

MEAT SAFETY KNOWLEDGE, ATTITUDE, AND PRACTICES OF POULTRY SLAUGHTERHOUSE WORKERS IN BORDJ BOU ARRERIDJ PROVINCE, ALGERIA

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Abstract

Meat handlers play a crucial role in preventing meat contamination and the spread of meat-borne diseases by following proper hygiene practices. This study aims to assess the level of knowledge, attitudes, and practices (KAPs) of 89 workers in 11 operational poultry slaughterhouses, located in Bordj Bou Arreridj region (Algeria). A cross-sectional study was conducted between February, 2024 and May, 2024, using a structured questionnaire and face-to-face interviews to collect data. The results showed that all respondents (100 %) were male, and all of them lacked formal food safety training, and over one-third of them (35.9 %) had a high level of education. The mean scores for workers' knowledge, attitudes, and practice were 9.90 ± 3.77 , 16.21 ± 3.07 , and 57 ± 8.7 , respectively. The results indicated that most participants (78.7 %) displayed insufficient knowledge, particularly on foodborne pathogens (21.6 %) and foodborne diseases (26.1 %). Although 78.7 % of workers had positive attitudes, 71.9 % of them were using poor practices regarding personal hygiene and obligation of wearing appropriate protective clothes. The level of education significantly associated with the KAP levels ($p = 0.000$, $p = 0.002$, and $p = 0.000$, respectively). In addition, a significant positive correlation was observed between knowledge and attitudes ($r_s = 0.563$, $p < 0.001$), as well as between knowledge and practices ($r_s = 0.389$, $p < 0.001$). These findings indicate that regular practical training is imperative for improving the knowledge, attitudes, and practices (KAPs) of meat handlers regarding meat safety and for preventing meat-borne diseases in the study area.

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Introduction

Foodborne diseases are a significant global issue, affecting approximately 600 million individuals and causing 420,000 deaths each year [1]. These diseases also lead to an estimated US\$110 billion in losses in terms of productivity and medical expenses in low- and middle-income countries, thus making them a global health issue and economic burden [2]. Foods of animal origin, particularly meat, are most often considered to be the cause of food poisoning [3].

White meat is an essential part of the human diet since it is an important source of animal protein, vitamins, minerals, and essential amino acids. Due to its nutritional value and reasonable price, it is widely consumed around the world and is considered the most popular meat in Algeria compared to other types of meat [4]. However, it is often contaminated with microorganisms, mainly with bacteria

such as *Campylobacter* spp., *Salmonella* spp., *Escherichia coli* O157: H7, *Staphylococcus aureus*, and *Listeria monocytogenes*, causing serious public health problems [5,6]. Furthermore, the sources of contamination by these pathogens are variable; they can originate from sick animals, the production environment, from the meat handlers, and from the contaminated water used during the slaughtering process. [7,8]. Therefore, preventing animal diseases and implementing strict hygiene policies during meat production are both essential for reducing the incidence of meat-borne diseases [8,9].

Meat handlers play a vital role in the cross-contamination of meat. In addition to acting as vectors for numerous pathogens derived from the slaughter environment, such as contaminated tools or the animals themselves, they can serve as reservoirs for various pathogenic bacteria,

including *Staphylococcus aureus*, which can colonize their hands and noses [10]. Foodborne outbreaks caused by *Staphylococcus aureus* associated with human-induced contamination pose a threat to consumers' health, particularly those concerning methicillin-resistant *Staphylococcus aureus* (MRSA) [11]. While good hygiene practices, such as proper hand washing with antimicrobial soap and wearing intact clean gloves when handling food, play an important role in preventing the transmission of foodborne pathogens [12,13].

Results of the surveys on the knowledge, attitudes, and practices of food handlers are widely used around the world; they serve as a diagnostic tool that can be used to identify weak points in food safety in order to recommend effective training and solutions to prevent food poisoning [14]. Several studies addressing various topics related to poultry meat safety in poultry slaughterhouses have been conducted in different regions of Algeria [15,16]. However, to our knowledge, no research has focused on the KAP of the workers in slaughterhouses or in other food businesses in the country. Thus, this study aims to assess the knowledge, attitudes, and practices of meat handlers in poultry slaughterhouses regarding meat safety and to examine the impact of participants' socio-demographic characteristics on their KAP level.

Objects and methods

Study design

A cross-sectional study was conducted between February, 2024 and May, 2024 to assess the level of knowledge, attitudes, and practices of the meat handlers, who worked in 11 operational poultry slaughterhouses located in Bordj Bou Arreridj province, northeast Algeria. This province is acknowledged as the third-largest poultry producer in the country, with an annual production exceeding 35,000 tons [17].

Sample group size

First, contact was made with the veterinary services of the Bordj Bou Arreridj province to explain the purpose of the study, identify the location of poultry slaughterhouses, and estimate the number of workers, which was equal to 104. Next, a sample group of 82 people was calculated using the Yamane formula [18]:

$$n = \frac{N}{1 + N(e)^2}, \quad (1)$$

where,

n: sample size;

N: population size;

e: level of precision at 95 % confidence interval.

Out of 104 workers, only 89 agreed to participate in this study, representing a response rate of 85.57 %.

Questionnaire

Based on previously published meat safety studies [19,20], a structured questionnaire that consists of four

sections was adopted and adjusted in English first, and then it was translated into the local language (Arabic) in order to achieve the aim of this study. The first section included 8 questions related to socio-demographic profiles of the workers (such as gender, age, educational level, work experience, marital status, employment status, and food safety training). The second section examined a workers' knowledge on meat safety, using 20 closed questions focused on personal hygiene, cross contamination, food-borne pathogens, meat-borne illnesses, and time-temperature control. Each question was provided with three optional answers: "true", "false" and "I don't know". The third section aimed to investigate the attitudes of the workers toward good hygiene practices using also 20 statements with three possible choice answers: "agree", "disagree" and "uncertain". Participants' practices were assessed through self-reported practices in the last sections of the questionnaire. This section had 18 questions addressing their hygiene practices and their wearing of protective cloth during the work. Each question required five levels of answers (never, rarely, sometimes, often, and always).

For the knowledge and attitude sections, a score of one point was awarded for each correct answer or statement, whereas the rest of the responses obtained zero. On the other hand, for the practices section, correct responses were scored from 1 (never) to 5 (always), and reversed scoring was employed for items 1, 2, 15, 16, 17, and 18. The total score of each participant was calculated by summing up the correct answers, and the range of scores for Meat Safety Knowledge (MSK), Meat Safety Attitude (MSA), and Meat Safety Practice (MSP) sections was 0–20, 0–20, and 18–90, respectively. Based on the established method [21], the total score was converted to 100 %, and graded as poor (<70 %) or good (≥70 %).

To improve the clarity of the questionnaire, a pre-test was conducted with 15 workers at a slaughterhouse located outside the study area. Based on their feedback, minor modifications were carried out for the final version of the questionnaire. However, the results of this pilot study were not included in the final data pool.

Data collection and statistical Analysis

In order to ensure the accuracy of the responses, a face-to-face interview was carried out by the first author with the assistance of veterinary inspectors during routine slaughterhouse inspections to encourage the workers' participation in this study. First, data was entered on Microsoft Excel and then analyzed through SPSS (Statistical Package for Social Sciences) Version 16. The study provided descriptive statistics (frequency and mean value). Chi-square (χ^2) was used to find the relationship between the socio-demographic profile of the participants and their KAP levels, while Spearman's correlation coefficient was also applied to check the correlation between knowledge, attitudes, and practices scores. A *p*-value < 0.05 was considered statistically significant for all tests.

Ethical consideration

This research was reviewed and approved by the scientific committee of the Agri-food department, faculty of natural and life sciences at the University of Saad Dahlab Blidah (Approval No.105/DSA/2023). Moreover, the permission to conduct the study was provided by the veterinary services department of Bordj Bou Arreridj state (Approval No. 1472/IVW/2023). Verbal consent was obtained after a clear explanation of the purpose of the study to all slaughterhouse workers, ensuring them in anonymity and confidentiality of their data in compliance with the World Medical Association's Code of Ethics Declaration of Helsinki [22].

Results

Demographic characteristics of the participants are illustrated in Figure 1. All respondents (100 %) were male and were untrained in food safety, but had their regular health check-up every 6 months, except for 4 people newly recruited. Out of 89 meat handlers involved, more than a third (36 %) were over 40 years old, while none of them was younger than 20 years. The study revealed that one-fourth of respondents (24.7 %) had high-level education and 11.2 % had graduated from a university. Additionally, approximately 44 % of total workers surveyed have less than 5 years of work experience in this sector. Nearly half of respondents (44.9 %) are daily workers, and the majority of them (71.9 %) are married.

Figure 2 summarizes the level of respondents' knowledge categories on meat safety (results for each question were provided as supplemental material). The mean score (SD) for the workers' knowledge was 9.90 (3.77), ranging between 1 and 19 points. However, a high percentage of correct answers (86.2 %) and (68.5 %) were obtained for the questions related to personal hygiene and cross-contamination, respectively. However, the majority of employees possessed poor knowledge of foodborne pathogens (21.6 %) and foodborne diseases (26.1 %). In addition, the workers were least aware on temperature and time control (42.7 %).

Attitude results are summarized in Table 1. The mean score (SD) for the workers' attitude was 16.21 (3.07), ranging between 10 and 20 points. Nearly all the respondents (97.8 %) agreed that washing hands and surfaces before starting work and disinfecting the working knives between meat processing are important practices that reduce the risk of meat contamination. In addition, 94.4 % of workers confirmed that they should use gloves while working, especially when they have injured hands, and they should cover mouths and noses when coughing or sneezing. In contrast, only a few workers disagreed with the following statements: workers can only contaminate meat when they are sick (12.4 %); wearing rings or watches during work increases the risk of meat contamination (18.0 %), and neither smoking (16.9 %), no rubbing hands over face or hair (19.1 %) while working contaminate meat.

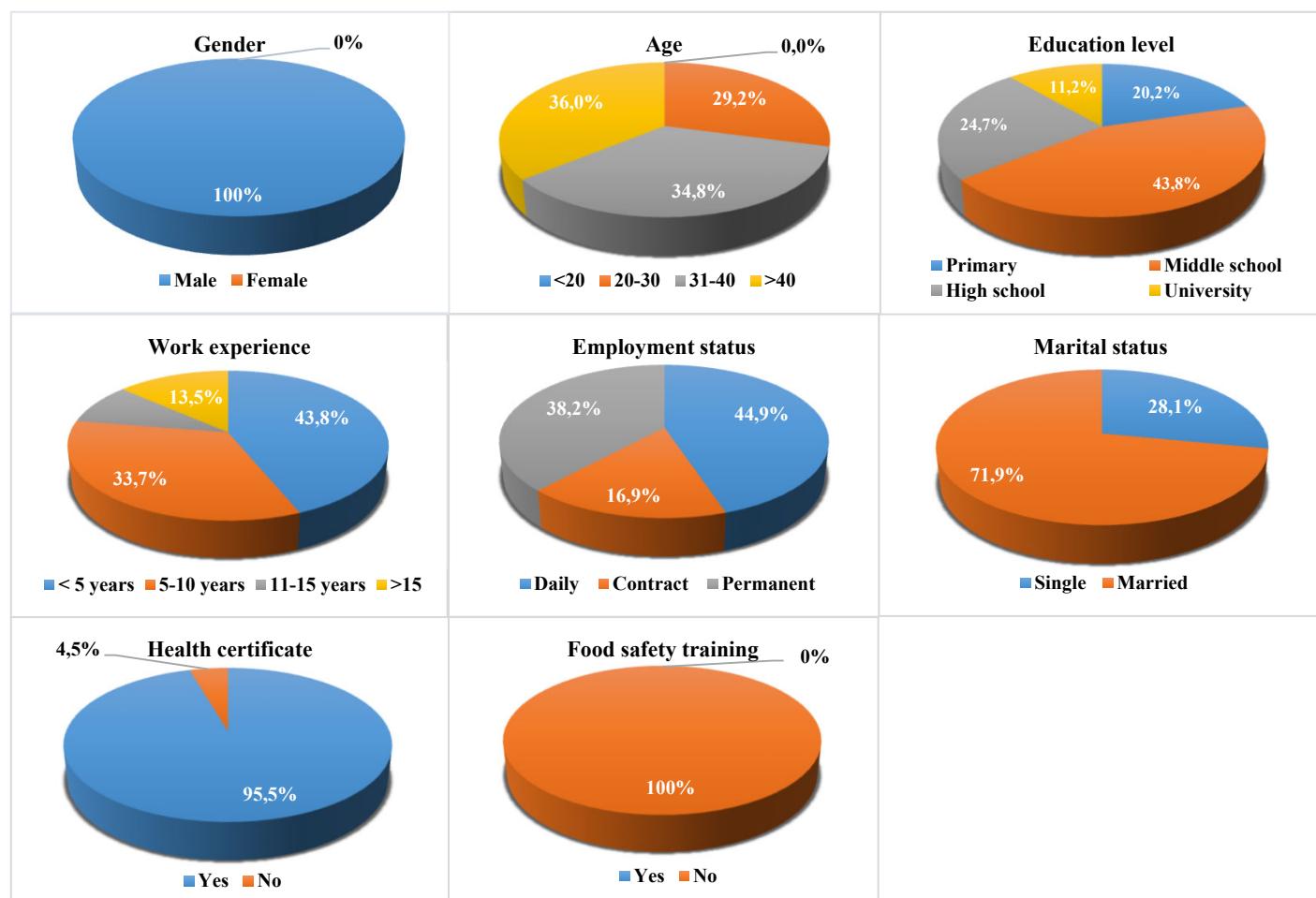


Figure 1. Socio-demographic profiles of a poultry slaughterhouse workers ($n = 89$)

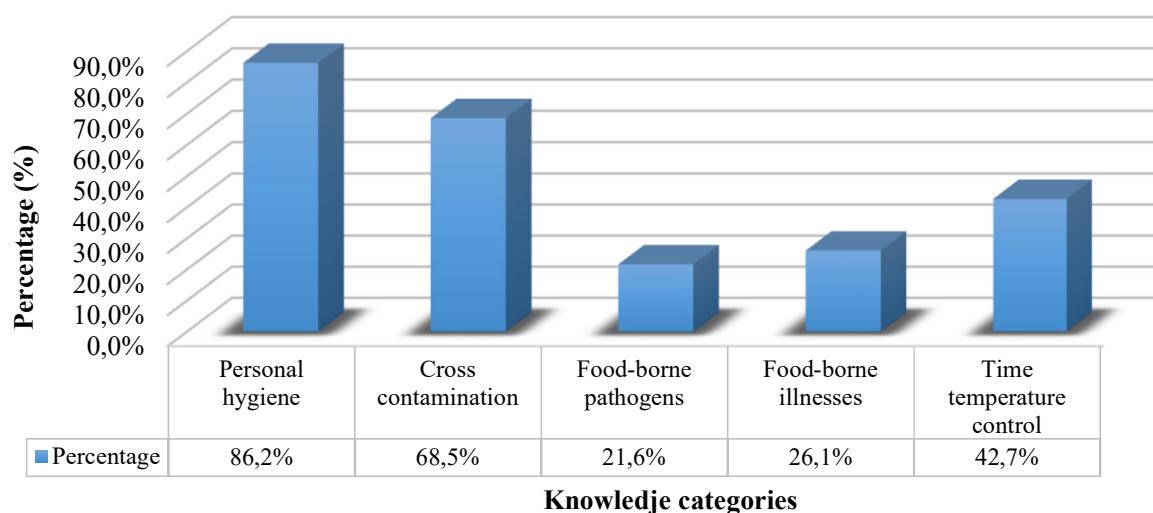


Figure 2. Meat handler's correct responses (%) according to different knowledge categories

Table 1. Summary of responses on meat safety attitude statements of 89 workers in poultry slaughterhouses, Bordj Bou Arreridj province, Algeria

	Attitude statements	Responses, n (%)		
		Agree	Disagree	Uncertain
A1	Foodborne illnesses can have harmful effects on a community's health and economy.	78 (87.6)	—	11 (12.4)
A2	Safe meat handling to prevent food-borne illnesses is part of your job responsibilities.	66 (74.2)	11 (12.4)	12 (13.5)
A3	Workers with injured hands must not touch meat without gloves.	84 (94.4)	2 (2.2)	3 (3.4)
A4	Workers can only contaminate meat when they are sick.	51 (57.3)	11 (12.4)	27 (30.3)
A5	Wearing rings or watches during work increases the risk of meat contamination.	58 (65.2)	16 (18)	15 (16.9)
A6	Using gloves is an important practice to improve meat safety.	84 (94.4)	1 (1.1)	4 (4.5)
A7	Wearing apron is an important practice to improve meat safety.	78 (87.6)	7 (7.9)	4 (4.5)
A8	Wearing masks is an important practice to improve meat safety.	77 (86.5)	6 (6.7)	6 (6.7)
A9	Wearing caps is an important practice to improve meat safety.	66 (74.2)	17 (19.1)	6 (6.7)
A10	Proper hands washing before starting work reduces the risk of meat contamination.	87 (97.8)	—	2 (2.2)
A11	Workers should cover their mouths and noses when coughing or sneezing.	84 (94.4)	—	5 (5.6)
A12	Workers should not smoke during work.	58 (65.2)	15 (16.9)	16 (18)
A13	Workers should not rub their hands on face, hair, etc. during work.	47 (52.8)	17 (19.1)	25 (28.1)
A14	Health status of the workers should be evaluated before employment.	77 (86.5)	3 (3.4)	9 (10.1)
A15	Food safety training for workers could improve meat safety and hygiene practices.	71 (79.8)	4 (4.5)	14 (15.7)
A16	Work surfaces and utensils should be properly cleaned before starting work.	87 (97.8)	—	2 (2.2)
A17	Knives should be properly sanitized or changed between meat processing to prevent meat contamination.	87 (97.8)	—	2 (2.2)
A18	Workers should use potable water to wash working surfaces and cutting tools after disinfection.	81 (91)	3 (3.4)	5 (5.6)
A19	Refrigerator temperature should be checked periodically to reduce risk of meat contamination.	81 (91)	—	8 (9)
A20	Improper meat storage can cause health issues for the consumers.	81 (91)	—	8 (9)
Total		16.21 ± 3.07 ^a ; (10-20) ^b		

^aMean score ± SD. ^b (Min-Max)

According to the self-reported practice results (Table 2), the mean score (SD) for the workers' practice was 57 (8.7), ranging between 40 and 75 points. Only 33.7 % and 60 % of workers do not eat/drink or smoke while working inside the slaughterhouse, respectively. Considering handwashing practices, less than half of respondents reported that they sometimes wash their hands before work (39.3 %), after a rest time (43.8 %), or after smoking, sneezing, or coughing (48.3 %). This study also found that a high percentage of participants always or often washed their hands properly after handling waste (85.4 %) and using the toilet (94.4 %), but 84.5 % of them never or rarely take off their equipment/clothes when using the bathroom. In addition, slightly more than half (51 %) never use masks, and the majority (83.1 %) do not use hair covers while working.

Chi-square (χ^2) test was performed to assess the association between respondents' demographic characteristics and their meat safety KAP levels (Table 3). The results reveal that the majority of participants had a poor level of knowledge (78.7 %) and practice (71.9 %), while 78.7 % had a good level of attitude regarding meat safety. In our study, education level was significantly associated with knowledge level ($\chi^2 = 14.933$; $p = 0.000$), attitude level ($\chi^2 = 9.882$; $p = 0.002$), and practice level ($\chi^2 = 19.615$; $p = 0.000$). On the other hand, work experience showed a significant relationship with attitude level ($\chi^2 = 6.911$; $p = 0.032$). Overall, age, marital status, and professional status were not significantly associated with the KAP levels of practice of safe meat handling.

Table 2. Summary of responses on meat safety practice statements of 89 workers in poultry slaughterhouses, Bordj Bou Arreridj province, Algeria

	Practices Statements	Responses, n (%)				
		Never	Rarely	Sometimes	Often	Always
P1	Do you eat or drink while working in the slaughterhouse?	30 (33.7)	11 (12.4)	41 (46.1)	4 (4.5)	3 (3.4)
P2	Do you smoke while working in the slaughterhouse?	53 (60)	7 (7.9)	15 (16.9)	8 (9)	6 (6.7)
P3	Do you wash your hands properly before starting work?	4 (04)	8 (9)	35 (39.3)	26 (29.2)	16 (18)
P4	Do you wash your hands before returning to work after a break?	5 (06)	27 (30.3)	39 (43.8)	7 (7.9)	11 (12.4)
P5	Do you wash your hand properly after smoking, sneezing or coughing?	2 (02)	21 (23.6)	43 (48.3)	7 (7.9)	16 (18)
P6	Do you use gloves while working at the slaughterhouse?	11 (12)	21 (23.6)	33 (37.1)	13 (14.6)	11 (12.4)
P7	Do you wash your hands properly before or after using gloves?	22 (25)	27 (30.3)	34 (38.2)	5 (5.6)	1 (1.1)
P8	Do you wash your hands properly after handling waste?	—	—	13 (14.6)	34 (38.2)	42 (47.2)
P9	Do you remove your work equipment/ clothes when using toilets?	55 (62)	20 (22.5)	10 (11.2)	—	4 (4.5)
P10	Do you wash your hands properly after using the toilet?	—	—	5 (5.6)	10 (11.2)	74 (83.1)
P11	Do you wear an apron while working at the slaughterhouse?	8 (09)	14 (15.7)	17 (19.1)	20 (22.5)	30 (33.7)
P12	Do you wash your apron after the workday?	18 (20)	30 (33.7)	30 (33.7)	11 (12.4)	—
P13	Do you use a mask while working at the slaughterhouse?	45 (51)	27 (30.3)	13 (14.6)	3 (3.4)	1 (1.1)
P14	Do you wear a hair cover while working at the slaughterhouse?	74 (83.1)	9 (10.1)	4 (4.5)	1 (1.1)	1 (1.1)
P15	Do you handle meat when suffering from gastroenteritis, coughs or skin diseases?	26 (29)	28 (31.5)	35 (39.3)	—	—
P16	Do you handle meat when you have cuts, wounds, bruises or hand injuries?	23 (26)	20 (22.5)	35 (39.3)	11 (12.4)	—
P17	Do you wear jewelry (rings, watches or other personal items) while working?	47 (53)	9 (10.1)	23 (25.8)	6 (6.7)	4 (4.5)
P18	Do you rub your hands over your face, hair, etc. while working?	12 (13)	13 (14.6)	54 (60.7)	10 (11.2)	—
Total		57.0 ± 8.7 ^a ; (40-75) ^b				

^aMean score ± SD. ^b(Min-Max)**Table 3.** Association between socio-demographic characteristics of respondents and their knowledge, attitude and practice levels on meat safety

	Knowledge level		p-Value	Attitudes level		p-Value	Practices level		p-Value
	Poor n (%)	Good n (%)		Poor n (%)	Good n (%)		Poor n (%)	Good n (%)	
Age (years)									
≤30	22 (22)	4(15.4)	0.514	6 (23.1)	20(76.9)	0.943	20(76.9)	6(23.1)	0.640
31-40	21(80.8)	5(19.2)		5 (19.2)	21(80.8)		17(65.4)	9(34.6)	
>40	27 (73)	10(27)		8 (21.6)	29(78.4)		27(73)	10(27)	
Education level									
Low level	52(91.2)	5(8.8)	0.000*	18(31.6)	39(68.4)	0.002*	50(87.7)	7(12.3)	0.000*
High Level	18(56.3)	14(43.8)		1 (3.1)	31(96.9)		14(43.7)	18(56.3)	
Work experience									
<5 years	31(79.5)	8 (20.5)	0.522	13(33.3)	26(66.7)	0.032*	28(71.8)	11(28.2)	0.967
5-10 years	25(83.3)	5(16.7)		5 (16.7)	25(83.3)		22(73.3)	8(26.7)	
>10 years	14 (70)	6(30)		1 (5)	19(95)		14(70)	6(30)	
Marital status									
Single	19 (76)	6(24)	0.703	6(24)	19(76)	0.703	17(68)	8(32)	0.608
Married	51(79.7)	13(20.3)		13(20.3)	51(79.7)		47(73.4)	17(26.6)	
Employment status									
Daily	30 (75)	10(25)	0.085	13(20.3)	51(79.7)	0.857	26(65)	14(35)	0.385
Contract	15 (100)	0(0)		4(26.7)	11(73.3)		11(73.3)	4(26.7)	
Permanent	25(73.5)	9(26.5)		7(20.6)	27(79.4)		27(79.4)	7(20.6)	
Total	70(78.7)	19(21.3)		19(21.3)	70(78.7)		64(71.9)	25(28.1)	

Note: Low level (primary/ Middle school). High Level (High school / University). *p-value < 0.05 indicates statistical significance.

Based on Spearman's rho (Table 4) significant positive correlation was found between knowledge and attitude ($r_s = 0.563, p < 0.001$) as well as between knowledge and practice ($r_s = 0.389, p < 0.001$). This study also shows a significant association between the level of education and knowledge ($r_s = 0.564, p < 0.001$), attitude ($r_s = 0.220, p < 0.05$), and practice ($r_s = 0.566, p < 0.001$). However, no correlation was obtained between attitude and practice. In addition, the rest of the socio-demographic characteristics of the respondents provided no significant effect on the

KAP score of workers, except for the correlation of work experience to attitude ($r_s = 0.309, p < 0.01$).

Discussion

This study is the first carried out in Algeria to assess the level of meat safety knowledge, attitudes, and practices among poultry slaughterhouse workers in the Bordj Bou Arreridj province. Similar figures and trends were observed with regard to gender and lack of food safety training when examining and comparing the socio-

Table 4. Correlation between various socio-demographic variables and KAP score the respondents

Variables	Age	EL	WE	MS	ES	MSK	MSA	MSP
Age	1.000							
EL	-0.002	1.000						
WE	0.549**	-0.017	1.000					
MS	0.655**	0.054	0.393**	1.000				
ES	0.355**	0.047	0.421**	0.175	1.000			
MSK	0.049	0.564**	0.162	-0.008	0.090	1.000		
MSA	0.062	0.220*	0.309**	0.114	0.178	0.563**	1.000	
MSP	0.001	0.566**	-0.020	-0.008	-0.146	0.389**	0.184	1.000

Note: EL = Education level. WE = Work Experience. MS = Marital Status. ES = Employment Status. MSK = Meat Safety Knowledge. MSA = Meat Safety Attitude. MSP = Meat Safety Practice; * Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed).

demographic profile of the participants in this study with the results of the recent meat safety studies carried out in other countries, such as Ethiopia [21], Burkina Faso [23], Kenya [24], and Bangladesh [25], where the male workers (untrained) accounted for 79.1% (98.9%), 82.6% (96.8%), 96.2% (92.3%), and 100% (100%), respectively. The predominance of men in this sector can be explained by the fact that slaughterhouses are located in rural areas far from residential areas. The training can improve food handlers' knowledge, attitudes, and practices on food safety [26,27]. The mean age of the workers was 37.2 ± 9.2 years, which is higher than the ages reported by [21] and [20] (29.7 ± 9.6 and 31 ± 9.4 , respectively), but lower than the age reported by [24] (41.51 ± 10.95). In this study, a considerable share of the participants possessed a high level of education (high school and university), exceeding one-third share. This phenomenon can be explained by a lack of job opportunities in the Algerian labor market [28].

The mean \pm SD of the knowledge score was 9.90 ± 3.77 , which was comparably lower than that of meat handlers surveyed in Iran [19] and Ethiopia [21], but higher than that obtained in Bangladesh [20], where the reported averages were 11.7 ± 3.1 , 13.12 ± 2.33 , and 7.0 ± 1.9 , respectively. In addition to the fact that the participants in this study were unaware of the appropriate temperature for storing meat and the effect of freezing on microorganisms, they demonstrated poor knowledge of foodborne diseases and foodborne pathogens such as *Escherichia coli*, *hepatitis A virus*, and *Salmonella*. A study conducted by Elgroud et al. [29] showed that avian salmonella isolated from broiler chicken farms and slaughterhouses in the Constantine province of Algeria may contribute to the emergence of human *Salmonella* strains, which is a disease commonly reported worldwide [30]. However, our study revealed a lack of awareness of this issue among our respondents. These findings, supported by the previous studies showing that meat handlers have less knowledge about foodborne pathogens [20,25,31,32] and foodborne diseases [20,31], could be related to a lack of training, as noted by [31-33], since none of the participants reported having prior formal food safety training.

Attitude is a key factor that can influence the behavior and practices of food handlers in terms of food safety; it reduces the incidence of foodborne diseases [34,35]. Accord-

ing to Zanin et al. [36], attitude is the principal link between knowledge and practices; the workers with adequate knowledge are more likely to put it into practice if they have a proper attitude. Generally, the workers in this study demonstrated positive attitudes toward food safety, with an average score of 16.21 ± 3.07 from a possible 20 points maximum, which is higher than the results obtained by [21,33]. This may be due to the hygiene instructions periodically provided by the veterinarian in order to ensure healthy condition of the meat.

Following proper personal hygiene practices is extremely important to ensure meat safety and prevent foodborne infections and poisoning among the consumers. This study revealed poor food safety practices, with an average score of 57 ± 8.7 out of a possible total of 90 points maximum. The only encouraging results reported by respondents were hand washing after handling waste (85.4%) and after using the toilet (94.4%). Interestingly, although workers have a positive attitude toward the meat safety aspects, yet their practices show significant deficiencies. For example, a large proportion of respondents agree that wearing protective clothing such as gloves (94.4%), aprons (87.6%), masks (86.5%), and hairnets (74.2%) is important for improving meat safety, but only a few of them actually wear such personal gear while working. The same observations were made in the studies conducted by [21,25,37]. Veterinarians and slaughterhouse owners underline that non-compliance with good hygiene practices mainly results from staff shortages and high turnover, which complicates the application of the sanctions against the employees. Similarly, food industry managers in Algeria (95.6%) [38], Abu Dhabi (87%) [39], and Turkey (89.3%) [40] have identified staff turnover as an obstacle to implementing food safety management systems such as HACCP.

As reported by Zelalem et al. [33] and Bahir et al. [14], education plays a key role in growing the meat handlers' awareness and improving their attitudes toward meat safety. In our study, the chi-square test (χ^2) showed that respondents with a higher level of education were significantly more likely to have good knowledge, attitudes, and practices regarding meat safety ($p = 0.000$, $p = 0.002$, and $p = 0.000$, respectively). These results are consistent with those of Adesokan and Raji [41], who demonstrated a significant association between education level and the

three variables, suggesting that education also improves food safety practices among meat handlers. Furthermore, our study revealed a positive correlation between knowledge and attitudes ($r_s = 0.563, P < 0.001$), as well as between knowledge and practices ($r_s = 0.389, P < 0.001$); this indicates that the attitudes and practices of meat handlers are improving as they acquire more knowledge. These results agree with the results reported in studies of [31,33,34,42], which also found a significant positive correlation between KAP levels, unlike the study of Ansari-Lari et al [19], which reported a negative correlation between knowledge and practice, as well as between attitudes and practices.

Limitations

Certain limitations should be acknowledged, including the number of the participants and the geographical area covered (Borj Bou Arreridj province). A larger number of participants from different regions would have made the study more representative. In addition, all participants were males with no food safety training, which limits our ability of better understanding the effect of gender and

training on meat safety knowledge, attitudes, and practices of the workers.

Conclusion

This study investigated the levels of knowledge, attitudes, and practices (KAPs) regarding meat safety among poultry slaughterhouse workers in the Bordj Bou Arreridj region of Algeria. The results revealed a lack of knowledge among the participants, particularly concerning food-borne pathogens and diseases. Although most participants surveyed showed positive attitudes toward observing personal hygiene and wearing appropriate protective clothes, their actual practices were suboptimal and still require improvement. Our findings indicated that knowledge improves attitudes and practices related to meat safety among the participants in this study. Additionally, education had a significant and favorable impact on their KAP levels. Accordingly, there is a critical need for regular practical training for the meat handlers in the study area to enhance their meat safety knowledge, attitudes, and practices, and to prevent meat-borne diseases.

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