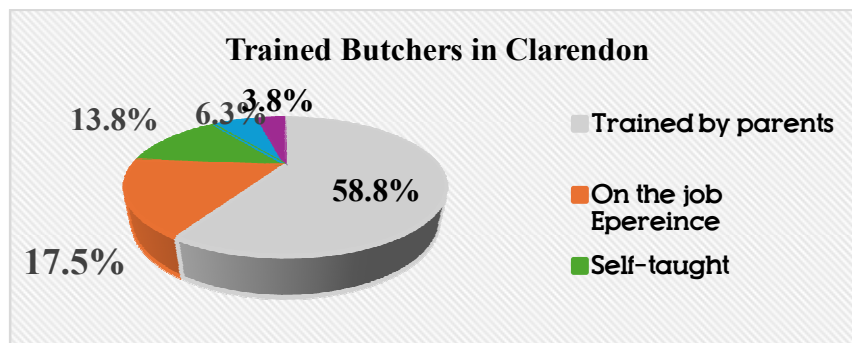


Figure 2: Trained Butchers in Clarendon

Correlation Results

The study aims to answer the first research question:

RQ1: Is there a statistically significant relationship between meat hygiene knowledge and compliance with public health standards?

H₀1: There is no statistically significant relationship between meat hygiene knowledge and compliance with public health standards among butchers in Clarendon.

H_a1: There is a statistically significant relationship between meat hygiene knowledge and compliance with public health standards among butchers in Clarendon.

A Pearson correlation was conducted to examine the relationship between meat hygiene knowledge and compliance. The analysis revealed a weak positive correlation, $r = .138$, which was not statistically significant ($p = .222$). As a result, we fail to reject the null hypothesis. Result indicates that although there is a slight trend suggesting that butchers with higher meat hygiene knowledge are more likely to comply with public health standards, the association is not strong enough to be considered meaningful in this sample ($n = 80$). Table 3 shows Pearson correlation between meat hygiene knowledge and compliance.

Table 3: Pearson Correlation Between Meat Hygiene Knowledge and Compliance

Variables	1	2
1. Meat Hygiene Knowledge	—	.138
2. Compliant with public health standards	.138	—

Note. $n = 80$. Pearson correlation coefficients shown.
 $p = .222$ (2-tailed); not statistically significant.

The study aims to answer the second research question:

RQ2: Is there a statistically significant relationship between self-reported hygiene practices and compliance with public health standards?

H₀2: There is no statistically significant relationship between self-reported hygiene practices and compliance with public health standards among butchers in Clarendon.

H_a2: There is a statistically significant relationship between self-reported hygiene practices and compliance with public health standards among butchers in Clarendon.

A Pearson correlation was conducted to examine the relationship between self-reported hygiene practices and compliance. The analysis revealed a moderate positive correlation, $r = .370$, which was statistically significant at the $p < .01$ level. As a result, the null hypothesis was rejected. The results indicates that butchers who reported higher levels of hygiene practices were significantly more likely to comply with public health standards. The finding underscores the importance of general hygiene awareness and practice in promoting overall compliance with food safety standards ($n = 80$). Table 4 shows Pearson correlation between self-reported hygiene practice and compliance.

Table 4: Pearson Correlation Between Self-Reported Hygiene Practice and Compliance

Variables	1	2
1. Self-Reported Hygiene Practice	—	.370**
2. Compliant with public health standards	.370**	—

Note. $n = 80$. Pearson correlation coefficients are shown.

** $p < .01$ (2-tailed); statistically significant.

Regression Results

The study aim to answer the third research question:

RQ3: Is there a combined effect of meat hygiene knowledge and self-reported practices on compliance with health standards?

H₀₃: Meat hygiene knowledge and self-reported practices do not jointly predict compliance with public health standards among butchers.

H_{a3}: Meat hygiene knowledge and self-reported practices jointly predict compliance with public health standards among butcher.

A binary logistic regression was conducted to examine the extent to which the independent variables predict compliance with health standards. The model yielded a -2 Log Likelihood of 93.162, with a Cox & Snell $R^2 = .186$ and a Nagelkerke $R^2 = .250$, suggesting that approximately 18.6% to 25.0% of the variance in the dependent variable (compliance with health standards) can be explained by the model. Table 5 represents the model summary predicting compliance with health standards.

Table 5: Model Summary Predicting Compliance with Health Standards

Step	-2 Log Likelihood	Cox & Snell R^2	Nagelkerke R^2
1	93.162	.186	.250

Note. Estimation terminated at iteration 20.

The Hosmer and Lemeshow goodness-of-fit test was conducted to assess how well the logistic regression model fits the data. The test yielded a Chi-square value of 1.737, with 2 degrees of freedom and a p-value of .420. Since the p-value is greater than .05, the result is not statistically significant, indicating that there is no evidence of poor fit. Table 6 shows the Hosmer and Lemeshow Test.

Table 6: Hosmer and Lemeshow Test

Step	Chi-square	df	Sig
1	1.737	2	.420

A binary logistic regression was conducted to determine whether meat hygiene knowledge and self-reported hygiene practices predicted compliance with health standards among butchers in Clarendon, Jamaica. Meat Hygiene Knowledge produced an extremely large coefficient ($B = 21.313$, $p = .999$).

However, Self-Reported Hygiene Practice was found to be a statistically significant predictor of compliance with health standards ($B = 1.302$, $p = .002$). The odds ratio ($\text{Exp}(B) = 3.678$) suggests that, for each one-unit increase in reported hygiene practice, the odds of being compliant with health standards increase by approximately 3.7 times, holding other factors constant. The constant term was not significant ($B = -21.979$, $p = .999$). Table 7 shows logistic regression predicting compliance with health standards.

Table 7: Logistic Regression Predicting Compliance with Health Standards

Predictor Variable	B	Exp(B)	95% CI for Exp(B)	Sig.
Meat Hygiene Knowledge	21.313	1,803	[.000, —]	.999
Self-Reported Hygiene Practice	1.302	3.678	[1.636, 8.269]	.002**
Constant	21.979	.999	—	.999

Note. B = unstandardized regression coefficient; $\text{Exp}(B)$ = odds ratio; CI = confidence interval. Dependent variable: Compliance with Health Standards.

** $p < .05$ (statistically significant).

Summary of Findings

The study assessed butchers' meat hygiene knowledge, self-reported hygiene practices, and their relationship to compliance with health standards in Clarendon, Jamaica. Descriptive results showed that the majority of participants were male (91.3%), with most having at least a high school education. All butchers reported having a food handler's permit and a butcher's license. Correlation analysis revealed a significant positive relationship between self-reported hygiene practices and compliance ($r = .370$, $p < .001$), indicating that butchers who reported better hygiene practices were more likely to comply with required with health standards. However, the correlation between meat hygiene knowledge and compliance was weak and not statistically significant ($r = .138$, $p = .222$). Binary logistic regression analysis identified self-reported hygiene practice as a significant predictor of compliance with health standards ($B = 1.302$, $p = .002$, $\text{Exp}(B) = 3.678$), suggesting that butchers who reported better hygiene practices were about 3.7 times more likely to comply with health standards. In contrast, meat hygiene knowledge was not a significant predictor ($p = .999$).

Discussion

The present study aimed to evaluate meat hygiene knowledge and self-reported hygiene practices among butchers in Clarendon, Jamaica, and to assess how these variables predict compliance

with health standards. The findings provide important insights into the behavioural and knowledge-based drivers of food safety practices within this occupational group.

Self-reported hygiene practice emerged as a statistically significant predictor of compliance with health standards. Butchers who reported self-reported hygiene practice, proper sanitation, and safe meat handling were significantly more likely to meet required public health guidelines. This finding aligns with studies conducted in similar developing country contexts, such as Nigeria and Kenya, where behavioural practices have been shown to strongly influence food safety outcomes, regardless of formal training levels (Adebowale et al., 2016; Kimani et al., 2020).

In contrast, meat hygiene knowledge did not significantly predict compliance. While knowledge is often assumed to drive behaviour, this disconnect is well-documented in the literature, particularly in low- and middle-income contexts. For instance, Clayton et al. (2002) noted that knowledge does not always translate into consistent food safety practices due to environmental constraints, cultural norms, or lack of reinforcement mechanisms. The present study supports this observation and raises concerns about over-reliance on knowledge-based interventions without accompanying behavioural reinforcements or structural support.

Moreover, the logistic regression model reported better hygiene practices were about 3.7 times more likely to comply with health standards. The correlation analysis also supported the regression findings. A significant positive correlation was found between self-reported hygiene practices and compliance with health practice guidelines, suggesting that day-to-day operational behaviour is a critical component of public health adherence. However, the correlation between knowledge and compliance was weak and nonsignificant, echoing the regression results and reinforcing the central theme that practice; not just knowledge; is key to compliance.

These findings have several practical implications. Public health authorities and regulatory bodies in Jamaica should consider complementing knowledge-based training with more behaviour-focused strategies. For example, mentorship, regular on-site assessments, and reward-based compliance programs may prove more effective in improving outcomes than informational seminars alone. Finally, while the results are informative, they should be interpreted with caution due to limitations and potential response bias in self-reported data, and limited generalizability beyond Clarendon.

Recommendations for Future Research

Building on the findings and limitations of this study, several avenues are recommended for future research to deepen understanding and improve public health interventions related to meat hygiene knowledge and self-reported practices in Clarendon, Jamaica. Moreover, future studies should consider incorporating direct observational methods or microbiological assessments to objectively verify hygiene practices and compliance with health standards. Observational checklists and on-site assessments would help validate self-reported data and provide a more accurate depiction of daily operations within meat-handling environments.

Longitudinal research designs should be employed to examine causal relationships over time. Tracking butchers' knowledge, behaviour, and compliance across multiple time points would

help determine whether training and practice improvements lead to sustained public health benefits. However, it is recommended that future research explores qualitative approaches to complement quantitative findings. In-depth interviews or focus groups could also uncover contextual factors, motivations, and barriers that influence hygiene behaviour but may not be captured through structured questionnaires.

Expanding the geographic scope of similar studies to include other parishes or urban centres in Jamaica would also improve the generalizability of findings. This could identify regional disparities in resources, training, and regulatory enforcement, offering insights for targeted interventions. Additionally, greater emphasis should be placed on understanding the content, duration, and quality of training received by butchers. Distinguishing between formal, informal, and on-the-job training, and examining their impact on both knowledge and behaviour, would allow researchers and policymakers to better tailor educational programs.

Nevertheless, integrating socioeconomic factors, such as income, access to infrastructure, and business licensing constraints, could provide a more comprehensive understanding of the determinants of compliance. These structural variables often influence the capacity of butchers to implement good hygiene practices, despite their knowledge or intentions. Furthermore, by addressing these areas, future research can contribute to more effective food safety policies, targeted public health interventions, and a healthier meat supply chain in Jamaica and comparable settings.

Conclusion

This study evaluated the relationship between meat hygiene knowledge, self-reported hygiene practices, and compliance with health standards among butchers in Clarendon, Jamaica. The findings revealed that while most butchers possessed a baseline level of knowledge regarding meat hygiene, knowledge alone did not significantly predict compliance with health regulations. Instead, self-reported hygiene practices emerged as a statistically significant predictor, highlighting the critical role of behaviour over awareness in ensuring food safety standards are upheld. These results reinforce the notion that knowledge must be accompanied by consistent, practical application to influence compliance effectively. The disconnection between knowing and doing; long acknowledged in public health literature, was evident in this setting.

Moreover, the data underscore the importance of behavioural reinforcement strategies such as routine inspections, mentorship, and community-based training initiatives to foster safer meat-handling practices. While the study offers valuable insights, it is not without limitations. Issues such as self-report bias, lack of observational data, and limited geographic scope constrain the generalizability of the findings. Nonetheless, it sets the groundwork for future research and intervention development by identifying key behavioural drivers of compliance among meat handlers.

Ultimately, improving food safety in Jamaica's meat industry requires a comprehensive approach, one that goes beyond information dissemination and embraces behaviour change models, systemic support, and policy enforcement. This study contributes to that effort by

highlighting practical gaps and proposing evidence-based directions for future inquiry and public health action.

References

- Abdullahi, A., Hassan, A., Kadarman, N., Saleh, A., Baraya, Y., & Lua, P. (2016, April 12). Food safety knowledge, attitude, and practice toward compliance with abattoir laws among the abattoir workers in Malaysia. *International Journal on General Medicine*, 9, 79- 87.
- Abebe, T., Yetneberk, T., & Gellaw, M. (2021). A cross-sectional survey of COVID-19 preparedness in governmental hospitals of North-West Ethiopia. *Sage Open Medicine*, 9. <https://doi.org/10.1177/2050312121993292>
- Adebowale, O. O., Adeyemo, O. K., & Awoyomi, O. (2016). Knowledge and practices of meat hygiene among meat vendors in southwestern Nigeria. *Journal of Food Safety*, 36(2), 160- 168. <https://doi.org/10.1111/jfs.12221>
- Adesokan, H., & Raji, A. (2014, March). Safe meat-handling knowledge, attitudes and practices of private and government meat processing plants' workers: implications for future policy. *Journal of Preventive Medicine and Hygiene*, 55(1), 10-16.
- Alhaji, N. B., & Babalobi, O. O. (2016). Qualitative and quantitative impacts assessment of contagious bovine pleuropneumonia in Fulani pastoral herds of North-central Nigeria: The associated socio-cultural factors. *Preventive Veterinary Medicine*, 128, 124- 134. <https://doi.org/10.1016/j.prevetmed.2016.04.004>.
- Ali, S., & Alsayeqh, A. F. (2022, December 15). Review of major meat-borne zoonotic bacterial pathogens. *Frontiers in Public Health*, 10(1045599.).
- Aljamali, D. N., Al Najim, D. M., & Alabbasy, A. J. (2021, November). Review on food poisoning (types, causes, symptoms, diagnosis, treatment). *Global Academic Journal of Pharmacy and Drug Research*, 3(4), 54-61.
- Aluko, O. O., Ojeremi, T. T., Olaleke, D. A., & Ajidagba, E. B. (2014). Evaluation of food safety and sanitary practices among food vendors at car park in Ile Ife, southwestern Nigeria. *Food Control*, 40 (1), 165-171. <https://doi.org/10.1016/j.foodcont.2013.11.049>
- Ashuro, Z., Zeyse, N., & Ayalew, M. (2023, September 14). Meat hygiene knowledge, handling practices and associated factors among meat handlers in Gedeo. *Scientific Reports*, 13.
- Basu, S. (2015). The transitional dynamics of caloric ecosystems: Changes in the food supply around the world. *Crit Public Health*, 25(3), 248- 264.
- Bhandari, R., Singh, A. K., Bhatt, P. R., & Timalina, A. (2022, November 9). Factors associated with meat hygiene-practices among meat-handlers in Metropolitan City of Kathmandu, Nepal. *PLOS Glob Public Health*, 2(11)., 1- 13.
- Birhanu, W., Weldegebriel, S., Mitku, F., Bassazin, G., Birku, L., & Tadesse, M. (2017, January). Assessment of microbiological quality and meat handling practices in butcher shops and abattoir found in Gondar Town, Ethiopia. *International Journal of Microbiological Research*, 8(2), 59-68.

- Brusa, V., Costa, M., Padola, N. L., Etcheverría, A., Sampedro, F., Fernandez, P. S., Signorini, M. L. (2020, November 13). Quantitative risk assessment of hemolytic uremic syndrome associated with beef consumption in Argentina. *PLoS ONE*, 15(11), 1-32.
- Caribbean Public Health Agency. (2019). *Foodborne diseases in the Caribbean: Summary report*. <https://carpha.org>
- Center of Diseases Control and Prevention. (2011, January 1). From foodborne illness acquired in the United States, major pathogens: https://wwwnc.cdc.gov/eid/article/17/1/p1-1101_article#;
- Center of Diseases Control and Prevention (CDC). (2018, November 5). Estimates of food borne illness in the United States. <https://www.cdc.gov/foodborneburden/index.html>
- Clayton, D. A., Griffith, C. J., Price, P., & Peters, A. C. (2002). Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research*, 12(1), 25-39. <https://doi.org/10.1080/09603120120110031>
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Currie, A., Cutler, J., Locas, A., Lavoie, M., Honish, L., Gaulin, C., & Galanis, E. (2019, September). Outbreak of Escherichia coli O157:H7 infections linked to mechanically tenderized beef and the largest beef recall in Canada, 2012. *Journal of Food Protection*, 82(9), 1532-1538.
- Espinosa, R., Tago, D., & Treich, N. (2020, August 4). Infectious diseases and meat production. *Environmental and Resource Economics*, 76(4), 1019- 1044.
- Food and Agriculture Organization. (1991). Guidelines for slaughtering, meat cutting and further processing - FAO animal production and health paper, 91. Rome: Food and agriculture organization of the United Nations.
- Gebeyehu, D., & Tsegaye, H. (2022, August 8). Food safety knowledge and practice of abattoir and butcher shop workers: A health risk management perspective. *One Health Outlook*, 4(14).
- Kimani, V. N., Ombui, J. N., & Githuku, J. G. (2020). Knowledge, attitude and practices of meat handlers on food hygiene in slaughterhouses in Kenya. *Pan African Medical Journal*, 36, 139. <https://doi.org/10.11604/pamj.2020.36.139.21779>
- Ko, W. (2021). Food safety knowledge, attitudes, and practices of meat handlers in wet markets in Asia: A systematic review. *International Journal of Environmental Research and Public Health*, 18(15), 7890. <https://doi.org/10.3390/ijerph18157890>
- Laws of Jamaica*. In the Public Health Act, 1985. <https://laws.moj.gov.jm/library/statute/the-public-health-act>
- Manyi-Loh, C. E., & Lues, R. (2023, September 20). A South African perspective on the microbiological and chemical quality of meat: Plausible public health implications. *Microorganisms*, 11(10).
- Matchawe, C., Ndip, L., Zuliani, A., Tsafack, J., Nsawir, B., Piasentier, E., & Joseph, N. (2019, September). Knowledge, attitude and practices (KAP) regarding meat safety and

- sanitation among carcass handlers operating at The Yaoundé Slaughterhouse, Cameroon. *International Journal of Advanced Research and Publications*, 3(9), 150-155.
- Ministry of Health & Wellness. Jamaica. (2022). *National report on foodborne illnesses and hygiene standards compliance*. <https://www.moh.gov.jm>
- Ponnampalam, E. N., Sinclair, A. J., & Holman, B. W. (2021, June 11). The sources, synthesis and biological actions of omega-3 and omega-6 fatty Acids in Red Meat: An Overview. *Foods*, 10(6), 1358.
- Public Health (Butchers) Regulations, 1989. Ministry of Justice, Jamaica. https://laws.moj.gov.jm/legislation/subsids/P/The%20Public%20Health%20Act_0.pdf
- Public Health (Food Handling) Regulations, (1998). Ministry of Justice, Jamaica. https://laws.moj.gov.jm/legislation/subsids/P/The%20Public%20Health%20Act_0.pdf
- Public Health (Food Handlings) Regulations, (2000) Ministry of Justice, Jamaica. https://laws.moj.gov.jm/legislation/subsids/P/The%20Public%20Health%20Act_0.pdf
- Public Health (Meat Inspection) Regulations, (1989). Ministry of Justice, Jamaica. https://laws.moj.gov.jm/legislation/subsids/P/The%20Public%20Health%20Act_0.pdf
- Public Health (Nuisance) Regulations, (1995). Ministry of Justice, Jamaica. https://laws.moj.gov.jm/legislation/subsids/P/The%20Public%20Health%20Act_0.pdf
- Ritchie, H., & Roser, M. (2019). Meat and dairy production. From our world in data. <https://ourworldindata.org/meat-production>
- Subedi, D., Bhattarai, T., & Acharya, D. R. (2022, December 2). Meat handling practices among retail meat shops in Dharan Sub-Metropolitan City. *Tribhuvan University Journal of Food Science and Technology*.
- Tchatchouang, C.-D. K., Fri, J., De Santi, M., Brandi, G., Schiavano, G. F., Amagliani, G., & Ateba, C. N. (2020, January 17). Listeriosis outbreak in South Africa: A comparative analysis with previously reported cases worldwide. *Microorganisms*, 8(1), 137.
- United Nations. (2020, June). Policy brief: The impact of COVID-19 on food security and nutrition. <https://unsdg.un.org/resources/policy-brief-impact-covid-19-food-security-and-nutrition>
- World Health Organization. (2020a). *Food safety: Key facts*. <https://www.who.int/news-room/fact-sheets/detail/food-safety>
- World Health Organization (WHO). (2020b). Zoonoses. <https://www.who.int/news-room/fact-sheets/detail/zoonoses>
- World Health Organization (WHO). (2022). Food safety. <https://www.who.int/news-room/fact-sheets/detail/food-safety>.