Original Article

Journal of Food Safety and Hygiene

journal homepage: http://jfsh.tums.ac.ir

Evaluation of meat safety knowledge, attitudes and practices among slaughter house workers of Amathole District in eastern Cape Province, South Africa

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ARTICLEINFO

Article history:
Received 10 Feb. 2017
Received in revised form
20 May. 2017
Accepted 03 Jun. 2017

Keywords:
Educational status;
Health;
Training programs;
Protective clothing

ABSTRACT

Good slaughter hygiene practices are mandatory to minimize chances of microbiological contamination during meat processing. Thus, knowledge and training in meat safety are important to improve attitudes of workers who are reported to frequently engage in poor handling practices. The objective of the study was to assess the level of knowledge, attitudes towards meat safety and personal hygiene of slaughter personnel from low throughput (LTA's) and high throughput abattoirs (HTA's). Data were collected using structured questionnaires with questions on some important meat safety cues. About 40% of abattoir employees attained secondary education and this was significantly greater than those with no education (25%), primary (26.7%) and tertiary (8.3%) ($P<0.05$). A significantly greater proportion of respondents (55%) had more than 5 years of experience compared to those with ≤5 years ($P<0.05$). Overall, a greater proportion of respondents had valid health certificates (62.5%), though a significant proportion (35%) were from the HTA's. More medical examination defaulters (7.5%) were from LTA's compared to HTAs (2.5%) ($P<0.05$). Majority (47.5%) of respondents were treated for illnesses in clinics or hospitals, whereas some self-medicated (22.5%), visited traditional healers (22.5%) and 7.5% went to pharmacies. Secondary and tertiary educated respondents who received professional training showed a significantly greater willingness to disinfect work clothes, contact surfaces and wear gloves ($P<0.05$). A significant proportion of respondents (70%) who received professional training showed greater willingness to report illness than untrained ($P<0.05$). In spite of results showing basic hygiene compliance, aspects such as medical examination and professional training still need improvement.

Citation: Nyamakwere F, Muchenje V , Mushonga B , Kandiwa K, Makepe M, Mutero G. **Evaluation of meat safety knowledge, attitudes and practices among slaughter house workers of Amathole District in Eastern Cape Province, South Africa.** J Food Safe & Hyg 2017; 3(1-2): 7-15.

1. Introduction

The slaughter process is a highly labour intensive operation which involves personnel handling carcasses at different stages. Good slaughter hygiene practices such as hand washing with soap and disposable towels, use of protective clothing, use of gloves, medical examination, cleaning equipment between carcasses and disinfecting the equipment when not in use have to be implemented during processing in order to reduce chances of microbiological contamination of the carcasses (1,2,3). It has been suggested that foodborne diseases occur commonly in developing countries as a result of poor hygiene and safety practices, inadequate food hygiene laws, poor regulatory mechanisms, poor funding to purchase safer equipment and poor education of meat handlers (4). Furthermore, it has also been reported that the majority of foodborne diseases arises from food of animal origin (4). According to Assefas study (5), improper food handling and poor

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personal hygiene of workers contributes to approximately 97% of foodborne-disease outbreaks amongst consumers and has led to death in some cases. Sources of contamination during meat processing include the equipment, water, contact surfaces and personnel (6,7,8).

Contamination of meat can also occur during evisceration when gut contents come into contact with exposed meat. Consequently, knowledge regarding meat safety laws, regulations and personal hygiene of personnel come in handy. Researches from Pretoria, South Africa (6), Western Romania (9) and Alexandria, Egypt (10) have shown that most meat handlers lack meat safety knowledge, adequate training and are frequently engaged in poor handling practices. Furthermore, though the South African abattoir hygiene management system (HMS) has adopted HACCP principles, there are no guidelines to identify critical control points (CCPs) within the HMS (11). Critical control points need to be identified and appropriate measures put in place for personnel to implement. A study by Santos (12) also highlighted the need to modify the training for meat handlers in order to enhance compliance with HACCP principles. Poor performance might result in cross-contamination of meat with pathogenic organisms like *Escherichia coli*, *Salmonella spp* and *Listeria monocytogenes* (2,8,10,13).

Currently, processing plants are under increased consumer and regulatory pressure to improve the microbiological safety of perishable raw commodities. Salmonella and E. coli outbreaks in the United Kingdom (1980), United States (1993), Scotland (1993), Japan (1996) and Canada (1998) have raised consumer and regulatory concerns to improve food safety control measures (14,15,16). To prevent the spread of such pathogens workers in food processing plants should be educated, trained, monitored as well as motivated to follow standard operating procedures and regulations set by the responsible authorities (9). Additionally, they are also expected to maintain a high degree of cleanliness in their body and clothing in order to ensure food safety and public health (3).

There are a number of reports dealing with different aspects of meat hygiene around the world (4,9,17), Africa (1,3,10,18), South Africa, in general (6,7), and even the Eastern Cape, in particular (8,19, 20,21,22; 23). Meat hygiene reports from the Eastern Cape have tended to concentrate on meat microbiological quality (8,23) and meat inspection (20, 22,24). The Study by Mazizi (19) have gone further and studied consumer perceptions on meat and meat product quality sold in the informal markets of selected municipalities in Amathole district. However, the level of knowledge and attitudes towards meat safety as well as personal hygiene and handling practices of the slaughter personnel in Amathole district remains unknown. The objective of this study was to assess the level of knowledge and attitudes towards meat safety as well as personal hygiene and handling practices of slaughter personnel from low and high throughput abattoirs in Amathole district, Eastern Cape Province of South Africa.

2. Materials and Methods

2.1. Study site

This study was designed to include all 12 low throughput and high throughput abattoirs in Amathole district, Eastern Cape Province of South Africa. Six of these abattoirs are Low Throughput Abattoirs (LTAs) and the other six are High Throughput Abattoirs (HTAs). All the abattoirs used were fully registered by the competent authorities at the time of the study. Each of the abattoirs employs casual workers with a limited number of permanent staff. Both permanent and casual workers participated in this study. The LTA's slaughter an approximate average of 18 animal units per day. In the LTA's category, different animal species are slaughtered in the same slaughter floor and about 20 workers are involved during the slaughter process on a particular day. The HTA's slaughter an approximate average of 165 animal units per day. However, different slaughter floors are used for different animal species and approximately 35 workers are involved in the slaughter process on a particular day.

2.2. Selection of respondents

A survey was conducted where 150 slaughter personnel were randomly selected from all the HTA's and 90 from all the LTA's. The selection of respondents was limited mostly to those directly involved during the slaughter process. This includes those responsible for stunning, skinning, evisceration, meat inspection, washing and packing. Selection of these slaughter personnel was done randomly.

2.3. Data collection

Data was collected using a structured questionnaire with modified questions from other similar studies (6,9). The questionnaires were administered to

randomly selected abattoir slaughter personnel during tea and lunch breaks with permission from the abattoir management staff. The questionnaires were organized into different sections comprising of questions on slaughter personnel demographic information, knowledge, attitudes, personal hygiene and handling practices regarding meat safety. The slaughter personnel also answered questions pertaining to their personal health and actions taken when they are sick or injured at work. The participants were briefly informed about the purpose of the study in their own vernacular language before the interview and given a chance to ask for further clarification. The questionnaire was written in English and a translator was used where necessary. They also signed an agreement as consent to participate freely without being forced and assured of confidentiality for all the information provided. The questionnaires were administered to the respondents by trained enumerators in a 10-minute one-on-one interview.

2.4. Statistical analysis

Descriptive statistics were computed using the Statistical Package for the Social Sciences (SPSS) version 22 of 2013 (25). Cross tabulations and Chi-square tests for goodness of fit were performed to examine the relationships between the demographic information and the knowledge regarding meat safety, personal hygiene and handling practices. The level of statistical significance was set at $P < 0.05$.

3. Results

3.1. Socio-demographic characteristics of slaughter personnel

The results of the social-demographic information about slaughter personnel interviewed from the selected abattoirs are shown in Table 1. Overall, the abattoirs under study employed significantly more men (80%) than women (20%) ($P<0.05$). A significantly greater proportion of the respondents (62.5%) was employed at HTA's in comparison to those employed at LTA's (37.5%) ($P<0.05$). Overall, all the abattoirs employed significantly more people in the 21-30 years age category (42.5%) than the rest of the age categories ($P<0.05$). There was no significant difference between the proportions of the 41-50 year and the over 50-year age categories ($P>0.05$). There was no significant difference between the proportions of married and single people employed by the studied abattoirs ($P>0.05$) through a significantly lower proportion of

Table 1. Socio-demographic characteristics of slaughter personnel interviewed in the selected abattoirs

Characteristic/Category	*LT Abattoirs respondents	Proportion (%)	**HT Abattoirs respondents	Proportion (%)	Total respondents	Overall proportion (%)
Overall	90	37.5	150	62.5	240	100
Gender						
Male	66	27.5	126	52.5	192	80.0
Female	24	10.0	24	10.0	48	20.0
Age group						
21-30yrs	36	15.0	66	27.5	102	42.5
31-40yrs	24	10.0	42	17.5	66	27.5
41-50yrs	24	10.0	18	7.5	42	17.5
>50yrs	6	2.5	24	10.0	30	12.5
Marital status						
Single	36	15.0	78	32.5	114	47.5
Married	48	20.0	60	25.0	108	45.0
Divorced	6	2.5	12	5.0	18	7.5
Educational Level						
None	42	17.5	18	7.5	60	25.0
Primary	40	16.7	24	10.0	64	26.7
Secondary	5	2.1	91	37.9	96	40.0
Tertiary	3	1.3	7	2.9	10	4.2
Tribe						
Xhosa	72	30.0	126	52.5	198	82.5
Zulu	6	2.5	8	3.3	14	5.8
Others	12	5.0	16	6.7	28	11.7
Religion						
Christian	55	22.9	96	40.0	151	62.9
Traditional	25	10.4	44	18.3	69	28.8
Muslim	10	4.2	10	4.2	20	8.3

*LT Abattoirs – Low Throughput Abattoirs; **HT Abattoirs – High Throughput Abattoirs

Table 2. Training of slaughter personnel on meat safety and their professional experience

Characteristic/category	*LT Abattoirs respondents	Proportion (%)	**HT Abattoirs respondents	Proportion (%)	Total respondents	Overall proportion (%)
Professional experience						
<2 yrs	18	7.5	54	22.5	72	30
2-5 yrs	6	2.5	30	12.5	36	15
>5 yrs	66	27.5	66	27.5	132	55
Professional training						
Yes	42	17.5	126	52.5	168	70
No	48	20	24	10	72	30
Training sessions received						
None	42	17.5	24	10	66	27.5
<2	41	17.1	66	27.5	107	44.6
2-5	5	2.1	18	7.5	23	9.6
>5	2	0.8	42	17.5	44	18.3
Last training session						
None	42	17.5	24	10	66	27.5
<2 yrs ago	3	1.25	78	32.5	81	33.75
2-5 yrs ago	6	2.5	12	5	18	7.5
>5 yrs ago	39	16.25	36	15	75	31.25

*LT Abattoirs – Low Throughput Abattoirs; **HT Abattoirs – High Throughput Abattoirs

divorces was employed (P>0.05). The proportion of abattoir employees with secondary level education (40%) was significantly greater than those with no education, primary and tertiary level of education with 25%, 26.7% and 8.3%, respectively (P<0.05). There was no significant difference between the proportion of respondents without any education and those with primary level education (P>0.05). A significant majority of the respondents were from the Xhosa tribe (82.5%) and 5.8% were from the Zulu tribe. The Sotho, Indian and Whites collectively made up 11.7% of the respondents. The proportion of Christian respondents (62.9%) were significantly higher than the proportions of traditional (28.8%) and Muslim respondents (8.3%) (P<0.05).

3.2. Information regarding professional experience and health evaluation of slaughter personnel

Statistical analysis of the results in Table 2 showed that a significantly higher proportion of respondents from all abattoirs (70%) had received professional training and a significantly greater proportion was from the HTA's (52.5%) (P<0.05). Overall, a significantly greater proportion of respondents had more than 5 years of experience (55%) in comparison to those with ≤5 years (P<0.05). A significantly lower proportion of respondents received their last training session 2-5 years ago (7.5%) in comparison to the rest of the categories (P<0.05). A significantly greater proportion of respondents received less than 2 training

Table 3. Practices for monitoring or maintaining the health status of slaughter personnel

Characteristic/Category	*LT Abattoirs respondents	Proportion (%)	**HT Abattoirs respondents	Proportion (%)	Total respondents	Total proportion (%)
Valid Health Certificate						
Yes	66	27.5	84	35	150	62.5
No	24	10	66	27.5	90	37.5
Medical Examination						
None	18	7.5	6	2.5	24	10
Every month	12	5	30	12.5	42	17.5
Every 6 months	6	2.5	48	20	54	22.5
Annually	54	22.5	66	27.5	120	50
Report illness						
Yes	30	12.5	102	42.5	132	55
No	12	5	24	10	36	15
Sometimes	48	20	24	10	72	30
Action/Treatment						
Self-medication	18	7.5	36	15	54	22.5
Traditional healers	30	12.5	24	10	54	22.5
Pharmacy	12	5	6	2.5	18	7.5
Clinic/Hospital	30	12.5	84	35	114	47.5

*LT Abattoirs – Low Throughput Abattoirs; **HT Abattoirs – High Throughput Abattoirs

Table 4. Cross-tabulation of educational level against respondents' general personal hygiene and handling practices regarding meat safety

Characteristic/attitude	Respondents in Educational level category			
	None	Primary	Secondary	Tertiary
Reporting illness				
Yes	33[a]	12[a]	78[b]	10[b]
No	0	23	6[c]	0[c]
Sometimes	27[d]	29[d]	6[e]	0[e]
Frequency of disinfection of work clothes				
Daily	0	29	78[a]	10[a]
After 2 days	20[b]	17[be]	6[c]	0[ce]
After 3 days	40	17[d]	12[d]	0[d]
Frequency of disinfection of contact surfaces				
Always	27[a]	29[a]	96	10
Sometimes	33[b]	35[b]	0	0
Frequency of wearing gloves				
Always	0	17[d]	66	0[d]
Sometimes	33[c]	30[c]	18	10
Never	27	17[b]	12[a]	0[ab]

*Within each characteristic, values with the same superscripts [a,b,c,d,e,f] are not significantly different since P>0.05

sessions (44.6%) in comparison to those with no training (27.5%), those that received 2-5 training sessions (9.6%) and those that received more than 5 training sessions (18.3%) (P<0.05).

Table 3 shows that overall, a greater proportion of respondents had valid health certificates (62.5%) than those without (37.5%). Further analysis, however, showed that the greatest proportion of respondents go for their medical examinations annually (50%), whereas others were never medically examined (10%). A significantly greater proportion of respondents who were never medically examined (7.5%) were from the LTA's (P<0.05). Overall, a greater proportion of respondents (55%) reported illness and majority of them (47.5%) received treatment for their illness from clinics or hospitals.

3.3. Personal hygiene and attitudes of slaughter personnel regarding meat safety

All the respondents indicated that they always clean their hands before starting the slaughter process. In addition, approximately 89.2% of meat handlers from all abattoirs know the correct way of washing hands which includes the use of hand sanitizer, soap and hot water, while the remainder uses water only. A relatively larger proportion of the interviewed workers from HTA's (90.91%) use disposable towels to dry hands compared to only 46.67% from LTA's. On the other hand, others indicated that they use cloth towel, while 26.67% from LTA's reported that they do not dry their hands.

3.4. Comparative analysis of slaughter personnel knowledge and practices on meat safety

Table 5. Cross-tabulation of professional training of respondents against respondents' general personal hygiene and handling practices regarding meat safety

Characteristic/attitude	Respondents Professionally trained	
	Yes	No
Reporting illness		
Yes	116	22
No	26[a]	8[a]
Sometimes	26	52
Frequency of disinfection of work clothes		
Daily	116	7
After 2 days	6	45
After 3 days	45[a]	30[a]
Frequency of disinfection of contact surfaces		
Always	136	37
Sometimes	32	45
Frequency of wearing gloves		
Always	84	8
Sometimes	58[a]	37[a]
Never	26	37

*Within each characteristic, values with the same superscripts are not significantly different since P>0.05.

Cross-tabulations (Table 4) of educational level and reporting illness showed that there was no significant difference between secondary and tertiary level schooled respondents as both categories showed a significantly greater ($P<0.05$) preference of reporting illness than unschooled and primary level schooled respondents. Respondents with primary level education showed the greatest unwillingness to report illness (23%). Unschooled respondents and those with only primary level education showed a greater tendency of disinfecting work clothes less frequently (2-3 days), not always disinfecting contact surfaces and not always wearing gloves. Whilst significantly greater proportions of respondents with secondary and tertiary level education preferred to disinfect their work clothes daily, disinfect contact surfaces and wear gloves frequently ($P<0.05$). Professionally trained respondents (Table 5) showed a significantly greater willingness to report illness than untrained respondents ($P<0.05$). Professionally trained respondents also showed a significantly greater willingness to disinfect work clothes, contact surfaces and to wear gloves than untrained respondents ($P<0.05$).

4. Discussion

This study highlighted the socio-demographics of slaughter personnel in Amathole district. Results indicate that the majority of slaughter personnel are men, most of the slaughter personnel are in the 21-30 years age category, the majority (48.3%) of the slaughter personnel have above secondary education and 26.7% have primary education with a race, ethnic and religious composition fairly representative of the district. The representation of females on the slaughter personnel composition, perhaps deserves special comment. Implementation of gender balance when employing slaughter personnel must be recommended to the abattoir management. Personal hygiene practices investigated in this study include wearing of protective clothing, cleaning and disinfection of working clothes. These practices are considered as mandatory preventative measures which have to be implemented during the slaughter process to reduce chances of cross contamination (3,6).

According to the South African Red Meat Regulation No. 1077 of 2004 (section 49) hand-washing basins, sterilizers and disposable towels should be made accessible to both abattoir workers and visitors (26). Washing hands by food handlers during processing is considered as one key important hygiene practice to prevent cross contamination (5). All respondents from the Assefas study (5) indicated that they always wash and properly sanitize their hands before starting the slaughter process. Our results contradict reports by a number of authors from other places in the world where hand washing and sanitization was found to be inadequate (9,10). Slaughter personnel of low and high throughput abattoirs of Amathole district should be applauded for observing this important component of meat hygiene. In addition, our results show that most of the slaughter personnel always put on protective clothing during slaughtering. Protective clothing helps to protect both the food product and the meat handler from cross contamination. The emphasis should not only be on protection but also on the cleanliness, they should be adequately cleaned and disinfected to eliminate pathogenic microorganisms. Working clothes should be cleaned at least every day since the slaughter process can involve a lot of dirty work. In this study, however, most respondents indicated that they only wash protective clothing after three working days.

Regulation No. 1077 of 2004 section 57 prescribes employment of slaughter personnel to only take place after production of a medical certificate as proof of health and absence of any communicable diseases. Some of meat handlers from LTA's (10 %) and HTA's (27.5%) indicated that they did not have valid health certificates. Similarly, the majority of slaughter personnel from other studies were reported to lack valid health certificates (1,10). Harker (27) highlighted that it is important to do a pre-employment health assessment for food handlers and inclusion of routine salmonellae screening sessions at least every year. Although a small percentage of our workers did not have valid health certificates in our study, rather than celebrate the lower percentages, we encourage abattoir management to obey the law and enforce the requirement of having all meat handlers examined every year for health certificates. Furthermore, the lower compliance of health certification in high throughput than low throughput abattoirs cannot be condoned. Since high HTAs handle large volumes of meat there is a higher risk of contamination with more far reaching implications than low throughput abattoirs. It is important that abattoir management address this anomaly.

A relatively large proportion of meat handlers from HTA's (42.5%) indicated that they always reported any illness to the supervisor, while a slightly larger proportion of LTA's (48%) declared that they reported sometimes. These findings are lower than those recorded by Nel (6), where 96.4% of the respondents indicated that they report always. Nel (6) also reported

that all the respondents declared that whenever they report an illness they were sent to the hospital, whereas in the present study only a few respondents indicated that they are taken to the hospital when sick (LTA's: 12.5% and HTA's: 35%). It is not clear if our results are a deterioration of what was reported in Gauteng province, South Africa (6). It is possible that our figures are fairly representative of the largely rural districts and that Nel's (6) figures are a reflection of better sanitary conditions in the affluent and metropolitan Gauteng abattoirs. The study has also revealed that most respondents have knowledge of and have once been victims of food borne diseases. Past experience with food-borne diseases or people who have worked in health systems before (28) have higher levels of common concern, risk perceptions and knowledge regarding food- borne diseases and safety.

From this study a relatively larger proportion of respondents (30 %) indicated that they did not receive any food safety training before attaining abattoir employment. Coliform counts were reported to be significantly lower on meat after training of meat handlers (29). Coliforms are an indicator of faecal contamination due to poor personal hygiene. Lower coliform counts on meat lead to a longer product shelf life and reduced risk of foodborne illnesses. Thus, food hygiene training prior employment is very important coupled with regular updating or refresher courses. This will help the meat handlers to refresh and have a better understanding of risks associated with contamination of food with microbiological pathogens and sanitation practices (17). The importance of refresher courses was highlighted (18), in line with prevalent zoonotic diseases such as Brucellosis, taking into consideration the roles of meat handlers. However, both training and supervision seem to be less effective since some respondents are still engaging in inappropriate practices. This critical violation is comparable to the proportions of respondents of other studies who also indicated that they did not receive professional training (6,9).

Furthermore, 34.6 % of the respondents from the LTA's who indicated that they had received training only attended one training session and no refresher or updating courses were offered. It was also noted that a substantial proportion of the respondents from LTA's (16.25%) attended the last session more than five years ago, implying that these workers may not have new and fresh knowledge regarding meat safety practices. The Chi-square tests performed also revealed professional training as a significant factor ($P< 0.05$) for knowledge, wearing gloves, reporting illness and frequency of disinfecting equipment, working clothes and surfaces. Similar to these findings (17,9,30), individuals with proper professional training regarding meat safety significantly do better practices compared to untrained. Additionally, training of meat handlers on sources of meat contamination, good hygienic practices and personal hygiene have proven benefits (29). This shows that the quality of practices is improved mainly by professional training.

An increase in meat safety knowledge can be seen increasing along the educational levels and also as the professional years of experience increases. This is in agreement with other studies (9,28,31) were the highest level of knowledge was significantly ($P< 0.05$) associated with workers who had better education. In addition, considerable number of slaughter personnel in Amathole district have received adequate training and have relevant experience in the slaughter process. This also shows that the level of knowledge is improved mainly by the educational level of an individual. That is why most workers from HTA's performed better as most of them had indicated that they had basic formal education. However, some practices have been reported to be linked mainly to individuals' attitudes and behavior which cannot be changed by either education or training (17). Therefore, employing workers with at least a primary education level is important and also properly training workers helps to assure good quality products to consumers.

From the foregoing discussion, it can be concluded that the abattoirs of Amathole district have a high level of adherence to standard hygiene practices including; appropriate personal hygiene, wearing appropriate clothing (gloves), taking appropriate action with regards to personal health (reporting illnesses, seeking treatment and getting health certificates). This implementation of hygiene practices is consistent with the high level of education observed in slaughter personnel in this study. Educational level and training of meat handlers regarding basic concepts of meat safety and personal hygiene play a vital role in ensuring that the consumers are provided with safe and wholesome products (9,3). Future policy enforcement especially in developing countries for improved food safety and quality delivery is important (32).

5. Conclusions

This study demonstrated a significant adherence to basic hygiene practices among slaughter personnel and a satisfactory level of knowledge, with workers from HTA's comparatively performing better. Gaps identified highlight the necessity of proper professional

training and routine medical examinations of workers coupled with health certificates. This warrants further investigations to assess how training is conducted in order to identify the actual causes of poor performance by these workers. The study also underlines the link between educational level and professional training on level of knowledge and personal hygiene practices regarding meat safety. Therefore, proper training, monitoring and educating slaughter personnel will help to assure that the consumers are provided with good quality wholesome meat all the times. Further research is recommended to validate the workers' knowledge and general practices through microbiological correlation of meat samples to these practices. Routine inspections by responsible authorities are also advisable to assess compliance with the standards and requirements according to the rules and regulations for safer meat processing in abattoirs.

Conflict of interest

The authors declare that there was no conflict of interest.

Acknowledgements

Authors wish to thank the National Research Foundation (NRF) Innovation Masters and Doctoral Scholarship for Non-South Africans, DST-NRF Center of Excellence in Food Security project number P801, Govan Mbeki Research and Development Centre and Department of Livestock and Pasture, University of Fort Hare for their co-operation and co-ordination in all the financial issues pertaining to this study. Special thanks also go to the abattoir staff and casual workers for their cooperation during data collection.

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