

Safe meat-handling knowledge, attitudes and practices of private and government meat processing plants' workers: implications for future policy

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Key words

Disease outbreak • Food handler • Public Health

Summary

Introduction. Food-borne disease outbreaks remain a major global health challenge and cross-contamination from raw meat due to poor handling is a major cause in developing countries. Adequate knowledge of meat handlers is important in limiting these outbreaks. This study evaluated and compared the safe meat-handling knowledge, attitudes and practices (KAP) of private (PMPP) and government meat processing plants' (GMPP) workers in south-western Nigeria.

Methods. This cross sectional study comprised 190 meat handlers (PMPP = 55; GMPP = 135). Data concerning their safe meat-handling knowledge, attitudes and practices as well as their socio-demographic characteristics, such as age, gender and work experience were collected.

Results. A significant association was observed between the type of meat processing plants and their knowledge ($p = 0.000$), attitudes ($p = 0.000$) and practices ($p = 0.000$) of safe meat-handling. Meat handlers in the GMPP were respectively, about 17 times ($OR = 0.060$, 95%CI: 0.018-0.203), 57 times ($OR = 0.019$, 95%CI: 0.007-0.054) and 111 times ($OR = 0.009$, 95%CI: 0.001-0.067) less likely to obtain good knowledge, attitude and practice level of safe meat-handling than those from PMPP. Further, KAP levels were significantly associated with age group, education and work experience ($p < 0.05$).

Discussion. Study findings suggest the need for future policy in food industry in developing countries to accommodate increased involvement of private sector for improved food safety and quality delivery. Public health education on safe food handling and hygiene should be on the front burner among food handlers in general.

Introduction

Food-borne illness remains a significant source of human disease [1]. Recent food safety failures have attracted widespread attention resulting in public confusion and mistrust of the food industry and regulators [2]. Food-borne diseases have caused a significant morbidity and mortality around the world [3]. World Health Organization (WHO) reports that 18% of children aged below 5 years old in developing countries die due to diarrhea globally [4].

Meanwhile, food contamination from raw meat is an important cause of food-borne disease outbreaks or food poisoning [5] due to improper food handling. Such contaminations often occur when food that does not require cooking such as salad is prepared on the same chopping board that has been used to prepare raw meat without adequate washing [3]. Cross-contamination can also occur when raw meat is stored above ready-to-eat meals. Thus, separating raw and cooked food and using safe raw materials are some of the five main keys to safer food as developed by the World Health Organization [6].

On the other hand, however, the potential contaminating effects from meat can be limited with proper handling by the meat handlers. As reported, food handlers are a major cause of food contamination [7]. Food-borne dis-

ease outbreaks reported in the United States for instance were associated with mishandling; with 79% from commercial or institutional establishments and 20% from homes [8]. Another report indicated the presence of *Escherichia coli* and *Staphylococcus aureus* on the hands of food handlers [9] while multi-drug resistant *Staphylococcus aureus* has been isolated from meat being sold for human consumption [10].

Despite the fact that the international food management agencies have already provided guidelines to member countries about safe handling procedures such as HACCP and Good Manufacturing Practices [11], the knowledge and perceptions of meat handlers on safe food handling in most developing countries particularly Nigeria remain largely unknown. Most studies [12, 13] conducted were based on food handlers in the restaurants, processed food establishments without any documented report on meat handlers; whereas, cases of food poisoning due to contaminated meat have been on the rise in recent years. The objective of this study was to evaluate and compare the safe meat-handling knowledge, attitudes and practices (KAP) of meat handlers between private and Government meat processing plants in south-western Nigeria. In addition, this paper was aimed at determining the relationship between the socio-demographic characteristics of the meat handlers and their KAP level.

Methods

STUDY SITE, DESIGN AND POPULATION

The study was carried out in Ibadan (7°21'N, 3°54'E), south-western Nigeria. This site is known with relatively high demand for meat [14], with meat being part of almost every diet. It has a high throughput municipal abattoir and other slaughter slabs owned by the Government in addition to privately owned meat processing plants (PMPP). This cross sectional study involved a total of 190 meat handlers. Of these, 135 from a population of 200 meat handlers in the Government meat processing plant (GMPP) and 55 from five of the 11 Local Government Areas where most PMPP were located volunteered to participate in the study after the study objectives had been communicated to them with technical assistance from the Veterinary Officer of the meat processing plant.

QUESTIONNAIRE ADMINISTRATION

A self-administered semi-structured questionnaire was designed to obtain data on meat handlers' knowledge, attitudes and practices of safe meat handling. The questionnaire included four parts. In the first part, we attempted to determine their socio-demographic profiles, with the ages of the respondents categorized into three groups while educational levels were classified into "none" (no formal education), low (received only primary education) and "high" (received education up to secondary or tertiary level). In addition, working experiences were categorized into four different levels. The second part had ten questions to determine their knowledge on safe meat handling. The third and fourth parts contained seven and ten questions to respectively determine their work place practices and attitudes to safe meat handling. A pre-test was carried out after which some of the questions were modified

in order to improve clarity. The potential participants were informed that they could choose either to participate in the study or not to. Consent was therefore obtained by their affirmative response to participation in the study.

DATA ANALYSIS

Data were analyzed using Stata 12. Knowledge and attitudes were scored with reference to answers to ten questions each. Correct responses were scored 1 and incorrect 0 and scores ranged between 0 and 10. Scores ≥ 5 were taken as good knowledge or attitudes while scores < 5 were taken as poor knowledge or attitudes. Practices related to safe meat handling were similarly scored based on seven questions with scores ≥ 4 taken as good practices and scores < 4 as poor practices. Chi-square test was used to determine the relationships between the socio-demographic characteristics of the meat handlers and their KAP levels and between the KAP levels and the type of meat processing plants. Statistical significance was assessed using p -values and all results were considered significant if $p \leq 0.05$. All variables significant at 10% significance level were included in the multivariate logistic regression model to determine the predictor variables for food handlers' KAP level. The odds ratios (OR) were reported with their 95% confidence intervals (CI).

Results

SOCIO-DEMOGRAPHICS OF THE PARTICIPANTS

The results show that more than 70% of the meat handlers were from GMPP and those within the age group 31-50 years comprised 47.4%. While 70% were males, 36.8% had low education and 35.3% had between 11-26 years of working experience.

Tab. I. Knowledge of safe meat-handling amongst meat handlers in private and Government meat processing plants.

Statements	Private		Government	
	Correct answers (%)	Incorrect answers (%)	Correct answers (%)	Incorrect answers (%)
Heard of the term HACCP.	23.6	76.4	0.0	100.0
Improper handling of meat could pose health hazards to consumers.	81.8	18.2	91.1	8.9
Insects and pests could be a source of contamination to raw meat.	81.8	18.2	65.2	34.8
Knew the symptoms associated with food poisoning.	100.0	0.0	4.4	95.6
Knew the causes of food borne illness.	63.6	36.4	56.3	43.7
Regular washing of hands during meat processing reduces risk of contamination.	72.7	27.3	94.1	5.9
High temperature or freezing is a safe method to destroy bacteria.	80.0	20.0	70.4	29.6
People with open skin injury, gastroenteritis, and ear or throat diseases should not be allowed to handle meat.	85.5	14.5	31.1	68.9
Washing and disinfection of working surfaces and tools are important to safety of meat.	87.3	12.7	34.8	65.2
Regular rotation of disinfectants for cleaning can reduce the risk of meat contamination from working surfaces and cutting tools.	50.9	49.1	1.5	98.5

KNOWLEDGE LEVEL OF MEAT HANDLERS ON SAFE MEAT-HANDLING

The majority from PMPP gave correct answers to most questions asked while those who gave correct answers from GMPP were only above average in five out the ten questions asked (Tab. I). Table II shows that 63.7% had good knowledge of safe meat-handling with significantly higher proportion of 94.6% from PMPP and 51.1% from GMPP ($X^2 = 31.877$; $p = 0.000$); the meat handlers in GMPP (OR = 0.060, 95%CI 0.018-0.203) being about 17 times less likely to demonstrate good knowledge than those from PMPP (Table III). In all, the age ($X^2 = 8.531$; $p = 0.014$), education ($p = 0.009$) and working experience ($p = 0.002$) were signifi-

cantly associated with knowledge level of safe meat handling (Tab. II). Meat handlers within age groups 31-50 years (OR = 0.387, 95%CI: 0.203-0.738) and ≥ 51 years (OR = 0.621, 95%CI: 0.204-1.886) were about 2.5 and 1.6 times less likely to obtain good knowledge level than those within 15-30 years. Similarly, those with high educational level (OR = 1.187, 95%CI: 0.845-4.145) were about two times more likely than those without any formal education. In addition, meat handlers within 4-10 years working experience (OR = 0.269, 95%CI: 0.089-0.813) and 11-20 years (OR = 0.147, 95%CI: 0.051-0.422) were respectively 3.7 and 6.8 times less likely to obtain good knowledge level than those within ≤ 3 years (Tab. III).

Tab. II. Relationship of meat handlers' knowledge, attitude and practice levels on safe meat-handling and their socio-demographic characteristics.

Variables	Knowledge				Attitudes				Practices				Total n (%)
	Good n (%)	Poor n (%)	X^2	p-Value	Good n (%)	Poor n (%)	X^2	p-Value	Good n (%)	Poor n (%)	X^2	p-Value	
Types of meat plants													
Private	52 (94.6)	3 (5.4)	31.877	0.000 ^a	50 (90.9)	5 (9.1)	92.440	0.000 ^a	54 (98.2)	1 (1.8)	67.313	0.000 ^a	55 (28.9)
Government	69 (51.1)	66 (48.9)			22 (16.3)	113 (83.7)			44 (32.6)	91 (67.4)			135 (71.1)
Age group													
15-30	62 (74.7)	21 (25.3)	8.531	0.014 ^a	51 (61.5)	32 (38.5)	35.265	0.000 ^a	59 (71.1)	24 (28.9)	22.633	0.000 ^a	83 (43.7)
31-50	48 (53.3)	42 (46.7)			19 (21.1)	71 (78.9)			32 (35.6)	58 (64.4)			90 (47.4)
≥ 51	11 (64.7)	6 (35.3)			2 (11.8)	15 (88.2)			7 (41.2)	10 (58.8)			17 (8.9)
Gender													
Male	82 (61.7)	51 (38.3)	0.790	0.374	43 (32.3)	90 (67.7)	5.832	0.016 ^a	62 (46.6)	71 (53.4)	4.371	0.037	133 (70.0)
Female	39 (68.4)	18 (31.6)			29 (50.9)	28 (49.1)			36 (63.2)	21 (36.8)			57 (30.0)
Level of education													
None	33 (63.5)	19 (36.5)	9.354	0.009 ^a	14 (26.9)	38 (73.1)	36.877	0.000 ^a	26 (63.5)	26 (36.5)	28.039	0.000 ^a	52 (27.4)
Low	36 (51.4)	34 (48.6)			13 (18.6)	57 (81.4)			21 (51.4)	49 (48.6)			70 (36.8)
High	52 (76.5)	16 (23.5)			45 (66.2)	23 (33.8)			51 (64.4)	17 (35.6)			68 (35.8)
Work experience (years)													
≤ 3	35 (87.5)	5 (12.5)	15.062	0.002 ^a	31 (77.5)	9 (22.5)	49.654	0.000 ^a	35 (87.5)	5 (12.5)	26.428	0.000 ^a	40 (21.0)
4-10	32 (65.3)	17 (34.7)			24 (49.0)	25 (51.0)			22 (44.9)	27 (55.1)			49 (25.8)
11-20	34 (50.8)	33 (49.2)			14 (20.9)	53 (79.1)			27 (40.3)	40 (59.7)			67 (35.3)
>20	20 (58.8)	14 (41.2)			3 (8.8)	31 (91.2)			14 (41.2)	20 (58.8)			34 (17.9)
Total	121 (63.7)	69 (36.3)			72 (37.9)	118 (62.1)			98 (51.6)	92 (48.4)			190 (100.0)

^aSignificant at $p < 0.05$ REF: Reference

Tab. III. Logistic regression predicting food handlers' safe meat handling with knowledge, attitude and practice levels as independent variables.

Variables	Knowledge		Attitudes		Practice	
	OR	CI	OR	CI	OR	CI
Types of meat plants						
Private	1.0 ^a (REF)		1.0 (REF)		1.0 (REF)	
Government	0.060	0.018-0.203	0.019	0.007-0.054	0.009	0.001-0.067
Age group						
15-30	1.0 (REF)		1.0 (REF)		1.0 (REF)	
31-50	0.387	0.203-0.738	0.168	0.086-0.329	0.224	0.118-0.426
≥ 51	0.621	0.204-1.886	0.084	0.018-0.0.390	0.285	0.097-0.835
Gender						
Male	^b N/A		1.0 (REF)		1.0 (REF)	
Female			2.168	1.150-4.086	1.963	1.038-3.711
Level of education						
None	1.0 (REF)		1.0 (REF)		1.0 (REF)	
Low	0.610	0.293-1.270	0.619	0.262-1.462	0.429	0.203-0.904
High	1.871	0.845-4.145	5.311	2.404-11.729	3.000	1.386-6.496
Work experience (years)						
≤ 3	1.0 (REF)		1.0 (REF)		1.0 (REF)	
4-10	0.269	0.089-0.813	0.279	0.110-0.706	0.116	0.039-0.347
11-20	0.147	0.051-0.422	0.077	0.030-0.198	0.096	0.033-0.277
> 20	0.205	0.064-0.651	0.028	0.007-0.114	0.100	0.031-0.319

^aREF: Reference^bN/A: Not applicable (Variable not significant at 10% significant level and was not entered into logistic model)

ATTITUDE LEVEL OF MEAT HANDLERS TO SAFE MEAT-HANDLING

Most of the meat handlers from PMPP had good attitudes towards the majority of the questions in contrast to the majority from GMPP (Tab. IV). Only 37.9% had good attitudes toward safe meat-handling with significantly higher proportion of 90.9% from PMPP and 16.3% from GMPP ($X^2 = 92.440$; $p = 0.000$) (Table II); with meat handlers in GMPP (OR = 0.019, 95%CI: 0.007-0.054) being about 57 times less likely to obtain good attitude level than those from PMPP (Tab. III). In all, the age ($p = 0.000$), gender ($p = 0.016$), education ($p = 0.000$) and working experience ($p = 0.000$) were significantly associated with attitude level toward safe meat-handling (Tab. II). Meat handlers within age groups 31-50 years (OR = 0.168, 95%CI: 0.086-0.329) and ≥ 51 years (OR = 0.084, 95%CI: 0.018-0.0.390) were respectively about 6 and 12 times less likely to obtain good attitude level than those within 15-30 years. The females (OR = 2.168, 95%CI: 1.150-4.086) were about two times more likely to obtain good attitude level than the males. Similarly, those with high educational level (OR = 5.311, 95%CI: 2.404-11.729) were about five times more likely to obtain good attitude level than those without any formal education. In addition, meat handlers within 4-10 years working experience (OR = 0.279, 95%CI: 0.110-0.706) and 11-20 years (OR = 0.077, 95%CI: 0.030-0.198) were respectively about 3.6 and 13 times less likely to obtain good attitude level toward safe meat-handling than those within ≤ 3 years (Tab. III).

PRACTICE LEVEL OF MEAT HANDLERS ON SAFE MEAT-HANDLING

Table V shows that the majority of the meat handlers from PMPP had correct practices in most of the areas contrary to the poor practices by those from GMPP. Table II reveals that only 51.6% had good practice level of safe meat-handling with a higher proportion of 98.2% from PMPP and a much lower 32.6% from GMPP ($X^2 = 67.313$; $p = 0.000$); the meat handlers in GMPP (OR = 0.009, CI 0.001 – 0.067) being about 111 times less likely to obtain good practice level than those from PMPP (Tab. III). In all, the age ($p = 0.000$), gender ($p = 0.037$), education ($p = 0.000$) and working experience ($p = 0.000$) were significantly associated with practice level of safe meat-handling (Tab. II). Meat handlers within age groups 31-50 years (OR = 0.224, 95%CI: 0.118-0.426) and ≥ 51 years (OR = 0.285, 95%CI: 0.097-0.835) were about 4.5 and 3.5 times less likely to obtain good practice level than those within 15-30 years; the females (OR = 1.963, 95%CI: 1.038-3.711) being about two times more likely than the males. Similarly, those with high educational level (OR = 3.000, 95%CI: 1.386-6.496) were three times more likely to obtain good practice level than those without any formal education. In addition, meat handlers within 4-10 years' working experience (OR = 0.116, 95%CI: 0.039-0.347) and 11-20 years (OR = 0.096, 95%CI: 0.033-0.277) were respectively 8.6 and 10.4 times less likely to obtain good practice level of safe meat-handling than those within ≤ 3 years (Tab. III).

Tab. IV. Attitudes toward safe meat-handling amongst meat handlers in private and Government meat processing plants.

Statements	Private			Government		
	Yes (%)	No (%)	Uncertain (%)	Yes (%)	No (%)	Uncertain (%)
We should not handle meat with an open wound.	83.6	5.5	10.9	23.7	58.5	17.8
Sneezing or coughing without covering our noses or mouth could contaminate the meat.	80.0	5.5	14.5	20.7	73.3	5.9
Regular training could improve meat safety and hygiene practices.	89.1	7.3	3.6	22.2	54.1	23.7
Wearing protective clothing and shoes could help improve work safety and hygiene practices.	80.0	14.6	5.4	19.3	52.6	28.1
Putting on hair cover on the head is a good practice in food industry.	87.3	3.6	9.1	17.8	48.9	33.3
It is important to use potable water to wash working surfaces and cutting tools after disinfection.	87.3	10.9	1.8	84.4	10.4	5.2
We should not use non-potable water for meat processing.	56.4	38.1	5.5	86.7	10.4	2.9
Meat handlers can only contaminate meat when they are ill.	47.3	47.3	5.4	10.4	39.2	50.4
Meat handlers can get ill if they have contact only with the blood of animals during work activity.	47.3	23.6	29.1	3.0	60.7	36.3
Changing or sterilizing the knives in-between meat processing could limit cross contamination of meat.	49.1	29.1	21.8	5.2	78.5	16.3

Tab. V. Practices of safe meat-handling amongst meat handlers in private and Government meat processing plants.

Statements	Private		Government	
	Correct answers (%)	Incorrect answers (%)	Correct answers (%)	Incorrect answers (%)
I wash my aprons after each day's work.	47.3	52.7	3.7	96.3
I replace my knives or sterilize them after each meat processing.	58.2	41.8	0.0	100.0
I wash my hands before and after handling meat.	78.2	21.8	41.5	58.5
I use potable water to process meat.	81.8	18.2	97.8	2.2
I protect any skin cut I sustain whenever I want to process meat.	85.5	14.5	45.9	54.1
I do not process meat when I am ill especially due to gastroenteritis, cough or skin diseases.	76.4	23.6	33.3	66.7
I freeze my left-over meat after each day's work.	92.7	7.3	97.8	2.2

Discussion

Adequate safe meat-handling knowledge and perception of meat handlers is very key to the overall safety and quality of food delivered on the table to man. The findings of this formative study provide a framework for future policy geared toward improving food safety and hence the health of man. As indicated, the type of meat plants was significantly associated with knowledge ($p = 0.000$), attitude ($p = 0.000$) and practice ($p = 0.000$) levels of safe meat-handling. The meat handlers in the PMPP had significantly higher good knowledge, attitude as well as practice level of safe meat-handling than those in the GMPP. This finding is a pointer to the observation that private establishments are generally better organized and tend to provide better quality services and products than the Government-owned facilities. The report of Irfan and Ijaz [15] which revealed that the private establishments in Pakistan were delivering better quality services than the public or Government establishment

further substantiated this finding. This might be consequent upon better supervision which often characterizes private establishments when compared to those owned by the Government. In addition, private facilities generally strive to gain competitive edge and remain on top and hence tend to provide superior services to their clients. The lower KAP levels among the meat handlers in the GMPP is a matter of public health concern since the bulk of meat supplied for human consumption particularly in the study area and in most developing countries is from the GMPP. As earlier stated, the GMPP in this study is a high throughput meat processing plant compared to the lower volumes of animals processed by all the PMPP combined. This therefore portends higher exposure risks considering the volume of consumers served by the plant.

From our study, only a few (23.6%) and none (0.0%) of the meat handlers from the PMPP and GMPP respectively had heard of HACCP. This is similar to the report of Gomes-Neves et al. [16] which showed that a

high proportion of meat handlers in Portugal were unacquainted with the concept. It seems to be very difficult therefore to implement an HACCP based system in meat processing industry in developing countries where a high proportion of employees are not familiar with the concept. Again, while Meyer [17] underscored the need for regular rotation of products for the purpose of disinfection, poor proportions gave correct responses regarding regular rotation of disinfectants. This observation coupled with the low dosages of disinfectants often being used generally in food establishments in a bid to reduce overhead costs therefore raises some concerns considering the possible resultant emergence of resistant pathogens.

Similar to the 83.6% of the meat handlers in PMPP who had correct attitudes toward avoiding handling meat with an open wound, Abdul-Mutalib et al. [3] reported that 95.3% of food handlers in Kuala Pilah, Malaysia agreed that food should not be touched with wounded hand. Although the hands of food handlers have been generally known as an important vehicle of food cross-contamination [9]; our results revealed that a much lower than half of meat handlers from GMPP washed their hands before and after handling meat. Improved personal hygiene and scrupulous hand washing should lead to the basic control of spread of potentially pathogenic transient microorganisms [9]. Besides, the practice of not replacing knives or sterilizing them after each meat processing by all the meat handlers from GMPP is a matter of public health concern. As reported, using the same utensils like cutting board or knife can cause cross contamination [3].

Furthermore, our findings show that the meat handlers in lower age groups generally demonstrated good knowledge, attitudes and practices of safe meat-handling. These findings are similar to the report [18] which indicated that age influenced food handlers' attitudes toward food hygiene. Therefore, incorporating younger age groups into the food industry by food hygiene policy makers should lead to improved food safety and quality delivery to the consumers.

In the same vein, the findings of this study show that gender influences meat handlers' attitudes and practices of safe meat-handling. This is consistent with a previous report [19] which indicated a significant difference in the mean percentage scores for KAP between male and females with the females scoring significantly better than the males on food safety knowledge and practices. Likewise, Altekruze et al. [18] reported that unsafe practices were reported more often by men and adults than by women.

Furthermore, this study reveals that the level of education is significantly associated with the knowledge, attitude and practice levels of safe meat-handling. This finding is in agreement with the report of Ansari-Lari et al. [20] who found that knowledge was significantly higher among food handlers with a higher educational level. Similarly, Abdul-Mutalib et al. [3] recommended that continuous education would strengthen knowledge of food hygiene. Again, the meat handlers with lower

years of working experience obtained significantly higher knowledge, attitude and practice levels of safe meat-handling. This is contrary to the report [13] that the food handlers with longer years in food establishment had better practice of food hygiene and safety. However, our findings are in agreement with Lin and Sneed [21] who found a negative correlation between personal hygiene practices and length of employment in the food facility. Our finding suggests that there appears to be a general laxity among meat handlers as the length of time spent in food establishments increases. The tendency to therefore take learning new instructions or guidelines for improved food safety and quality delivery for granted might ensue.

Our findings notwithstanding, this study had some limitations. One, the issue of professional training among the meat handlers was not captured. This would have provided more insights into the impacts of training on the meat handlers' knowledge, attitude and practice levels of safe meat-handling. Two, the males constituted more of the respondents in this study. However, it is generally known that such activities as meat processing which require physical strength are generally dominated by the males.

Conclusions

This study provides a framework for future policy geared toward improving food safety and hence the health of man. The authors propose that while the significance of intensifying general food safety awareness campaigns cannot be underestimated, increasing the involvement of private sector in the food industry especially in the developing countries holds the promise of improved safety and quality delivery. Our findings also show that higher education, lower years of working experience and younger age groups significantly enhance safe meat-handling knowledge, attitude and practice levels among meat handlers. It is therefore pertinent that Public Health education and regular refresher course on safe meat-handling and general hygiene should be intensified among meat handlers. In the same vein, the people in the lower age groups should be engaged more in the handling of food in the food industry.

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