DOI: https://doi.org/10.21323/2414-438X-2024-9-1-24-31
Received 09.11.2023
Accepted in revised 06.02.2024
Accepted for publication 12.02.2024

Available online at https://www.meatjournal.ru/jour
Original scientific article
Open Access

FOOD SAFETY KNOWLEDGE, ATTITUDE AND PRACTICES OF MEAT HANDLERS IN KHULNA CITY, BANGLADESH

Gourpada Biswas[1]*, Md. Shafiqul Islam[1], S. M. Mahbubur Rahman[2], Md. Matiul Islam[1]
[1] Agrotechnology Discipline, Khulna University, Khulna, Bangladesh
[2] Biotechnology and Genetic Engineering Discipline, Khulna University, Khulna, Bangladesh

Keywords: *cross contamination, foodborne disease, food safety, meat handler, raw meat*

Abstract

The research was conducted to identify the present status of the food safety knowledge, attitude and practices of meat handlers in retail meat shops of Khulna City, Bangladesh. The research was performed through face-to-face interviews of randomly selected 65 meat handlers in six areas of Khulna City. Socio-demographic information of all respondents was collected. The illiteracy rate was 15.38%, while the majority (42.9%) of the respondents had secondary education. The highest proportion (43.07%) of meat handlers was low experienced in meat handling. Among the respondents, 58.46% were sellers, while no respondents had any training on butchery and food safety. All respondents worked at least three days a week and meat handling was the main occupation for all respondents. Most of the respondents (50.76%) had low media contact. The highest proportion (74.3%) of the respondents had medium (scores of 11 to 20) food safety knowledge. About 62.9% of the respondents had moderately favorable food safety attitude (scores of 28 to 54), while 60.0% of the respondents had medium food safety practices (scores of 15 to 28). The mean score of the food safety knowledge, attitude and practices was 18.65 ± 3.81, 50.71 ± 9.49 and 27.20 ± 3.22, respectively. This study shows that there is an identified gap in knowledge and correct practices among meat handlers and that there is a need to raise awareness about food safety through education programs regarding food safety and safe food handling practices. These findings can help public health professionals in developing initiatives to improve food safety knowledge and practices of meat handlers and prevent foodborne diseases (FBDs). The government should pay special attention for improving knowledge and ensuring proper food safety practices to avoid the transmission of FBDs in Khulna City.

For citation: Biswas G., Islam Md. S., Rahman S. M. M., Islam Md. M. (2024). Food safety knowledge, attitude and practices of meat handlers in Khulna City, Bangladesh. *Theory and Practice of Meat Processing*, 9(1), 24-31. https://doi.org/10.21323/2414-438X-2024-9-1-24-31

Introduction

Foodborne diseases (FBDs) occur both in developed and in developing countries, and each year 10% of the worlds' population falls ill and 420,000 people die after eating contaminated food [1]. In Bangladesh, FBDs are prevalent due to poor food handling practices, inadequate sanitation facilities, insufficient food safety legislation, weak regulatory systems, lack of financial resources to invest in food safety equipment, and lack of food handlers' education and knowledge. Microbiological agents causing infections, biotoxins and chemical pollutants in food pose significant health risks to millions of people [2,3]. Most FBDs are caused by animal-based foods. Worldwide, food safety is a great public health concern, especially when food is handled in a highly contaminated environment [3,4]. Food handlers should have solid food safety knowledge to prevent FBDs. Good knowledge and a positive attitude among food handlers, and proper food handling practices can help control FBDs [2,4]. In Bangladesh, food handlers' knowledge, attitude, and practice (KAP) concerning food safety and FBDs are essential in promoting food safety and safeguarding humans from FBDs. Red meat, which is rich in nutrients, is an appropriate substrate for the growth of a wide variety of microorganisms [5,6]. Food contamination is mostly caused by a poor food handler's health and hygienic practice, according to [7]. A KAP study is a representative study of a single community that uses questionnaires to collect data on what people know, believe, and do about a certain topic. In Bangladesh, there has been little research on vendors' awareness, attitudes, and experience regarding the presence of hazardous bacteria, such as *E. coli*, *Salmonella* sp., and *Staphylococcus aureus* in red meat, which can lead to food poisoning and spreading FBDs to humans [4,8,9,10,11]. Evidence from [3,12,13,14] shows that meat handlers with a greater understanding of food safety and suitable food handling methods have better food safety practices. However, there is also evidence of variations in food safety knowledge and practices among meat handlers. In a study similar to [13] meat handlers' educational level and professional training were positively associated with their knowledge and procedures pertaining to food safety [3]. Food handlers' training has been connected to food safety knowledge and practices, as well as sanitary and hygienic status, and product microbiological quality [15,16]. There are gaps in regular food safety training of handlers, notably training of under-supervised meat

handlers in butcher shops according to Bangladesh Food Safety Act 2013, which emphasizes knowledge-based food safety management systems. However, few studies have been conducted on the essential criteria that determine red meat handlers' KAP regarding food safety. These findings will support a better understanding of how the food safety KAP of handlers interacts across the country, as the study's purpose is to examine factors related to food safety KAP of red meat handlers in the Khulna City Corporation area, Bangladesh. These factors could hinder governments' abilities to accurately apply measures to address food contamination problems that affect public health. Therefore, this study was designed to assess food safety KAPs in meat handling in the Khulna City Corporation area, Bangladesh.

Material and Methods

Study area

Khulna is the third-largest city in Bangladesh, after Dhaka and Chittagong. It is the administrative center of Khulna District and Khulna Division. Khulna's economy is the third-largest in Bangladesh. In the 2011 census, the city had a population of 770,498 (male 423,496, female 347,002). The Khulna City Corporation area is 40.79 sq km, located between 24°45' and 24°54' north latitudes and between 89°28' and 89°35' east longitudes.

Sampling technique and data collection

A cross-sectional survey using a random sampling technique was conducted among 65 meat handlers from retail meat shops in Khulna City, Bangladesh (Figure 1). An interview schedule was developed in English for data collection. To obtain data on the identified variables, the interview schedule included both easy and straightforward questions. Before the final data collection, the interview schedule was pre-tested. Based on pre-test results, the necessary corrections, additions, changes, and re-arrangements were made in the interview schedule. The interview schedule was then finalized and multiplied to collect data.

An interview schedule was structured into four distinct parts including socio-demographic information including gender, age, level of education, year of experience, training on food safety/butchery, monthly income, family size, media contact/communication/organizational participation. For measuring a level of media contact of the respondents, 13 media types (radio, television, newspapers, online agricultural apps, CIG, clubs, tours, office call (ULO), office call (ADLO/DLO), mobiles, friends, relatives, neighbors) were incorporated in the interview schedule and the respondents were asked to indicate their level of media contact (regularly, often, occasionally, rarely and not at all) against 13 media types. Scores of 4, 3, 2, 1, and 0 were assigned to a level of media contact. Similarly, three places (houses of friends, relatives and others, other upazilla headquarters, other district towns) were incorporated for measuring the level of communication and six organizations (Govt. mentioned organization, NGO, Bazar committee, Masjid/Madrasha/Mandir, Co-operative society/society, CIG of DLS) were incorporated for measuring the level of organizational participation. Scores of 2, 1, and 0 were assigned for an executive member, general member and no membership, respectively.

Figure 1. Face-to-face interview of a meat handler

The second section was about food safety knowledge. Questions on food safety knowledge referred to their personal hygiene, symptoms of foodborne diseases, time-temperature control etc. For measuring the knowledge of the respondents, 15 questions were incorporated into the interview schedule and each question had three optional answers ("full", "half" and "don't know"). Scores of 2, 1and 0 were assigned to "full", "half" and "don't know", respectively. The knowledge score of a respondent was calculated by summing up all scores for 15 selected questions. The knowledge score could range from 0 to 30, where 0 indicates the lowest knowledge and 30 indicates the highest knowledge. Meat handlers that got an overall score of ≤10 points were considered to have low knowledge, those scored 11 to 20 points medium knowledge and ≥21 points high knowledge about food safety.

The third section was about food safety attitudes. For measuring an attitude of the respondents, 16 statements (8 +ve and 8 -ve) were incorporated in the interview schedule. A Likert Type 5-point rating scale (strongly agree, agree, undecided, disagree and strongly disagree) was employed against 16 statements. Scores of 5, 4, 3, 2 and 1 were assigned to positive statements and opposite scores (1, 2, 3, 4 and 5) were assigned to negative statements, respectively. An attitude score of a respondent was calculated by summing up all scores against 16 selected statements. The attitude score could range from 16 to 80 where ≤27 points indicate a less favorable attitude, 28 to 54 points indicate a moderately favorable attitude and ≥55 points indicate a highly favorable attitude.

The fourth section was about food safety practices. To measure the score of food safety practices of the respondents, 14 practices were included. The respondents were asked to indicate their level of food safety practices (regularly, occasionally, rarely and not at all) against 14 practices. Scores of 3, 2, 1 and 0 were assigned to a level of food

safety practices. The practice score of the respondents was calculated by adding all scores for 14 practices. The food safety practices score could be in a range from 0 (lowest scores) to 42 (highest scores) where ≤14 points indicate low food safety practices,15 to 28 points indicate medium food safety practices and ≥29 points indicate high food safety practices.

Statistical analysis

After collection, data were analyzed according to the objectives following the SPSS version 20. Statistical measures, such as number, percentage (%), range, standard deviation, and mean, were used to interpret the data.

Results

Sociodemographic characteristics of the respondents

The sociodemographic profiles of the respondents are summarized in Table 1. All respondents (100.0%; N = 65) were males. The mean age of the respondents was 36.22 ± 8.34, ranging between the ages of 19 to 53 years. Most of the respondents (42.9%) had secondary education, followed by a considerable amount of illiterate (22.0%) and primary education (22.0%). More than half (54.3%) of the respondents were sellers. The majority of the respondents (57.1%) had a monthly income of 13,000 BDT to 25,000 BDT. A greater number (42.9%) of respondents had working experience of up to 10 years with an average length of 16.00 ± 9.65 years. All respondents (100.0%; N=65) worked at least three times a week. No respondents had training in both food safety and butchery. Although most of the studies have shown that training may contribute to upgrading the food safety knowledge of food handlers, this does not always translate into a positive change in food handling behavior and attitudes [11,17]. Approximately 51.4% of the meat handlers had 5–6 family members with an average number of family members equal to 5.02 ± 2.06.

Media contact/communication/organizational participation

Media contact/ communication /organizational participation of the respondents are summarized in Table 2. Most of the respondents (54.3%) had low media contact

Table 1. Sociodemographic characteristics of the respondents

Characteristics	Categories	Number(N)	Percentage (%)	Mean ± SD	Range
Gender	Male	65	100		
	Female	0	0.0		
Age (Years)					
(Up to 35)	Young aged	33	50.76	36.22 ± 8.34	19–53
(36–50)	Middle aged	28	43.07		
(>50)	Old aged	4	6.15		
Level of education (Year of schooling)					
(0)	Illiterate	10	15.38		
(1–5)	Primary	17	26.15	6.14 ± 4.66	0–17
(6–10)	Secondary	29	44.61		
(11–12)	Higher Secondary	5	7.69		
(>12)	Above Higher Secondary	4	6.15		
Field of Duty	Helper	4	6.15		
	Seller	38	58.46		
	Entrepreneur	1	1.53		
	Entrepreneur and Seller	22	33.84		
	Butcher	0	0.0		
Monthly income					
Up to 12,000 BDT	Low	15	23.07	19.02 ± 7.50	12–40
13,000–25,000 BDT	Medium	37	56.92		
>25,000 BDT	High	13	20.0		
Year of experience					
Up to 10	Low	28	43.07	6.00 ± 9.65	1–38
11–20	Medium	19	29.23		
>21	High	18	27.69		
Working day per week					
1–2	One or two times a week	0	0.0		
3–6	At least three times a week	65	100.0		
7	Daily	0	0.0		
Food Safety Training	Yes	0	0.0		
	No	65	100.0		
Training on Butchery	Yes	0	0.0		
	No	65	100.0		
Family size					
Up to 4	Small	15	42.9	5.02 ± 2.06	2–15
5–6	Medium	18	51.4		
>6	Large	2	5.7		

followed by 45.7% of the respondents who had medium media contact. The mean score of the media contact was 19.37 ± 4.98 and the maximum score was 35. There was a medium communication among most of the respondents. The mean score of the communication was 4.29 ± 1.20 and the maximum score was 7. About 68.6% of respondents had low organizational participation and the mean score of the organizational participation was 4.29 ± 1.20. The maximum score was 8.

Table 2. Media contact/communication/organizational participation

	Scores	Categories	Number (N)	Percentage (%)	Mean ± SD	Range
Media contact	≤17 18–35 ≥36	Low Medium High	33 32 0	50.76 49.23 0.0	19.37 ± 4.98	13–35
Communication	≤3 4–6 ≥7	Low Medium High	22 39 4	33.84 60.00 6.15	4.29 ± 1.20	3–7
Organizational participation	≤4 5–8 ≥9	Low Medium High	45 20 0	69.23 30.76 0.0	4.69 ± 1.32	3–8

Food safety knowledge

The overall food safety knowledge of the respondents is summarized in Table 3. About 74.3% of respondents had a medium level of food safety knowledge with a mean score of 18.65 ± 3.81. Only 10.47% of respondents could name two health problems arising due to improper handling of meat. Most of the respondents (63.07%) knew what cleaning agents are used for washing hands. About 60.0% of the respondents knew how long meat remains safe without using preservatives. Among the respondents, 55.38% knew that diarrhea can be transmitted through food and they also knew how to prevent it. Respondents had the least knowledge about storage time without using preservatives (53.84%), the fact that irregular washing of hands before and after handling of meat causes health problems (30.76%), disinfectants used for disinfecting working surfaces and types of equipment (15.38%), main practices to keep food safe (38.46%), the fact that uncovered meat is more unsafe than covered meat (36.92%), food adulteration and commonly used adulterants in food (35.38%), health problems associated with food adulteration (26.15%), protective equipment used during meat processing (23.07%). Most of the respondents had good knowledge about safe water for washing meat (76.92%), changes in deteriorated meat (92.30%), and a refrigerator as an ideal place to store meat (55.38%).

Attitude about food safety

The overall food safety attitude of the respondents is summarized in Table 4. About 62.9% of respondents had a moderately favorable attitude toward food safety with a mean score of 50.71 ± 9.49. The highest score was 26 and the lowest score was 69. About 29.0% and 52.0% of respondents strongly agreed and agreed with the statement that people with open skin injury, gastroenteritis, and ear or throat diseases should not be allowed to touch/ handle meat. Only 3.07% of respondents disagreed that regular training can improve meat safety and hygiene practices. Only 10.76% of respondents agreed with the statement that wearing watches, earrings, and rings will increase the risk of meat contamination, whereas 26.15% of respondents strongly agreed that regular waste disposal reduces the risk of contamination. About 29.0% and 57.0% of respondents strongly agreed and agreed that keeping working surfaces and utensils clean reduces the risk of illness. Only 23.07% of respondents thought that knives, hooks and cutting boards can be a source of food contamination. An extremely small

Table 3. Food safety knowledge of the respondents

Knowledge	Percentage (Number)			
	Don't know	Half	Full	Total
Can you name two health problems arising due to improper handling of meat?	20.0(13)	69.23(45)	10.47(7)	100.0(65)
What are cleaning agents used for washing hands?	0.0(0)	36.92(24)	63.07(41)	100.0(65)
How long does your meat remain safe in an open place without using any preservative?	12.30(8)	26.15(17)	61.53(40)	100.0(65)
Is diarrhea transmitted through food? If yes, how to prevent it?	7.69(5)	36.92(24)	55.38(36)	100.0(65)
Is it possible to preserve meat for a long time without using any preservative? If yes, how will you do this?	3.07(2)	43.07(28)	53.84(35)	100.0(65)
Does irregular washing of hands before and after handling of meat cause any health problems? If yes what are the health problems?	3.07(2)	66.15(43)	30.76(20)	100.0(65)
What are the disinfectants used for disinfecting working surface and equipment?	23.07(15)	61.53(40)	15.38(10)	100.0(65)
Can you name two items of protective equipment used during meat processing?	46.15(30)	30.76(20)	23.07(15)	100.0(65)
Is pond water safe for washing meat? If not, what is the source of safe water?	4.61(3)	18.46(12)	76.92(50)	100.0(65)
Can you name three main practices to keep food safe?	3.07(2)	58.46(38)	38.46(25)	100.0(65)
Is uncovered meat more unsafe than covered meat? If yes what is the reason?	4.61(3)	58.46(38)	36.92(24)	100.0(65)
Is there any change in deteriorated meat? If yes, what type of changes occurs?	0.0(0)	7.69(5)	92.30(60)	100.0(65)
What is food adulteration? Can you name one commonly used adulterant in food?	18.46(12)	46.15(30)	35.38(23)	100.0(65)
What are the health problems associated with food adulteration?	12.30(8)	61.53(40)	26.15(17)	100.0(65)
Is a refrigerator an ideal place to store raw meat? If yes, what is the reason?	6.15(4)	38.46(25)	55.38(36)	100.0(65)
Mean score	18.65 ± 3.81			

percentage of respondents strongly agreed (6.15%) and agreed (7.69%) that drinking or eating in the workplace increases the risk of contamination. About 31.0% of respondents were undecided whether insects and pests can be a source of raw meat contamination. Most of respondents (58.0%) disagreed with the statement that wearing protective clothing and shoes does not improve work safety and hygiene practices. About 11.0% and 52.0% of respondents strongly agreed and agreed that the use of potable water to wash working surfaces and cutting tools is important.

About 28.0% of respondents strongly disagreed that working surfaces and equipment should not be cleaned before re-using for meat processing, whereas 16.92% of respondents strongly disagreed that covering the nose or mouth when sneezing or coughing cannot reduce contamination. A very low percentage (15.38%) of respondents agreed that inspecting meat for freshness and wholesomeness is not valuable. Only 7.69% of the respondents strongly agreed that high temperature or freezing is unsafe for meat preservation whereas only 3.07% of respondents strongly agreed that we should use non-potable water for meat processing. Almost none of the respondents disagreed that smoking in the workplace does not increase the risk of contamination (3.07%).

Food safety practices

Table 5 shows the food safety practices of the meat handlers. About 60.0% of the respondents had medium food safety practices with a mean score of 27.20 ± 3.22 where the lowest and highest scores were 19 and 3, respectively. It was found that 50.76% of the respondents washed their hands regularly before and after handling meat. About 85.0% of the respondents washed their hands regularly after handling waste/garbage and disposed waste regularly after working. Most of the respondents covered their meat (69.23%), used potable water to process meat or to wash working surfaces and cutting tools (100.0%), used a sanitizer when washing service utensils (knives, hooks and cutting boards) (53.84%), avoided meat processing when they were ill especially due to gastroenteritis, cough or skin diseases (58.46%), used soaps or detergents after using toilet (93.84%) regularly. Concerning using washing agents, 50.76% of respondents used washing agents such as soap or detergent when washing hands occasionally. Most of the respondents did not remove their jewelry materials while handling meat (53.84%), did not avoid smoking in the workplace (58.46%), and did not replace knives after each meat processing (55.38%). About 48.0% and 35.0% of the respondents checked their meat for freshness and wholesomeness regularly and occasionally, respectively. Concerning hand washing after sneezing or coughing, none of the respondents washed their hands regularly, whereas 30.76% and 38.46% of the respondents washed their hands occasionally and rarely, respectively.

Discussion

Unlike other food processing, males are most likely involved in meat processing [16,18,19]. This is also true for our finding. The mean age of the respondents in this study (36.22 ± 8.34) is lower than that in the studies conducted

Table 4. Food safety attitude of the respondents

Statement	Percentage (Number)					
	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Total
People with open skin injury, gastroenteritis, and ear or throat diseases should not be allowed to touch/ handle meat.	29.23(19)	52.30(34)	12.30(8)	6.15(4)	0.0(0)	100.0(65)
Regular training can improve meat safety and hygiene practices.	10.76(7)	58.46(38)	27.69(18)	3.07(2)	0.0(0)	100.0(65)
Wearing watches, earrings and rings will increase the risk of meat contamination.	0.0(0)	10.76(7)	58.46(38)	7.69(5)	23.07(15)	100.0(65)
Regular waste disposal reduces the risk of contamination.	26.15(17)	55.38(36)	7.69(5)	10.76(7)	0.0(0)	100.0(65)
Keeping working surfaces and utensils clean reduces the risk of illness.	29.23(19)	56.92(37)	6.15(4)	7.69(5)	0.0(0)	100.0(65)
Knives, hooks and cutting boards can be a source of food contamination.	0.0(0)	23.07(15)	30.76(20)	32.30(21)	13.84(9)	100.0(65)
Drinking or eating in the workplace increases the risk of contamination.	6.15(4)	7.69(5)	38.46(25)	24.61(16)	23.07(15)	100.0(65)
Insects and pests can be a source of raw meat contamination.	12.30(8)	21.53(14)	30.76(20)	29.30(19)	6.15(4)	100.0(65)
Wearing protective clothing and shoes does not improve work safety and hygiene practices.	3.07(2)	18.46(12)	20.0(13)	58.46(38)	0.0(0)	100.0(65)
It is not important to use potable water to wash working surfaces and cutting tools.	13.84(9)	7.69(5)	15.38(10)	52.30(34)	10.76(7)	100.0(65)
Covering the nose or mouth when sneezing or coughing cannot reduce contamination.	7.69(5)	13.84(9)	10.76(7)	50.76(33)	16.92(11)	100.0(65)
Working surfaces and equipment should not be cleaned before re-using for meat processing.	6.15(4)	9.23(6)	6.15(4)	50.76(33)	27.69(18)	100.0(65)
Inspecting meat for freshness and wholesomeness is not valuable.	0.0(0)	15.38(10)	33.84(22)	46.15(30)	4.61(3)	100.0(65)
High temperature or freezing is unsafe for meat preservation.	7.69(5)	9.23(6)	23.07(15)	53.84(35)	6.15(4)	100.0(65)
We should use non-potable water for meat processing.	3.07(2)	7.69(5)	15.38(10)	61.53(40)	12.30(8)	100.0(65)
Smoking in the workplace does not increase the risk of contamination.	35.38(23)	30.76(20)	30.76(20)	3.07(2)	0.0(0)	100.0(65)
Mean score	50.71 ± 9.49					

Table 5. Food safety practices of the respondents

Practices	Percentage (Number)				
	Regularly	Occasionally	Rarely	Not at all	Total
Do you wash your hands before and after handling of meat?	50.76(33)	49.23(32)	0.0(0)	0.0(0)	100.0(65)
Do you wash hands after handling waste/garbage?	84.61(55)	15.38(10)	0.0(0)	0.0(0)	100.0(65)
Do you dispose waste after working?	83.07(54)	16.92(11)	0.0(0)	0.0(0)	100.0(65)
Do you use washing agents such as soap or detergent when washing hands?	43.07(28)	50.76(33)	6.15(4)	0.0(0)	100.0(65)
Do you remove your jewelry materials while handling meat?	20.00(13)	15.38(10)	10.76(7)	53.84(35)	100.0(65)
Do you cover your meat?	69.23(45)	6.15(4)	3.07(2)	21.53(14)	100.0(65)
Do you check your meat for freshness and wholesomeness?	47.69(31)	35.38(23)	15.38(10)	3.07(2)	100.0(65)
Do you wash your hands after sneezing or coughing?	0.0(0)	30.76(20)	38.46(25)	30.76(20)	100.0(65)
Do you use potable water to process meat or to wash working surfaces and cutting tools?	100.0(65)	0.0(0)	0.0(0)	0.0(0)	100.0(65)
Do you avoid smoking in the workplace?	20.0(13)	13.84(9)	7.69(5)	58.46(38)	100.0(65)
Do you use a sanitizer when washing service utensils (knives, hooks and cutting boards)?	53.84(35)	30.76(20)	15.38(10)	0.0(0)	100.0(65)
Do you replace knives after each meat processing?	0.0(0)	0.0(0)	44.61(29)	55.38(36)	100.0(65)
Do you avoid meat processing when you are ill especially due to gastroenteritis, cough or skin diseases?	58.46(38)	18.46(12)	12.30(8)	10.76(7)	100.0(65)
Do you use soaps or detergents after using toilet?	93.84(61)	6.15(4)	0.0(0)	0.0(0)	100.0(65)
Mean score	27.20 ± 3.22				

by [20] (41.5 ± 9.5), [21] (43.9 ± 8.4), and [7] (43.9 ± 8.4) but higher than that in [22] (25.1 ± 9.6). In our study, the literacy rate of food handlers was higher than that in [19], but lower than the findings of other studies [20,23]. It has been found that none of the respondents attended training on food safety and butchery. Lack of training among food handlers has a negative consequence on performing behaviors [24]. Several studies mentioned that food safety trainings should be provided to improve the knowledge, attitude and safety practices of food handlers [20,25]. Our study has found that respondents had a medium level of food safety knowledge with a mean score of 18.65 ± 3.81, although this is higher than the findings of other studies [15,19]. Previous studies showed that food safety training increased knowledge regarding food safety issues [26]. Training and education may be effective tools to increase food safety knowledge among food handlers and thus improve food safety practices [17]. It is necessary to know the importance of proper meat handling, proper hand washing and other important hygienic procedures by meat handlers since meat handlers can serve as vehicles for cross-contamination and spread of foodborne pathogens [17]. According to [27], proper hand washing among meat handlers has a significant impact on reducing the threat of diarrheal disease transmission.

An attitude of meat handlers plays a key role influencing food safety practices that help to decrease the chance of foodborne disease outbreaks. The study carried out by [20], showed a strong linkage between positive attitudes and maintaining safe food handling practices. About 29.0% and 52.0% of meat handlers strongly agreed and agreed that a person with open skin injury, gastroenteritis, and ear or throat diseases should not be allowed to touch/ handle meat. Our findings are lower than those in other studies [13,19,28], in which 82.0%, 85.0% and 98.9% of respondents were aware of the risk of touching or handling meat by persons with open skin injury, gastroenteritis, and ear or throat diseases, respectively. About 69.0% and 63.0% of respondents thought that regular training can improve meat safety and hygiene practices, and it is important to use potable water to wash working surfaces and cutting tools. Our findings are lower than those in [19].

Food safety practices play a vital role in ensuring food safety and safeguarding a consumer from foodborne infection and intoxication. A higher percentage (93.84%) of the respondents in this study said that they used soaps or detergents regularly after using the toilet. In [19], about 86.8% of the meat handlers reported that they washed their hands after using the toilet.

Conclusion

The purpose of the study was to investigate the present status of knowledge, attitude and practices of the meat handlers regarding food safety in Khulna City. Meat handlers had unsatisfactory knowledge and practices with respect to food safety. It may be due to low media contact and communication, lack of training and low level of experience among the meat handlers in the study area. They need to improve their expertise, gain more work experience, increase training, increase media contact and communication. These factors are linked to better food safety awareness among meat handlers in Bangladesh. Training programs must be institutionalized with specific guidelines that cover food safety and meat hygiene topics to educate meat handlers better. Meat handlers play an important role in preventing food contamination that can develop into foodborne disease outbreaks. Meat handlers in Khulna City must handle meat properly to avoid food contamination. Finally, to reduce foodborne infections and diseases

in Bangladesh, intervention and longitudinal studies including large, diverse samples of Bangladeshi meat handlers, are needed to investigate characteristics associated with their food safety knowledge and practices. The findings of this study can help public health professionals in developing initiatives to improve food safety knowledge and practices of meat handlers and prevent FBDs. The government should pay special attention to improving knowledge and ensuring proper food safety practices to avoid the transmission of FBDs in Khulna City.

REFERENCES

1. WHO (2022). Food Safety Fact sheets. Retrieved from https://www.who.int/news-room/fact-sheets/detail/food-safety Accessed October 14, 2023
2. Abdullahi, A., Hassan, A., Kadarman, N., Saleh, A., Shu'aibu Y.B., Lua, P.L. (2016). Food safety knowledge, attitude, and practice toward compliance with abattoir laws among the abattoir workers in Malaysia. *International Journal of General Medicine*, 9, 79–87. https://doi.org/10.2147/IJGM.S98436
3. Nyamakwere, F., Muchenje, V., Mushonga, B., Kandiwa, E., Makepe, M., Mutero, G. (2017). Evaluation of meat safety knowledge, attitudes and practices among slaughter house workers of Amathole District in eastern Cape Province, South Africa. *Journal of Food Safety and Hygiene*, 3(1–2), 7–15.
4. Al-Ghazali, M., Al-Bulushi, I., Al-Subhi, L., Rahman, M. S., Al-Rawahi, A. (2020). Food safety knowledge and hygienic practices among different groups of restaurants in Muscat, Oman. *International Journal of Food Science*, 74, Article 8872981. https://doi.org/10.1155/2020/8872981
5. Bersisa, A., Tulu, D., Negera, C. (2019). Investigation of bacteriological quality of meat from abattoir and butcher shops in Bishoftu, Central Ethiopia. *International Journal of Microbiology*, 2019, Article 6416803. http://doi.org/10.1155/2019/6416803
6. Akinyera, B., Maimadu, A.A., Akinsulie, O.C., Olabode, M. P., Sabo, J. A., Osemeke, O. H. (2018). Microbial loads of beef and hygienic practice of butchers in Jos municipal abattoir. *Advances in Animal and Veterinary Sciences*, 1(4), 1–9. http://doi.org/10.9734/AJRAVS/2018/42570
7. Sharif, L., Al-Malki, T. (2010). Knowledge, attitude and practice of Taif University students on food poisoning. *Food Control*, 21(1), 55–60. https://doi.org/10.1016/j.foodcont.2009.03.015
8. Islam, M.A., Mondol, A.S., Azmi, I.J., de Boer, E., Beumer, R.R., Zwietering, M.H. et al. (2010). Occurrence and characterization of Shiga toxin–producing Escherichia coli in raw meat, raw milk, and street vended juices in Bangladesh. *Foodborne Pathogens and Disease*, 7(11), 1381–1385. https://doi.org/10.1089/fpd.2010.0569
9. Khairuzzaman, M., Chowdhury, F. M., Zaman, S., Al Mamun, A., Bari, M. L. (2014). Food safety challenges towards safe, healthy, and nutritious street foods in Bangladesh. *International Journal of Food Science,* 2014, Article 483519. http://doi.org/10.1155/2014/483519
10. Murshed, H.M., Al-Amin, M., Kabir, S.M.L., Rahman, S.M.E., Oh, D.-H. (2016). Quality and safety of meat and meat products available in Mymensingh, Bangladesh. *Journal of Meat Science and Technology*, 4(2), 61–70.
11. Faruque, O., Mahmud, S., Munayem, M., Sultana, R., Molla, M., Ali, M. et al. (2019). Bacteriological analysis and public health impact of broiler meat: A study on Nalitabari Paurosova, Sherpur, Bangladesh. *Advances in Microbiology*, 9(7), 581–601. https://doi.org/10.4236/aim.2019.97036
12. Gomes-Neves, E., Cardoso, C.S., Araújo, A.C., Correia da Costa, J. M. (2011). Meat handlers training in Portugal: A survey on knowledge and practice. *Food Control*, 22(3–4), 501–507. http://doi.org/10.1016/j.foodcont.2010.09.036
13. Al-Shabib, N.A., Mosilhey, S.H., Husain, F.M. (2016). Cross-sectional study on food safety knowledge, attitude and practices of male food handlers employed in restaurants of King Saud University, Saudi Arabia. *Food Control*, 59, 212–217. http://doi.org/10.1016/j.foodcont.2015.05.002
14. Wambui, J., Karuri, E., Lamuka, P., Matofari, J. (2017). Good hygiene practices among meat handlers in small and medium enterprise slaughterhouses in Kenya. *Food Control*, 81, 34–39. https://doi.org/10.1016/j.foodcont.2017.05.036
15. Adesokan, H.K., Raji, A.O.Q. (2014). 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.
16. Jubayer, M.F., Kayshar, M.S., Hossain, M.S., Uddin, M.N., Al-Emran, M., Akter, S.S. (2020). Evaluation of food safety knowledge, attitude, and self-reported practices of trained and newly recruited untrained workers of two baking industries in Dhaka, Bangladesh. *Heliyon*, 6(9), Article e05021. https://doi.org/10.1016/j.heliyon.2020.e05021
17. Ansari-Lari, M., Soodbakhsh, S., Lakzadeh, L. (2010). Knowledge, attitudes and practices of workers on food hygienic practices in meat processing plants in Fars, Iran. *Food Control*, 21(3), 260–263. http://doi.org/10.1016/j.foodcont.2009.06.003
18. Jianu, C., Golet, I. (2014). Knowledge of food safety and hygiene and personal hygiene practices among meat handlers operating in western Romania. *Food Control*, 42, 214–219. http://doi.org/10.1016/j.foodcont.2014.02.032
19. Tegegne, H.A., Phyo, H.W.W. (2017). Food safety knowledge, attitude and practices of meat handler in abattoir and retail meat shops of Jigjiga Town, Ethiopia. *Journal of Preventive Medicine and Hygiene*, 58(4), E320-E327. https://doi.org/10.15167/2421–4248/jpmh2017.58.4.737
20. Akabanda, F., Hlortsi, E.H., Owusu-Kwarteng, J. (2017). Food safety knowledge, attitudes and practices of institutional food-handlers in Ghana. *BMC Public Health,* 17, Article 40. https://doi.org/10.1186/s12889-016-3986-9
21. Soares, L.S., Almeida, R.C.C., Cerqueira, E.S., Carvalho, J.S., Nunes, I.L. (2012). Knowledge, attitudes and practices in food safety and the presence of coagulase-positive staphylococci on hands of food handlers in the schools of Camaçari, Brazil. *Food Control*, 27(1), 206–213. https://doi.org/10.1016/j.foodcont.2012.03.016
22. Farahat, M.F., El-Shafie, M.M., Waly, M.I. (2015). Food safety knowledge and practices among Saudi women. *Food Control*, 47, 427–435. http://doi.org/10.1016/j.foodcont.2014.07.045
23. Siau, A.M.F., Son, R., Mohhiddin, O., Toh, P.S., Chai, L. C. (2015). Food court hygiene assessment and food safety knowledge, attitudes and practices of food handlers in Putrajaya. *International Food Research Journal*, 22(5), 1843–1854.
24. Roberts, K.R., Barrett, B.B., Howells, A.D., Shanklin, C.W., Pilling, V.K., Brannon. L.A. (2008). Food safety training and foodservice employees' knowledge and behavior, *Food Protection Trends*, 28(4), 252–260.
25. Park, S.-H., Kwak, T.-K., Chang, H.-J. (2010). Evaluation of the food safety training for food handlers in restaurant operations. *Nutrition Research and Practice*, 4(1), 58–68. https://doi.org/10.4162/nrp.2010.4.1.58

26. Lynch, R.A., Elledge, B.L., Griffith, C.C., Boatright, D.T. (2003). A comparison of food safety knowledge among restaurant managers, by source of training and experience, in Oklahoma County, Oklahoma. *Journal Environmental Health*, 66(2), 9–14.
27. Xavier, C.A.C., Oporto C. F.O., Silva, M.P., Silveira I. A., Abrantes, M.R. (2007). Prevalence of Staphylococcus aureus in food handlers from grades schools located in Natal city, RN, Brazil. *The Brazilian Magazine of Clinical Analyses*,39(3), 165–168. (In Portuguese)
28. Zanin L. M., da Cunha D. T., Stedefeldt, E., Capriles, V.D. (2015). Seafood safety: Knowledge, attitudes, self-reported practices and risk perceptions of seafood workers. *Food Research International*, 67, 19–24. https://doi.org/10.1016/j.foodres.2014.10.013

AUTHOR INFORMATION

Gourpada Biswas, PhD Scholar, Agrotechnology Discipline, Khulna University. Khulna-9208, Bangladesh,
Tel: +88–0171–096–60–86, E-mail: gourbiswas2010@gmail.com
ORCID: https://orcid.org/0009-0009-9446-5821
* corresponding author

Md. Shafiqul Islam, Professor, Agrotechnology Discipline, Khulna University. Khulna-9208, Bangladesh.
Tel:+88–0171–119–07–98, E-mail: shafiqueatku@gmail.com
ORCID: https://orcid.org/0000-0003-2598-7254

S. M. Mahbubur Rahman, Professor, Biotechnology and Genetic Engineering Discipline, Khulna University.bKhulna-9208, Bangladesh. Tel: +88–0171–113–15–73, E-mail: manmr2018@gmail.com
ORCID: https://orcid.org/0000-0002-9505-6810

Md. Matiul Islam, Professor, Agrotechnology Discipline, Khulna University. Khulna-9208, Bangladesh.
Tel: +88–0171–701–50–74, E-mail: matiul_rubel@yahoo.com
ORCID: https://orcid.org/0000-0001-7892-4666

All authors bear responsibility for the work and presented data.

All authors made an equal contribution to the work.

The authors were equally involved in writing the manuscript and bear equal responsibility for plagiarism.

The authors declare no conflict of interest.