

## Assessment of Food Safety Knowledge, Attitudes, and Practices among Meat Handlers in Bishoftu City, Ethiopia

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**Abstract.** Meat handlers play a critical role in food safety by preventing contamination of food for human consumption. A cross-sectional survey was undertaken with 391 meat handlers working in abattoirs and retail meat stores in Bishoftu, Ethiopia, to investigate their food safety knowledge, attitudes, and practices (KAP). Data were collected in interviews using a semistructured questionnaire adapted from previous research. An overall score for each topic area was calculated based on the responses to individual questions. Logistic regression was used to assess the independent associations between sociodemographic characteristics and good knowledge, attitudes, and practices. Almost all meat handlers were males (97.2%), and more than half (51.9%) had primary-level education. Most (72.4%) meat handlers had a good knowledge level with a median score of 16 out of 21 (interquartile range [IQR] = 6). Similarly, most (94.6%) meat handlers had a positive attitude toward food safety with a median score 18 out of 20 (IQR = 1). However, most (83.7%) meat handlers had poor food safety practices with median score of 11 out of 20 (IQR = 3). In multivariable models, good knowledge was significantly ( $P < 0.05$ ) associated with male gender and older age; positive attitudes were associated with lower educational attainment and good knowledge; and good practices were associated with working in an abattoir and having received training on food safety. Regular hands-on training and enforcement of general and personal hygiene is recommended.

### INTRODUCTION

Globally, about 600 million people fall ill after consuming contaminated food each year, equivalent to 27 million healthy life years lost.<sup>1</sup> Foodborne illness is one of the most important causes of human disease, with consumption of contaminated meat playing a major role in illness.<sup>2</sup> Meat is a common source of foodborne illness as it provides a good medium for multiplication of microorganisms, including pathogens and spoilage organisms.<sup>3</sup> Because of the high potential for meat to support growth of pathogens, meat has to be handled with care from the point of slaughter as well as post-harvest to avoid contamination.<sup>4</sup> Contamination and cross-contamination of raw meat is a major cause of foodborne diseases, particularly in developing countries.<sup>5</sup> In many developing countries, strict control of meat hygiene and safety is not easy and meat for human consumption is approved mainly based on visual inspection.<sup>6</sup>

Like many developing countries, the majority of foodborne illness in Ethiopia can be attributed to organisms that are shed intermittently in feces of infected animals and contaminate carcasses during the slaughter process as a result of unhygienic handling and cross-contamination.<sup>7,8</sup> Studies of children with diarrhea in Ethiopia, for example, reveal a high prevalence of pathogenic *Escherichia coli* (28.8%)<sup>9</sup> and *Salmonella* (3.1%<sup>9</sup> and 1.3%<sup>10</sup>). Other studies have revealed a *Salmonella* prevalence of 7.2%, 4.7%, and 4.4% in human patients, poultry, and swine, respectively.<sup>7,11</sup> Microbial contamination of animal source foods along the value chain has also been reported in Ethiopia. A recent meta-analysis of studies on the prevalence of *E. coli* in milk and meat found an overall random pooled prevalence of 15% (95% CI = 13–17%),<sup>12</sup> whereas another review highlighted the occurrence *E. coli*, *Salmonella*, *Listeria*, and *Campylobacter* in beef sold in retail stores.<sup>13</sup>

Given the critical role that slaughterhouses and meat retailers play in food safety, it is useful to have insight into the level of food safety knowledge, attitudes, and practices (KAP) of meat handlers, so that interventions can be developed accordingly. Studies conducted in different parts of Ethiopia have revealed that meat handlers' behavior is an important risk factor for food contamination and can reduce the quality of food served for human consumption. For example, in one study conducted in eastern Ethiopia, meat handlers had poor knowledge regarding foodborne pathogens, time-temperature control to prevent bacteria growth, cross-contamination, and the difference between cleaning and sanitation.<sup>14</sup> Another study in northern Ethiopia found that approximately 15.4% of abattoir personnel had no health certificate and that there was no hot water, sterilizer, or cooling facility in the abattoir. Furthermore, 11.3% of butchers did not use protective clothes when handling meat.<sup>15</sup>

In Ethiopia, "downstream" food safety measures such as investigating food establishments and recalling food products are not well established. For this reason, special attention must be given to "upstream" factors including personal hygiene of meat handlers in slaughterhouses and retail shops to ensure safe foods are available for consumers. Inadequately trained employees practicing unhygienic handling of meat can expose the public to meat-borne illness, which could be ameliorated through training and implementation of quality control systems.<sup>16</sup> Although there have been some studies on food safety KAP in food handlers in food establishments in Ethiopia,<sup>17–19</sup> only one study<sup>14</sup> has undertaken an in-depth investigation of food safety KAP of meat handlers in abattoirs and retail meat shops. Other studies in this setting have focused mainly on food safety practices.<sup>15,16,20</sup> Therefore, this study aimed to assess the food safety KAP and the influence of knowledge and attitudes on food safety practices of abattoir and retail meat shop workers' in central Ethiopia.

### MATERIALS AND METHODS

**Study setting.** This study was undertaken in Bishoftu city, in the Oromia region of Ethiopia, located 47 km southeast of

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the capital, Addis Ababa. Geographically, the city is located at 8°45'8.1" N latitude and 38°58.708' E longitude. The city is located in mid-highland at an altitude of approximately 1,920 meters above sea level. It is characterized by moderate weather conditions with an average annual temperature ranging between 16 and 24°C. Most precipitation occurs in August with an average precipitation of 220 mm. The annual amount of precipitation is 968 mm, and humidity is close to 75%. The total population of the city was projected to be 197,557 in 2021.<sup>21</sup> Retail meat shops purchase cattle from different open markets or fattening farms located in neighboring towns and bring the animals to abattoirs for slaughter. There are five abattoirs with different slaughtering capacities and approximately 137 retail meat shops operating in the study area.

**Study design, sample size, and data collection.** A cross-sectional survey was undertaken with meat handlers working in abattoirs (involved in slaughtering and handling of carcasses) and retail meat shops in Bishoftu city. Assuming a 50% level of knowledge, attitudes, and practices, with 95% confidence level and  $\pm 5\%$  precision, a minimum sample size of 384 was calculated. This was increased to 391 meat handlers assuming 10% nonresponse. A purposive sampling technique was used to select the retail meat shops/abattoirs. Subsequently, meat handlers were selected using simple random sampling.

A semistructured, pretested questionnaire was used to obtain data on meat handlers' knowledge, attitudes, and practices toward food safety. The questionnaire was adapted from previously published research articles<sup>14,17,22–24</sup> and translated into the local languages (Afan Oromo and Amharic). The questionnaire was organized into four distinct parts. The first section included questions on demographic characteristics of respondents such as sex, age, years of experience, and level of education. The second section of the questionnaire focused on food safety knowledge, and questions on personal hygiene, cross-contamination, and causes of foodborne diseases. The third part of the questionnaire dealt with the food safety attitude of meat handlers. It comprised 20 questions such as handwashing, cross-contamination, food handling, and storage. The fourth section of the questionnaire addressed food safety practices among meat handlers. It comprised 20 questions on topics related to basic food safety and hygiene, protective clothing, and prohibited and equipment handling practices. Questions were mostly closed-ended and required participants to respond with "Yes" or "No" ("Agree" or "Disagree").

Interviews were conducted in a private area inside the respondents' work establishment to make the interview comfortable for the respondent and without disturbance. The questionnaire was read out loud by an interviewer who recorded the results on a paper form. The respondents were interviewed face-to-face during working hours without prior notice of the interview. On average individual interviews took 10 to 15 minutes to complete. The research took place during the COVID-19 pandemic, and thus preventive measures were practiced during face-to-face data collection by wearing facemasks, observing social distance (at least 2 m), washing hands, using alcohol-based hand sanitizer, and conducting interviews in a well-ventilated space.

**Statistical analyses.** Data analysis was performed in Stata Statistical Software, release 14.2 (StataCorp LP, College Station, TX). For knowledge questions, a score of 1 was

given for each correct answer. The sum of scores (ranging between 0 and 21) was then calculated giving an overall score on food safety knowledge. Meat handlers that had an overall score of  $< 15$  were considered to have "poor knowledge," and those who scored  $\geq 15$  (i.e.,  $\geq 70\%$  of questions answered correctly) were deemed to have "good knowledge" of food safety. Similarly, for attitudes and practices questions, a score of 1 was given to each answer that was consistent with "good attitudes/practices" and an overall score out of 20 was calculated. Consistent with other studies,<sup>29,43</sup> meat handlers with a score of  $\geq 14$  (i.e.,  $\geq 70\%$  of questions answered in the affirmative) were deemed to have "good attitudes/practices," and respondents with scores  $\leq 13$  were deemed to have "poor attitudes/practices." This cutoff point was used to generate a binary dataset (i.e., good = 1, poor = 0) for each indicator. Descriptive statistics (median, interquartile range [IQR]) were used to summarize the overall scores of knowledge, attitude, and practice questions. Mann-Whitney *U* test was used to compare scores by sociodemographic characteristics. Finally, logistic regression was used to assess the independent associations between sociodemographic characteristics of the study participants (independent variables) and good knowledge, attitudes and practices (dependent variables; separate models each variable). Consistent with the KAP model of health behavior, knowledge was included as a predictor in the model exploring factors associated with good attitudes, whereas knowledge and attitudes were included as predictors in the model exploring factors associated with good practices. Predictor variables with  $P < 0.25$  in univariable analysis were retained in the final multivariable logistic model.

**Ethics approval and consent to participate.** This research was reviewed and approved by the ethical committees of Addis Ababa University (Protocol number 031/21) and the University of Liverpool (Reference No. 9935). Before commencement of the interview, the purpose of the study was explained to the respondents and requested their willingness to participate in this study.

## RESULTS

**Demographic characteristics.** The sociodemographic profile of respondents is summarized in Table 1. The majority (61.6%) of the respondents were aged 16 to 25 years. The mean age of the meat handlers was  $25.2 \pm 6.6$  years (range 16–68). The majority of the meat handlers were men (97.2%) and slightly

TABLE 1  
Sociodemographic characteristics of randomly selected meat handlers working in abattoirs and retail meat shops in Bishoftu, Ethiopia (N = 391)

Variable	Category	Frequency, n (%)
Age (years)	16–25	241 (61.6)
	26–68	150 (38.4)
Gender	Female	11 (2.8)
	Male	380 (97.2)
Education	Primary	203 (51.9)
	Above primary	158 (40.4)
Year of service	$\leq 3$	230 (58.8)
	$> 3$	161 (41.2)
Training	No	256 (65.5)
	Yes	135 (34.5)
Place of work	RMS	223 (57.0)
	Abattoir	168 (43.0)

RMS = retail meat shop.

above half (51.9%) had primary-level education. Participants had worked for  $3.6 \pm 3$  years of service on average (range 0.1–30 years). Approximately one-third (34.5%) of respondents indicated they had received training in food safety, all of whom worked in abattoirs; no formal training had been given to any meat handler working in retail meat shops.

**Food safety knowledge of meat handlers.** Food safety knowledge of meat handlers is presented in Supplemental Table 1. Nearly three-quarters (72.4%) of the respondents had a good knowledge level with a median score of 16 out of 21 (IQR = 6). Most participants correctly identified that improper meat handling posed a risk to consumers and that good hand hygiene practices and proper cleaning, sanitization, and disinfection could reduce the risk of contamination. Knowledge of specific foodborne pathogens such as bacteria and viruses was, however, poor with only approximately half of the participants able to identify that meat contaminated with fecal material could cause foodborne illnesses. The importance of meat workers' health status was also not well appreciated by a sizable proportion of the respondents.

**Food safety attitude of meat handlers.** Supplemental Table 2 shows the frequency distribution of meat handlers' attitudes towards food safety. Most respondents (94.6%) had a positive attitude toward food safety with a median score of 18 of 20 (IQR = 1). In general, meat handlers appreciated their role in reducing contamination through measures such as washing hands regularly, keeping surfaces clean, and inspecting meat for freshness. Nonetheless, views on cleaning methods were not always consistent with good food hygiene practices, with a majority (90.3%) expressing that the same towel could be used to clean many places. Further, attitudes toward raw meat were not consistent with good food safety, with a majority of meat handlers believing that raw meat is healthier and more nutritious than cooked meat. A considerable proportion (33.5%) also expressed that it was not unsafe to leave meat out of the refrigerator for 2 hours.

**Food safety practices by meat handlers.** Supplemental Table 3 summarizes the meat handlers' practices regarding food safety. Most of the meat handlers (83.7%) had below the acceptable level of food safety practices with median score of 11 out of 20 (IQR = 3). Although a majority of meat handlers

practiced good handwashing before and after handling meat, after handling waste/garbage, and after using the toilet, lapses in practices were reported around the time of donning/doffing gloves and after smoking, sneezing, or coughing. Moreover, although hairnets or caps were worn by a majority of meat handlers, gloves, masks, aprons, or other protective clothing were not commonly used. Close to half of the respondents stated they handled/processed meat when they were ill (45%) or when they had cuts or other injuries on their hands (47.1%).

Median KAP scores by sociodemographic characteristics of the respondents are presented in Table 2. Male individuals had a higher median score for food safety knowledge, attitudes, and practices than females. Older age and longer service was associated with higher median knowledge. KAP scores showed disparity with the age of the respondents. Meat handlers in the age range of 25 to 45 years scored better in terms of knowledge and attitudes toward food safety compared with younger and older individuals (Figure 1A). In contrast, older individuals scored higher in terms of food safety practices. Good knowledge was associated with higher median attitude score, while positive attitude was associated with higher median practice score (Table 2). Both food safety attitudes and practices scores increased with knowledge score, albeit to a lesser degree for food safety practices scores (Figure 1B).

Table 3 shows the results of regression analysis exploring the association between respondents' sociodemographic characteristics and food safety knowledge, attitudes, and practices. In multivariable models, good knowledge was significantly ( $P < 0.05$ ) associated with male gender and older age; positive attitudes were associated with lower educational attainment and good knowledge; and good practices were associated with working in an abattoir and having received training on food safety. An interaction term between training and place of work was explored in the latter model but it was found to be nonsignificant ( $P = 0.28$ ).

## DISCUSSION

This study investigated the food safety knowledge, attitudes, and practices of meat handlers working in abattoirs and retail

TABLE 2  
Median (IQR) knowledge, attitudes and practices scores of meat handlers' working in abattoir and retail meat shops of Bishoftu city, Ethiopia ( $N = 391$ ), by sociodemographic characteristics

Variable	Level	Knowledge score		Attitudes score		Practices score	
		Median (IQR)	<i>P</i> value	Median (IQR)	<i>P</i> value	Median (IQR)	<i>P</i> value
Gender	Female	13 (5)	0.00	15 (8)	0.00	10 (4)	0.02
	Male	16 (6)		18 (1)		11 (3)	
Age (years)	16–25	16 (6)	0.02	18 (1)	0.18	11 (3)	0.68
	> 25	18 (5)		18 (2)		11 (2)	
Education	Primary	17 (6)	0.16	18 (1)	0.03	11 (3)	0.66
	Above primary	16 (6)		18 (2)		11 (3)	
Service (years)	≤ 3	16 (6)	0.05	18 (1)	0.71	11 (3)	0.91
	> 3	18 (5)		18 (1)		11 (3)	
Training	No	16 (6)	0.33	18 (1)	0.20	11 (2)	0.00
	Yes	16 (6)		18 (1)		11 (4)	
Place of work	RMS	16 (6)	0.66	18 (2)	0.14	11 (2)	0.01
	Abattoir	17 (6)		18 (1)		11 (4)	
Knowledge	Poor	NA	NA	17 (3)	0.00	11 (4)	0.36
	Good	NA		18 (1)		11 (3)	
Attitude	Negative	NA	NA	NA	NA	10 (6)	0.00
	Positive	NA		NA		11 (3)	

IQR = interquartile range; NA = not applicable; RMS = retail meat shop. *P* values were obtained from Mann Whitney *U* tests and are rounded to two decimal places.

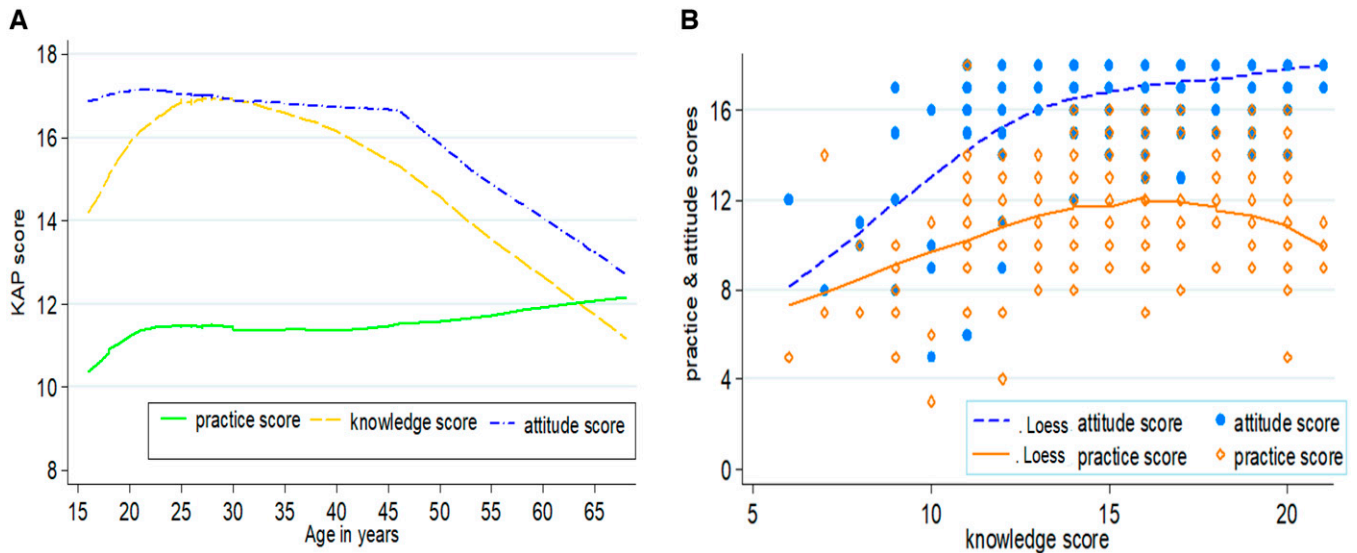


FIGURE 1. Loess curve showing the relationship between (A) age and knowledge, attitudes, and practices (KAP) scores and (B) knowledge score vs. attitude and practice scores.

meat shops in Bishoftu city, Ethiopia. In this study, meat handlers were found to have satisfactory knowledge of food safety, including of the importance of general sanitary measures such as frequent handwashing, proper cleaning and sanitization of equipment, avoidance of eating and drinking in the workplace, and cross-contamination. Likewise, most of the meat handlers had positive attitudes toward food safety and their role in reducing contamination through washing hands regularly, keeping surfaces clean and inspecting meat for freshness. However, this study showed that despite good knowledge and positive attitudes toward food safety, this did not always translate into adequate practices during meat handling.

The level of food safety knowledge reported in this study was higher than those reported among meat handlers in western Ethiopia<sup>14</sup> but similar to those reported among food handlers working in hotels in northwestern Ethiopia.<sup>17</sup> Despite the good food safety knowledge in this study, there were still several misunderstandings that could be improved through training. Specifically, gaps in knowledge related to the exact causes of foodborne illness were identified, along with lack of understanding of the difference between cleaning/washing and sanitizing. The importance of the health status of the worker also seemed to be a knowledge gap and may again reflect a poor understanding of the causes of food-borne illness and the fact that humans are the source of some pathogens. Indeed, another study with meat handlers in Ethiopia<sup>14</sup> revealed that most of the respondents did not know that hepatitis A and *Staphylococcus aureus* were the cause of food-borne diseases.

Positive attitudes toward food safety were also documented in this study, with the main deficiencies related to beliefs about raw meat and towel use. Eating raw meat is a common tradition in Ethiopia, and the finding that raw meat is perceived to be healthier and more nutritious is not surprising. Use of the same towel to clean many places can contribute to cross-contamination. Most (90.3%) participants in this study believed it was possible to use the same towel to clean many surfaces. This is considerably higher

than another study of meat handlers in Ethiopia (53%)<sup>14</sup> and may reflect a specific gap in training or equipment available in the workplaces in this study.

Codex Alimentarius Commission recommends food handlers wash their hands, particularly before handling food, after using the toilet, and after handling raw food or contaminated material. Further, it recommends personal effects such as jewelry not be worn and that cuts and abrasions on hands be covered while working.<sup>25</sup> Although the majority of meat handlers in this study did practice good hand hygiene, lapses in handwashing practices were reported around the time of donning/doffing gloves and after smoking (both rare in this setting) as well as after sneezing/coughing. Notably, only a third of meat handlers reported wearing a mask in this study. The latter findings are particularly important given this study was undertaken during the COVID-19 pandemic. Indeed, slaughterhouses around the world were implicated in outbreaks.<sup>26,27</sup> Again, this would seem to suggest that meat handlers may not appreciate the role they may play in being a source of infection to others.

Discordance between knowledge/attitudes and practices was observed across several areas in this study. For instance, although nearly all (93.4%) respondents agreed that meat handlers with injuries on their hands should not touch or handle meat, more than half stated that they did, in fact, do this. Similarly, a majority (98.2%) believed that wearing protective clothing improves food safety, yet a minority reported wearing protective clothes, aprons, or gloves. These findings are not unlike other studies in Ethiopia where a sizeable proportion of meat handlers reported handling meat when they have injuries on their hands and/or not using gloves.<sup>14,16,20</sup>

Of the several factors identified in multivariable analysis as being associated with good food safety KAP, training was the only modifiable factor. That is to say, food hygiene training which specifically targets gaps identified in this study could potentially improve food safety in slaughterhouses and retail meat shops in Ethiopia. This may be particularly important in retail meat shops where food safety practices were lower and

TABLE 3  
Multivariable logistic regression of factors associated with food safety knowledge, attitude and practices of meat handlers' working in an abattoir and retail meat shops of Bishoftu city, Ethiopia (N = 391)

Variable	Level	n (%)	Good knowledge (N = 283)				Positive attitude (N = 370)				Good practices (N = 103)					
			Univariable		Multivariable		Univariable		Multivariable		Univariable		Multivariable			
			OR (95% CI)	P	aOR (95% CI)	P	n (%)	OR (95% CI)	P	aOR (95% CI)	P	n (%)	OR (95% CI)	P	aOR (95% CI)	P
Gender	Female	3 (27.3)	Ref	NA	Ref	NA	Ref	NA	Ref	NA	1 (9.1)	Ref	NA	Ref	NA	
	Male	280 (73.7)	7.5 (1.9-28.7)	0.00	9.3 (2.3-37.4)	0.00	364 (95.8)	19.0 (5.3-68.7)	0.00	4.5 (0.9-21)	0.06	2.0 (0.3-15.8)	0.52	2.0 (0.3-15.8)	0.52	
Age (years)	16-25	161 (66.8)	Ref	NA	Ref	NA	Ref	NA	Ref	NA	33 (13.7)	Ref	NA	Ref	NA	
	> 25	122 (81.3)	2.2 (1.3-3.5)	0.00	1.9 (1.1-3.2)	0.03	137 (91.3)	0.4 (0.1-0.9)	0.28	NA	NA	31 (20.7)	1.6 (1.0-2.8)	0.72	1.6 (1.0-2.8)	0.72
Education	Primary	146 (71.9)	Ref	NA	Ref	NA	Ref	NA	Ref	NA	34 (16.7)	Ref	NA	Ref	NA	
	Above primary	137 (72.9)	1.0 (0.7-1.6)	0.83	NA	NA	172 (91.5)	0.3 (0.1-0.8)	0.01	0.3 (0.1-0.9)	0.03	0.9 (0.6-1.6)	0.83	0.9 (0.6-1.6)	0.83	
Service (years)	≤ 3	154 (67.0)	Ref	NA	Ref	NA	219 (95.2)	Ref	NA	NA	34 (14.8)	Ref	NA	Ref	NA	
	> 3	129 (80.1)	2.0 (1.2-3.2)	0.00	1.7 (1.0-2.9)	0.05	151 (93.8)	0.8 (0.3-1.8)	0.54	NA	NA	30 (18.6)	1.3 (0.8-2.3)	0.31	1.3 (0.8-2.3)	0.31
Training	No	185 (72.3)	Ref	NA	Ref	NA	239 (93.4)	Ref	NA	Ref	NA	8 (3.2)	Ref	NA	Ref	NA
	Yes	98 (72.6)	1.0 (0.6-1.6)	0.95	NA	NA	131 (97.0)	2.3 (0.7-7.0)	0.14	1.6 (0.5-5.7)	0.43	22.0 (10.0-48.1)	0.00	21.2 (9.5-47.1)	0.00	
Place of work	RMS	163 (73.1)	Ref	NA	Ref	NA	207 (92.8)	Ref	NA	Ref	NA	17 (7.6)	Ref	NA	Ref	NA
	Abattoir	120 (71.4)	0.92 (0.6-1.4)	0.72	NA	NA	163 (97.0)	2.5 (0.9-7.0)	0.08	1.8 (0.6-5.7)	0.32	4.7 (2.6-8.6)	0.00	4.4 (2.2-8.6)	0.00	
Knowledge	Poor	NA	NA	NA	NA	NA	90 (83.3)	Ref	NA	Ref	NA	19 (17.6)	Ref	NA	Ref	NA
	Good	NA	NA	NA	NA	NA	280 (98.9)	18.7 (5.4-64.8)	0.00	17.3 (4.8-62.2)	0.00	0.9 (0.5-1.6)	0.69	0.9 (0.5-1.6)	0.69	
Attitude	Negative	NA	NA	NA	NA	NA	NA	NA	NA	NA	3 (14.3)	Ref	NA	Ref	NA	
	Attitude	NA	NA	NA	NA	NA	NA	NA	NA	NA	61 (16.5)	1.2 (0.3-4.1)	0.79	1.2 (0.3-4.1)	0.79	

aOR = adjusted odds ratio; NA = not applicable; OR = odds ratio; RMS = retail meat shop; P values were obtained from regression models and are rounded to two decimal places.

training stated to be nonexistent at least among respondents in this study. Personal communication with the abattoir managers and retail meat shop owners revealed that there are attempts to train employees regarding meat hygiene, but it is not on regular basis and not sufficient. There was also a positive association between knowledge and attitudes of meat handlers toward food safety, which suggests that training that leads to improved knowledge will lead to improved attitudes of meat handlers toward food safety. Similar positive association between food safety knowledge and attitudes was observed in slaughterhouse workers in Cameroon.<sup>28</sup>

However, it is notable that good food safety knowledge and positive attitudes were not in themselves associated with good food safety practices in this study. Similar findings have been reported in other studies. For example, a study of food handlers in the United Kingdom revealed that 63% of respondents with good knowledge of food safety practices acknowledged they did not always practice the corresponding positive behavior.<sup>29</sup> Barriers to good food safety practices in that study included time constraints and lack of staff. In Ethiopia, further reasons could be poor regulatory systems and enforcement, inhibitory attitudes of supervisors and colleagues, as well as structural factors, such as lack of facilities and availability of supplies. Indeed, informal observation during the interviews identified several factors that likely contributed to poor practices, such as lack of hot water baths for handwashing and dipping of knives/equipment, as well as lack of cooling facilities. Similar observations were also reported in another study that used direct observation and checklist of beef-handling practices in slaughterhouses and beef retail shops in the same area.<sup>16</sup> Thus, although quality and reach of food safety training clearly needs to be improved in Ethiopia, these other factors must be simultaneously addressed to reduce the risk to consumers.

There are several limitations in this study that need to be acknowledged. In particular, the number of female respondents is too small to make this comparison meaningful; this may have inflated the odds ratio and contributed to spurious findings for gender in logistic regression models. Second, assessment of practices was largely done using self-report. Given that participants typically had good knowledge and attitudes toward food safety, it is likely that they overreported good practices. Personal observation was made informally during the study, and discrepancies between what people said they did and what they were observed to do were noted. However, for the majority of the questions, the respondents' responses did match our observations at the meat establishments. In any case, our conclusion based on the self-reported data in this study and confirmed by direct observation in another study in the same area<sup>16</sup> is that food safety practices were poor.

### CONCLUSIONS

This study contributes to an understanding of food safety in abattoirs and retail meat shops in Bishoftu city, Ethiopia. The study showed that there was a good level of food safety knowledge, which was reflected in a positive attitude toward food safety; however, this did not adequately translate into practice. In particular, gaps related to the use of personal protective equipment and other hygienic practices necessary to reduce the risks emanating from the contamination of food during handling were documented. It is recommended that

hands-on induction and continuing/refreshment training be provided to meat handlers working in abattoirs and retail meat stores. In addition, this training needs to be accompanied by improvements to work conditions and supportive infrastructure that remove barriers to enacting good food safety practices in these environments.

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