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Siyasamkela Mbobo, Charles Byaruhanga, Ishmael Festus Jaja

Corresponding author: Siyasamkela Mbobo, Department of Livestock and Pasture Science, University of Fort Hare, Alice 5700, South Africa. siyasa202@gmail.com

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Knowledge, attitudes and practices of abattoir workers towards cystic echinococcosis in the Eastern Cape Province, South Africa

Siyasamkela Mbobo[1,2,&], Charles Byaruhanga[3], Ishmael Festus Jaja[1,2,4]

[1]Department of Livestock and Pasture Science, University of Fort Hare, Alice 5700, South Africa, [2]SAMRC Microbial Water Quality Monitoring Centre, University of Fort Hare, Alice, Eastern Cape, South Africa, [3]Department of Veterinary Tropical Diseases, Faculty of Veterinary Science, University of Pretoria, Private Bag X04, Onderstepoort, 0110, South Africa, [4]Department of Agriculture and Animal Health, University of South Africa, Roodepoort, Johannesburg, South Africa

[&]Corresponding author

Siyasamkela Mbobo (SM), Department of Livestock and Pasture Science, University of Fort Hare, Alice 5700, South Africa

Abstract

Introduction: *abattoir workers have a crucial role in protecting public health because of their actions, which have a direct impact on preventing and controlling the spread of zoonotic diseases from animals to humans. Cystic echinococcosis/hydatid disease is a parasitic zoonotic disease prevalent in developing countries, leading to serious public health concerns and economic impact.* ***Methods:*** *this study aims to determine the knowledge, attitude, and practices regarding echinococcosis among abattoir workers in the Eastern Cape, South Africa. Questionnaires were distributed to 152 abattoir workers from April 2024 to June 2024 in the Eastern Cape Province, South Africa. IBM SPSS was used to analyse descriptive statistics, quantitative data, abattoir worker´s KAP and calculate performance scores. Cronbach's alpha was used to evaluate reliability, which was 0.701. The p-value was considered statistically significant at 0.05 or less (P≤0.05).* ***Results:*** *only 32.9% had adequate knowledge of cystic echinococcosis, 63.2% had a positive attitude towards cystic echinococcosis (CE), and 96.1% of the respondents had good practices. Factors associated with knowledge of risk factors were educational level (χ^2=8.588 P=0.014), and working title (χ^2=19.466; P=0.013, χ^2=20.725; P=0.008).* ***Conclusion:*** *respondents were aware of CE and its risk factors, they lacked adequate knowledge about the disease. It is vital that public health education, training on zoonotic disease prevention, and awareness raising programs must be conducted to raise awareness and promote food safety and transmission of cystic echinococcosis.*

Introduction

Cystic echinococcosis, commonly known as hydatidosis or hydatid disease and caused by the tapeworm *Echinococcus granulosus sensu lato*, is a zoonotic parasitic disease with an estimated worldwide annual economic cost of 3 billion United States dollars [1]. The disease occurs in most parts of the world, affecting about 1 million people [1]. Globally, annual deaths due to the disease were recorded to be 19,300 and 871,000 disability-adjusted life-years [2,3]. Economic costs in animals are attributed to liver condemnation, decreased milk production, reduced carcass weight, and reduced fertility [1]. The World Health Organization (WHO) recognizes echinococcosis as one of the 17 neglected tropical diseases and a serious health concern [4]. Meat-eating animals such as dogs and other canids are the definitive hosts of *Echinococcus granulosus*, which feeds in the small intestine and releases eggs into the faeces. They get infected by eating organs of intermediate hosts such as sheep, cattle, goats, camel, swine, buffalo, and other herbivores that contain parasitic cysts. Intermediate hosts become infected by grazing or drinking water contaminated with eggs of the tapeworm. Humans are accidental hosts and get infected by ingesting parasitic egg-contaminated water or food or by close contact with infected canids [1]. In the intermediate hosts, the development of *Echinococcus granulosus* cysts usually starts in the liver, followed by other organs, such as the brain and lungs [5].

Prevalence rates in humans can be as high as 5-10% in some endemic African regions, whereas in other hyperendemic locations, the rates of livestock infection in slaughterhouses range from 20% to 95%. The highest prevalence of cystic echinococcosis is in developing countries, especially in rural areas characterised by home slaughter, inappropriate meat inspection, poor sanitation, and inadequate knowledge among communities [6]. A major element in the ongoing occurrence of echinococcosis is the lack of

understanding regarding risk factors, transmission, signs and symptoms in humans and animals, prevention, and treatment [7]. In addition to the intricacy of the parasite's life cycle, several variables contribute to the increasing disease prevalence. Due to ecological shifts and rising urbanization, individuals are now more likely to come into contact with infected dogs. Furthermore, some studies have demonstrated that socioeconomic, demographic, and cultural factors such as age, sex, occupation, and educational attainment, as well as home-raising dogs and not washing hands before meals, influence the ability to spread the disease to humans [8-10]. Studies on knowledge, attitudes, and practices (KAP) towards echinococcosis are appropriate for evaluating the level of understanding among human populations and documenting behaviors that may increase the risk of contracting a tapeworm [11]. This is essential for informing public health education initiatives to fill knowledge gaps and decrease the prevalence of predisposing behaviors.

Among abattoir workers, knowledge and practice gaps may be caused by inadequate meat safety legislation implementation, inadequate food safety standards, and inadequate training. Execution of this study is essential because the level of expertise and practices among abattoir workers is critical to policy development and consumer awareness, thus ensuring that consumers have access to safe meat [12]. Therefore, understanding the abattoir worker´s KAPs is essential to effective control and elimination. There is shortage of data on KAPs associated with echinococcosis in many African nations, including South Africa. Research on the knowledge, attitudes, and practices regarding cystic echinococcosis among communities, veterinarians, dog owners, farmworkers, and those who work in slaughterhouses has shown that there are differences in comprehension and compliance with regulations around the world [7-9,13-20]. Although some studies on echinococcosis have been done in South Africa [21-25], to the best of our knowledge, none have focused on the KAPs regarding cystic echinococcosis among abattoir workers. Therefore, this study aims to determine the knowledge, attitude, and practices regarding echinococcosis among abattoir workers in the Eastern Cape Province, South Africa. We hypothesized that abattoirs workers have low knowledge level and poor attitude regarding the source, transmission, clinical signs, prevention and control of echinococcosis. We also hypothesized that occurrence of the disease is related to inappropriate personal and abattoir hygiene practices, as well as inappropriate handling of animal carcasses and consumption of meat.

Methods

Study area: the study was conducted in seven different abattoirs in the Eastern Cape Province (ECP), South Africa (Figure 1). The targeted abattoirs are both low throughput (LTP) (n=2) and high throughput (HTP) (n=5), located in five local municipalities, namely Enoch Mgijima (Queenstown), Buffalo City metropolitan (East London), Nelson Mandela Bay Metropolitan (Gqeberha), Raymond Mhlaba (Adelaide) and Makana (Makhanda). According to mid-year population projections from 2018, Eastern Cape is the second-largest province by land mass with 169,580 square kilometres in South Africa (SA), having an estimated population of 6,522,700 people. It is one of the provinces with a large number of livestock in the country: 3.2 million cattle, 6.6 million sheep, and 2.1 million goats compared to the national livestock population of 14 million cattle, 21.6 million sheep, and 5.2 million goats, respectively [26]. The vast land mass supports various agricultural practices, ranging from communal to commercial farming. Different production systems, such as extensive, semi-intensive, and intensive systems, are applied in these agricultural systems. High-throughput abattoirs are big facilities that feed national and worldwide markets; they are more automated and subject to tougher regulations than low-

throughput abattoirs, which are smaller businesses serving local markets. These slaughterhouses are dispersed throughout the Eastern Cape's six district municipalities: Chris Hani, O.R. Tambo, Joe Gqabi, Alfred Nzo, Amathole, and Sarah Baartman. All low (n=2 in the study area) and high (n=5) throughput abattoirs in the study area where eligible for selection, but we focused on those that consented to participate (2 low, 5 high).

Study design and sample size: this cross-sectional design involving questionnaire interviews about cystic echinococcosis amongst abattoir workers was conducted from April 2024 to June 2024. The questions included in the questionnaire were adapted from literature related to KAPs on cystic echinococcosis in Central Sudan [17] and China [20], Pakistan [16], Peru [27] and Algeria [28] and this was validated in terms of content and flow by the present research team with their vast experience on zoonotic helminth parasites, including *Echinococcus,* to meet both the scientific merit of the studied pathogen and to fit in the actual field situations of the study area. Both permanent and casual staff in the study abattoirs were eligible for selection, and both males and females were interviewed. The selection of the respondents was purposive, depending on the abattoir workers who provided consent to participate. These included workers involved in meat inspection, stunning, skinning, deboning, evisceration, meat classifiers, and packers. General managers and supervisors were also included in the study to measure their awareness of cystic echinococcosis. The minimum sample size for the questionnaire respondents (n=152) was determined using a formula for single proportions [29].

$$\frac{Z_{\alpha}/2^2 p(1-p)}{d^2}$$

Applying a confidence interval (Z) of 95%, 8% error margin (d) and assuming 50% proportion of abattoir workers with correct knowledge, attitudes, and practices. The required sample of 152 was proportionally allocated to high (n=135; average 35 workers per abattoir) and low throughout abattoirs (n=17; average 8 workers per abattoir), depending on the size of the work force in the two categories. On the day of the visit, workers in an abattoir were selected in a systematically random manner within the settings of their working routine, with a predetermined interval calculated by dividing the abattoir worker population by the required number of participants in that abattoir. The selection approach controlled for selection bias for the participant interviews. If a selected worker declined to participate, we moved to the next selection until the required number was obtained. A minimum of 5 workers was required in a low throughput and 10 in the high throughput. Therefore, the number of participants per abattoir varied depending on their availability and the size of the abattoir.

Data collection: questionnaire data were collected by the principal researcher. The questionnaire was pre-tested with 5 abattoir workers in one abattoir in the study areas, and these responses were not included in the final dataset. The pre-testing ensured that relevant questions were asked, that the respondents understand the questions and there was good flow of the content. The interviews were about 30 minutes during the abattoir workers´ tea and lunch breaks. The respondents were briefly informed about the study and given a chance to ask questions that they didn´t understand. The domains of the questionnaire were: i) demographic information such as age, occupation, gender, and marital status; ii) knowledge section that included questions on causes, transmission, risk factors and symptoms of echinococcosis, and iii) attitudes and practices towards the disease, such as animal slaughter habits and meat inspection practices. Questions were written in English and translated to their respective languages where necessary.

knowledge, attitudes, and practices scores: the knowledge questions were 24 in total, of which 14 questions were on awareness, four on risk factors

and six on disease symptoms. A correct knowledge response was assigned a score of 1, and an incorrect or “I do not know” response scored as 0. The scores were added and the participant´s overall score for the 24 questions varied from 0 to 24 points. The knowledge score was divided into two categories: poor knowledge (less than or equal to 50%; 0-12 points) and adequate knowledge (more than 51%; 13-24 points). There were 9 attitude questions with possible “yes” or “no” responses, which were assigned scores of 1 and 0, respectively. The total score for the attitudes was calculated. Respondents were deemed to have a positive attitude if they received more than 50% (5-9 points). Four practice questions were asked I with possible “yes” or “no” answers (score 1 and 0, respectively) and individuals were deemed to have good practice if they earned more than two out of four (51% and above) of the possible points.

Data analysis: the collected data was coded in the Microsoft Excel spreadsheet and later transformed into IBM Statistical package for social science (IBM SPSS) for analyses where descriptive statistics and frequency were determined. The Chi-square Pearson's test (x^2) was used to determine association between the demographic information (gender, age, educational level, work experience, work tittle, abattoir name and abattoir type) and various KAPs questions. The p-value was considered statistically significant at 0.05 or less(P≤0.05). Cronbach's alpha was used to evaluate reliability, which was 0.701. Further analyses were conducted by multivariable logistic regression to evaluate the relationship between the dependent variables (KAP status, attitude, and practice variables) and the explanatory variables (sociodemographic characteristics and knowledge status) The hypothesis was that these explanatory variables have an effect on the dependent variables. A “yes” or the right response was coded, 0, while a "no" or the incorrect answer, was coded as 1. These new binary variables are then analysed against the participant demographic or occupational characteristics, which served as the independent variables.

Ethical considerations: ethical clearance for this study was provided by the Interfaculty Research Ethics Committee (IFREC) of the University of Fort Hare, South Africa (REC-270710-028-RA Level 01 with project number JAJ021SMBO01). Official permission was obtained from participating abattoirs. Additionally, the participants were assured that they would engage voluntarily and without coercion by signing a consent form issued by the researcher, which guarantees the confidentiality of all the information shared before the questionnaires were administered.

Results

Demographics of the respondents: the information about socio-demographic information is summarized in Table 1. A total of 152 abattoir workers were interviewed from seven different abattoirs in 5 different local municipalities of the Eastern Cape. Most respondents were male (n=128, 84.2%) compared to female respondents (n=24, 15.8%). The respondents´ age ranged from 19 to 75, with the highest proportion of the respondents in the age range of 18-30 years (44.7%). Most respondents (69.1%) had attained secondary education, while only 15.1%) and 15.8% had attained primary and tertiary education, respectively. Most respondents (53.3%) were general workers with working experience of less than five years. Furthermore, 75 (49.3%) of the respondents never went for medical check-ups unless in case of sickness. A few respondents had attended zoonosis training at work (20.4%). Zoonosis training showed a significant relationship (P≤0.05) with age, educational level, work experience, and work title.

Knowledge of cystic echinococcosis among abattoir workers: the results of the knowledge of cystic echinococcosis, risk factors, and symptoms are shown in Table 2, Table 3 and Table 4, respectively. The respondents´ overall knowledge

was adequate (32.9%) and low (67%). Most respondents (80.3%) had never heard the word zoonosis. In addition, 83 (54.6%) respondents knew cystic echinococcosis as a zoonosis. Furthermore, 101 (66.4%) have noticed hydatid cysts from slaughtered animals. They indicated that cattle (62.5%), goats (2.6%), dogs (10.5%), sheep (48.7%), pigs (28.9%) and foxes (5.9%) could be affected by cystic echinococcosis. According to the respondents, the most common organ in which cysts can be found is in the liver (80.3%), as indicated in Table 2. Knowledge of risk factors associated with cystic echinococcosis was evaluated by 65.8% of the respondents, saying feeding condemned offal to animals is a risk factor (Table 3). There was a statistical relationship ($P \leq 0.05$) between type of work and feeding condemned offal to animals. At least 46.1% of the respondents disagree that keeping dogs at home and farm could contribute to the transmission of zoonotic diseases like cystic echinococcosis. In addition, most respondents agreed that purchasing uninspected meat (78.9%) and consuming undercooked meat (77.6%) is a risk factor. There was an association ($P \leq 0.05$) between the consumption of undercooked meat as a risk factor and work title and educational level. Most of the respondents agreed that symptoms of cystic echinococcosis include coughing (52.6%), blood sputum (59.9%), vomiting (62.5%), seizures (51.3%) and abdominal discomfort (57.2%) (Table 4).

Sources of information on cystic echinococcosis among abattoir workers: a high proportion (Figure 2) indicated that their source of information is from health care professionals or veterinarians, followed by television or radio.

Attitudes towards cystic echinococcosis amongst abattoir workers: most respondents had a positive attitude towards various aspects of cystic echinococcosis, with a 63.2% attitude score. The respondents agreed that veterinarians play an important role in promoting the prevention of zoonotic diseases like cystic echinococcosis in their abattoirs (70.4%), abattoir workers are among the people who are at risk of contracting cystic echinococcosis (72.4%), and that regular training on zoonosis and foodborne diseases is important (73.7%) (Table 5). Regular training was associated with age ($p=0.038$), educational level ($p=0.016$), and working experience ($p=0.020$). In addition, 67.1% of the respondents wash their hands before and after slaughtering is important. Furthermore, out of 152 respondents, 43 (28.3%) prefer not to take medical treatment if they were infected with cystic echinococcosis. According to the respondents (59.9%), the use of herbal medicine (iyeza), such as aloe (Ikhala), is important in the treatment of zoonosis. Although half of them would still prefer conventional medicine over traditional medicine. About 78.3% of the respondents disagreed that abattoir workers have the right to consume condemned meat. Lastly, 75% of the respondents believed that condemned meat is not suitable for human consumption

Practices of abattoir workers towards prevention/control of the zoonotic disease, cystic echinococcosis: most respondents exercised proper abattoir practices to prevent the spread or the transmission of zoonotic diseases like cystic echinococcosis (Table 6), for instance, the proper disposal of condemned offal (92.8%), wearing of gloves during slaughtering hours (94.7%) and cleaning work surfaces (98%). Lastly, the respondents agreed that the open disposal of condemned offal compromises the environment and leads to transmission of cystic echinococcosis (90.8). The total practice score was 96.1%.

Multivariate logistics regression associated with KAP scores of abattoir workers (n=152): Table 7 shows the multivariable analysis of the factors associated with the KAP scores amongst abattoir workers. There was no significant association with neither the knowledge, attitude, or practice scores nor with demographic characteristics. Although the OR indicates that females are substantially more likely to have positive knowledge, the huge CI and high p-value (0.107) show this finding is not statistically significant.

Discussion

Knowledge of abattoir workers about the zoonotic disease, cystic echinococcosis: most respondents (80.3%) had never heard the word zoonosis. These findings are similar to those Pakistan [8]. However, about half of the respondents (54.6%) in participating abattoir had knowledge about cystic echinococcosis being a zoonosis. The proportion is higher than that reported in Morocco [9] among community members and abattoir workers (50%). The overall knowledge score of abattoir workers was 32.9%, which is generally lower than those reported in Central Sudan [17], among CE patients in Southern Iran (11.1%) and community members in Uganda (17.8%) [19,30]. Moreover, our observed proportion were lower than those conducted in university students (76.1%) and in municipal veterinary practitioners in Portugal (75.4%) [14,28]. These results suggest a notable knowledge difference between abattoir workers and other investigated groups like CE patients, community members, university students, and municipal veterinarians. The lower knowledge score emphasizes how urgently focused educational interventions and capacity-building programs are needed to raise abattoir workers' awareness and comprehension. They have a crucial role in upholding public health standards, combating zoonotic illnesses, and guaranteeing food safety; therefore, expanding their knowledge is very important. In this high-risk group, closing this knowledge gap may result in better occupational safety and more efficient disease prevention.

Liver (80.3%) and lungs (38.3%) were mentioned as the most common organs that were seen infected with cysts. Hydatid cysts are found in the liver and lungs in approximately 90% of cases [31], as observed in Pakistan. In another study [32], the most implicated organs with cystic echinococcosis in animals and humans were the lungs (10-40%) and liver (52-77%). The frequent incidence of cysts found in the liver and lungs in slaughtered livestock, predominately cattle, that result in the condemnation of the carcasses, may be the cause of the high awareness of zoonotic cystic echinococcosis. Respondents were knowledgeable about the hosts for cystic echinococcosis (cattle, sheep, goats, pigs, dogs, and foxes) and indicated that cattle were mostly affected. This finding is consistent with those reported in Pakistan [33], where cattle were more affected with 21% prevalence of cystic echinococcosis and in construct with other studies where sheep were more affected [34,35]. The disease is accountable for significant economic losses due to the variety of intermediate hosts it affects, including camels, horses, goats, sheep, and cattle [18]. Thus, evaluating the degree of information about this illness and increasing awareness of preventative measures and dangerous behaviors that contribute to its spread might undoubtedly lead to the successful prevention and control of CE. Regarding the source of information, 57.2% have indicated that their source of information is from health care professionals or veterinarians, while 22.4%, 7.4%, and 13% indicated TV/radio, Books, and articles, respectively. These results may be explained by their working environment; in every slaughterhouse, there´s a veterinarian who oversees and reports cases of abnormalities of an animal and zoonotic diseases like cystic echinococcosis to raise awareness among the abattoir workers. Moreover, this finding contrasts with those of [36], where 68% of the respondents showed radio and television as the primary electronic media sources of information. Moreover, 81.7% and 75.4% of human and bovine TB information, respectively, was obtained from TV/radio [37].

Knowledge of risk factors and symptoms regarding cystic echinococcosis: the respondents (65.8%) were aware that feeding condemned meat to dogs is a risk factor that can lead to transmission of zoonotic diseases like echinococcosis; the results differ from the study conducted in Tibetan, China, where villagers (66.4%) fed condemned meat to dogs [20]. This

might also be the reason why China is one of the endemic countries with cystic echinococcosis. Moreover, 54.3% of the interviewed community members in Morocco feed infected organs, predominately liver and lungs, to dogs [9]. The knowledge from the respondents on consumption of undercooked meat as a risk factor and can lead to transmission of CE was high (77.6%). Zoonoses are mostly transmitted through the consumption of raw or undercooked meat. The consumption of undercooked meat is statistically significant at the educational level. Knowledgeable people might have easier access to safer and healthier food through a variety of sources, such as the media, healthcare professionals, and formal education. Similarly, to work title, meat inspectors, classifiers, and hygiene control respondents are more knowledgeable about the risks of consuming raw or undercooked meat. This may result in improved preventive measures, such steering clear of undercooked meat. The majority of research participants were aware of the symptoms of cystic echinococcosis in livestock. But it is important to note that 59.2% of participants misidentified the option about oversleeping as a symptom of cystic echinococcosis. This may have created biasness of their knowledge about the symptoms of echinococcosis in animals.

Attitudes of abattoir workers about the zoonotic disease, cystic echinococcosis: most respondents had a positive attitude towards cystic echinococcosis, with an attitude score of 63.2%; for example, washing hands before and after handling meat was important (67.1%). In homes, food safety and healthcare settings, handwashing is widely acknowledged as one of the most crucial infection control procedures [38]. Stricter hand washing and improved personal sanitation should result in the fundamental prevention of the spread of potentially harmful transitory pathogen [39]. This proportion is lower than those reported in South-East Nigeria, where 71.3% of the respondents knew regular hand washing was important in the abattoir [40]. Moreover, 95.4% and 95.3% of the respondents in a study among meat handlers in Ethiopia and Lagos state, Nigeria, respectively, agreed that hand before and during meat handling reduces the risk of contamination [41,42]. Poor handwashing is a major risk factor for food contamination that results in food poisoning and transmission of micro-organisms. Proper handwashing procedures in abattoirs potentially lower the frequency of zoonosis and foodborne illnesses [43].

Furthermore, respondents (70.4%) agreed that veterinarians play a vital role in promoting the prevention of zoonotic diseases like CE. When animals are taken to abattoirs, veterinarians examine them before slaughtering. This examination aids in locating any indications of diseases or hydatid cysts. Veterinarians condemn the damaged organs if hydatid cysts are found. This keeps them out of the food chain and protects the general public's health and promotes food safety. Forty-three (28.3%) of the respondents in our findings prefer not to take medical treatment if they were to be infected with cystic echinococcosis. Respondent's predisposition to medical treatment poses a risk to food safety and to other personnel who work in the food sector. in this instance, low awareness or misunderstandings regarding CE may be the cause of the unwillingness to seek treatment, which might encourage dangerous meat handling and disposal practices. These results are higher than those reported in South Sudan from pastoral communities [13]. The respondents do not believe they are at risk; they are unlikely to take precautions against contracting illness or to seek medical assistance, which increases the chance of infection. Herbal remedies have long held a significant place in complementary and alternative medicine practices all across the world [44]. The respondents agreed that the use of herbal medicine is important for the treatment of zoonosis. Traditional disease treatment techniques are still widely employed, in part because they are not only easily accessible but also deeply ingrained in the culture, identity, and tradition. In the context of this study, half of the respondents

prefer conventional medicine over traditional (*iyeza*), this could be that conventional medicine is frequently backed by clinical studies, scientific research, and standardized dosages, respondents may be more likely to trust it than traditional medicine. The respondents (91.9%) agreed that training about zoonotic and foodborne diseases is important. The lack of interdisciplinary training among abattoir workers makes it more difficult for them to work together to treat zoonotic infections. Adopting policies that link the health of people, animals, and the environment must be the primary priority of policymakers [45]. Multidisciplinary and interdisciplinary education in the fields of environmental, animal, and human health is required, as is cooperative research on zoonotic disease prevention.

Practices of abattoir workers towards prevention/control of the zoonotic disease, cystic echinococcosis: regarding personal hygiene, most of the respondents (98%) were aware of the significance of maintaining a clean workstation using soap and water, and they mentioned the significance of cleaning their work area in between each animal rotation, which is to avoid food-borne diseases and adhering to the meat inspector´s manual. Water cleaning has been proven to be ineffective at removing pathogens from surfaces used in meat processing unless disinfectants or detergents are used. This finding is higher than in Nigeria, where 45.2% of the respondents clean their work surfaces with water and soap [40]. Furthermore, respondents wore gloves during the slaughtering process (94.7%). These findings are consistent with a study conducted in Ghana among food handlers where 77.9% wear gloves while handling food [46]. Protective gear is generally used in slaughterhouses to prevent contamination of meat products. Still, it has also been demonstrated to shield meat handlers from zoonoses that are spread directly to them [47].

The proper disposal of condemned meat in slaughterhouses must be in accordance with the Meat safety [No. 40 Act of 2000]. According to the respondents, proper disposal of condemned offal through burning and burial helps prevent the transmission of zoonosis in humans and animals (92.8%). These findings reveal awareness among the participants regarding the spread of diseases from the environment to meat or the lax enforcement of environmental sanitation regulations [42]. The positive practice from the respondents is that they have a receptacle to discard the condemned meat. Having a veterinarian oversee the slaughter of animals at abattoirs lowers the possibility of *Echinococcus*life cycle completion by ensuring that contaminated offal is properly disposed [48]. According to a study conducted in Northern Morocco, social, infrastructural, economic, and political factors are linked in Moroccan abattoirs, normalizing the open disposal of hydatid cysts to free roaming dogs [49]. The respondents agreed that open disposal of condemned carcasses compromises the environment (91.4%). Therefore, it is important to take precautions before disposing of abattoir waste, as it can have negative effects on both the environment and human health. Abattoir risks include the possibility of air, soil, surface water, and groundwater pollution, which can have an impact on public health [50].

Conclusion

In conclusion, this study has shed light on the knowledge, attitudes and practices of abattoir workers in the Eastern Cape regarding CE. Although respondents were aware of CE and its risk factors, they lacked adequate knowledge about the disease, and a significant number of people were not knowledgeable about the symptoms of the disease. Moreover, a high number of respondents have seen hydatid cysts, considering this may have raised the awareness of the disease. The fact that they are always in contact with meat, awareness about the transmission and preventatives of the disease must be raised. It is vital that public health education, training on zoonotic disease prevention, and awareness-raising programs must be conducted to raise awareness and promote

food safety and transmission of cystic echinococcosis. Our study targeted abattoir workers, and so for future studies, we recommend the extension of the study to other segments of the population, for instance, dog owners, since dogs are the definitive hosts of the diseases, farm owners, veterinarians in the Eastern Cape, as well as in provinces in the country, in order to obtain more comprehensive information on cystic echinococcosis and to check if there are any differences in these categories.

What is known about this topic

- *It has been reported by the World Health Organisation that cystic echinococcosis is one of the 17 neglected tropical diseases;*
- *Research findings in various demographics about cystic echinococcosis were inconsistent;*
- *The One Health concept is useful in understanding the spread, evaluating prevention and control of cystic echinococcosis.*

What this study adds

- *KAP study regarding cystic echinococcosis have never been studied in the Eastern Cape Province, South Africa. This study provides a knowledge gap among abattoir workers;*
- *This study will add to the existing abattoir studies regarding zoonotic diseases in the Eastern cape province, South Africa;*
- *This study will serve as a baseline for policy makers to improve zoonoses and foodborne diseases' training among abattoirs and enforce regulations.*

Competing interests

The authors declare no competing interests.

Authors' contributions

All authors participated in the conceptualization and study design. Siyasamkela Mbobo, Charles Byaruhanga, Ishmael Festus Jaja: acquisitions of data and drafting. Siyasamkela Mbobo: data analysis, interpretation and drafting. Charles Byaruhanga, Ishmael Festus Jaja: critical reviewing of the manuscript. All the authors have read and agreed to the final version of this manuscript.

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Tables and figures

Table 1: socio-demographic of abattoir workers in the Eastern Cape, South Africa

Table 2: evaluation of knowledge about cystic echinococcosis amongst abattoir workers

Table 3: evaluation of knowledge of risk factors associated with cystic echinococcosis among abattoir workers in the Eastern Cape province, South Africa

Table 4: evaluation of knowledge of symptoms regarding cystic echinococcosis among abattoir workers in the Eastern Cape province, South Africa

Table 5: attitudes associated with control of cystic echinococcosis among abattoir workers in Eastern Cape Province, South Africa

Table 6: practices associated with control of cystic echinococcosis among abattoir workers in Eastern cape, Province, South Africa

Table 7: multivariate logistics regression of factors associated with knowledge, attitude and practices towards cystic echinococcosis among abattoir workers in the Eastern Cape province, South Africa

Figure 1: the map shows the distribution of the local municipalities marked in red, and the insert is a map of the Eastern Cape province with red dots that indicate the location of the abattoirs

Figure 2: sources of information regarding cystic echinococcosis among abattoir workers in the Eastern Cape, South Africa (n=152)

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Table 1: socio-demographic of abattoir workers in the Eastern Cape, South Africa (n=152)			
Demographic characteristic	**Category**	**Frequency N=152**	**Percentage %**
Gender	Female	24	15.2
	Male	128	84.2
Age	18-30	68	44.7
	31-45	58	38.2
	46+	26	17.1
Race	Black	127	83.6
	Coloured	20	13.2
	White	5	3.3
	Indians	-	-
Educational level	Never	-	-
	Primary	23	15.1
	Secondary	105	69.1
	Tertiary	24	15.8
Work title	Supervisor	2	1.3
	Meat inspector	11	7.2
	Slaughterer	36	23.7
	Offal worker	14	9.2
	General worker	81	53.3
	Manager	4	2.6
	Meat classifier	1	0.7
	Hygiene control	1	0.7
	Meat packer	2	1.3
Work experience	≤5	114	75.0
	6-10	24	15.8
	≥11	14	9.2
Local municipality	Buffalo City Metropolitan	75	49.0
	Makana	11	7.2
	Enoch Mgijima	26	17.1
	Nelson Mandela Bay Metropolitan	34	22.4
	Raymond Mhlaba	6	3.9
Abattoir name/number	1	19	12.5
	2	56	36.8
	3	11	7.2
	4	26	17.1
	5	17	11.2
	6	6	
	7	17	11.2
Abattoir type	High throughput	135	88.8
	Low throughput	17	11.2
How often do you go for medical check-up?	Never	75	49.3
	Monthly	9	5.9
	Quarterly	10	6.6
	Twice a year	26	17.1
	Yearly	32	21.1

Table 2: evaluation of knowledge about cystic echinococcosis amongst abattoir workers	
Question (s)	**Responses (n)%**
Have you heard the word zoonosis?	
Yes	(30)19.7
No	(112)80.3
Zoonosis is an infectious disease that is transmitted between species, from animals to humans	
Yes	(92)60.5
No	(60)39.5
Is cystic echinococcosis a zoonosis?	
Yes	(83)54.6
No	(69)45.4
Have you noticed hydatid cysts from slaughtered animals in this abattoir	
Yes	(101)66.4
No	(51)33.6
Indicate which animals are mostly affected by Cystic echinococcosis	
Cattle	
Yes	(95)62.5
No	(57)37.5
Goats	
Yes	(4)2.6
No	(148)97.4
Dogs	
Yes	(16)10.5
No	(136)89.5
Sheep	
Yes	(74)48.7
No	(78)51.3
Pigs	
Yes	(44)28.9
No	(108)71.5
Foxes	
Yes	(9)5.9
No	(143)94.1
Indicate which organ can are cysts commonly found	
Lungs	
Yes	59(38.8)
No	(93)61.2
Liver	
Yes	128(84.2)
No	24(15.8)
Skin	
Yes	34(22.4)
No	(118)77.6
Heart	
Yes	19(12.5)
No	133(87.5)

Table 3: evaluation of knowledge of risk factors associated with cystic echinococcosis among abattoir workers in the Eastern Cape province, South Africa (n(%); number of respondents and their percentages, χ2; chi-square)

	Characteristics	**Response**							
		Feeding condemned offal is a risk factor		**Keeping dogs at home and on the farm could play a role in the transmission of zoonosis**		**Cystic echinococcosis can be contracted through the consumption of undercooked meat**		**Purchasing uninspected meat from informal slaughter is a risk factor**	
		Yes	No	Yes	No	Yes	No	Yes	No
Gender	Male	82(64.1)	46(35.9)	65(50.8)	63(49.2)	97(75.8)	31(24.2)	101(78.9)	27(21.1)
	Female	18(75.0)	6(25.0)	17(70.8)	7(29.2)	21(87.5)	3(12.5)	19(79.2)	5(20.8)
Statistics		χ2=1.074; P=0.300		χ2=3.271; P=0.071		χ2=1.598; P=0.206		χ2=0.001; P=0.977	
Educational level	Never	-	-	-	-	-	-	-	
	Primary	16(69.5)	7(30.5)	10(43.5)	13(56.5)	18(78.3)	5(21.7)	17(78.3)	6(21.7)
	Secondary	65(61.9)	40(39.1)	57(54.3)	48(47.7)	76(72.4)	29(27.6)	82(78.1)	23(21.9)
	Tertiary	19(79.2)	5(20.8)	15(62.5)	9(37.5)	24(100)	0(0)	21(87.5)	3(12.5)
Statistics		χ2=2.758; P=0.252		χ2=1.726; P=0.422		**χ2=8.588 P=0.014**		χ2=1.453 P=0.484	
Work title	Supervisor	2(100)	0(0)	2(100)	0(0)	1(50)	1(50)	2(100)	0(0)
	Meat Inspector	11(100)	0(0)	8(72.7)	3(27.3)	11(100)	0(0)	11(100)	0(0)
	Slaughterer	27(75)	9(25)	20(75)	16(25)	33(91.7)	3(8.3)	31(86.11)	5(13.9)
	Offal worker	10(71.4)	4(28.6)	8(57.1)	6(42.9)	13(92.9)	1(7.1)	10(71.4)	4(28.6)
	General worker	42(62.28)	39(37.72)	39(48.1)	42(51.9)	52(64.2)	29(35.8)	58(71.6)	23(28.4)
	Manager	4(100)	0(0)	2(50)	2(50)	4(100)	0(0)	4(100)	0(0)
	Meat classifier	1(100)	0(0)	1(100)	0(0)	1(100)	0(0)	1(100)	0(0)
	Hygiene control	1(0)	1(0)	0(0)	1(100)	1(50)	1(50)	1(100)	0(0)
	Meat packer	2(100)	0(0)	2(100)	0(0)	2(100)	0(0)	2(100)	0(0)
Statistics		**χ2=19.466; P=0.013**		χ2=8.218; P=0.412		**χ2=20.725; P=0.008**		χ2=9.815; P=0.278	

Table 4: evaluation of knowledge of symptoms regarding cystic echinococcosis among abattoir workers in the Eastern Cape province, South Africa (n=152)	
Question(s)	**Responses (n)%**
Is coughing a symptom of cystic echinococcosis?	
Yes	(80)52.6
No	(72)47.4
Is blood sputum a symptom of cystic echinococcosis?	
Yes	(91)59.9
No	(61)40.1
Is vomiting a symptom of cystic echinococcosis?	
Yes	(95)62.5
No	(57)37.5
Are seizures symptoms of cystic echinococcosis?	
Yes	(79)51.3
No	(74)48.7
Is abdominal discomfort a symptom of cystic echinococcosis?	
Yes	(87)57.2
No	(65)42.8
Is oversleeping a symptom of cystic echinococcosis?	
Yes	(90)59.2
No	(62)40.8

Table 5: attitudes associated with control of cystic echinococcosis among abattoir workers in Eastern Cape Province, South Africa (n=152)	
Question(s)	**Responses (n)%**
Veterinarians play an important role in promoting the prevention of zoonotic diseases like cystic echinococcosis	
Yes	(107)70.4
No	(45)29.6
Abattoir workers are among people who are at risk of contracting cystic echinococcosis	
Yes	(110)72.4
No	(42)27.6
Washing hands before and after slaughtering is not important	
Yes	(50)32.9
No	(102)67.1
Would you take any medical treatment if you were infected by cystic echinococcosis	
Yes	(109)71.7
No	(43)28.3
Regular training on zoonosis and food borne diseases is important	
Yes	(112)73.7
No	(40)26.3
The use of herbal medicine (iyeza) such as aloe (Ikhala) is important in the treatment of zoonosis	
Yes	(91)59.9
No	(61)40.1
Would you prefer the use of conventional medicine over traditional medicine	
Yes	(76)50.0
No	(76)50.0
Abattoir workers have the right to consume condemned meat	
Yes	(33)21.7
No	(119)78.3
Condemned meat is not necessarily bad meat to consume	
Yes	(38)25.0
No	(114)75.0

Table 6: practices associated with control of cystic echinococcosis among abattoir workers in Eastern cape, Province, South Africa	
Question(s)	**Responses (n)%**
Proper disposal of condemned offal through burning and burial will help prevent the transmission of zoonosis in humans and animals	
Yes	(141) 92.8
No	(11) 7.2
Wearing masks and gloves during slaughtering hours is important in preventing transmission of zoonosis?	
Yes	(144) 94.7
No	(8) 5.3
Good abattoir practices, such as cleaning work surfaces, can prevent or control the spread of Cystic echinococcosis	
Yes	(149) 98.0
No	(3) 2.0
The open disposal of condemned offal compromises the environment and then leads to the transmission of Cystic echinococcosis	
Yes	(138) 90.8
No	(14) 9.2

Table 7: multivariate logistics regression of factors associated with knowledge, attitude and practices towards cystic echinococcosis among abattoir workers in the Eastern Cape province, South Africa (n=152)

Factors	**Knowledge**			**Attitude**			**Practice**		
	Average	OR	P-value	Positive	OR	P-value	Positive	OR	P-value
	n(%)	(95% CI)		n(%)	(95% CI)		n(%)	(95% CI)	
Gender									
Male	41(82)	Reference		77(80.2)	Reference		123(84.2)	Reference	
Female	9(18)	28.9(0.5,1757.1)	0.107	19(19.8)	0.8	1.00	23(15.8)	0.8(0)	1.00
Age									
18-30	26(52)	Reference		40(41.7)	Reference	-	66(45.2)	Reference	-
31-45	16(32)	0.8(0.1,5.3)	0.801	37(38.5)	0.8(0)		54(37)	0.8(0)	1.00
46+	8(16)	0.6(0.1,5.8)	0.464	19(19.8)	1.3(0)	1.00	26(17.8)	1.3(0)	1.00
Working experience									
<5	38(76)	Reference	-	69(71.9)	Reference		108(74)	Reference	
6-10	7(14)	0.5(0,4.4)	0.513	15(15.6)	1.2(0)	1.00	24(16.4)	1.2(0)	1.00
>11	5(10)	0.4(0,5.8)	0.539	12(12.5)	0.9(0)		14(9.6)	0.9(0)	1.00
Abattoir type									
High throughput	43(86)	Reference		83(86.5)	Reference		129(88.4)	Reference	
Low throughput	7(14)	29.5(0)	0.543	13(13.5)	0.4(0)	1.00	17(11.6)	0.4(0)	1.00

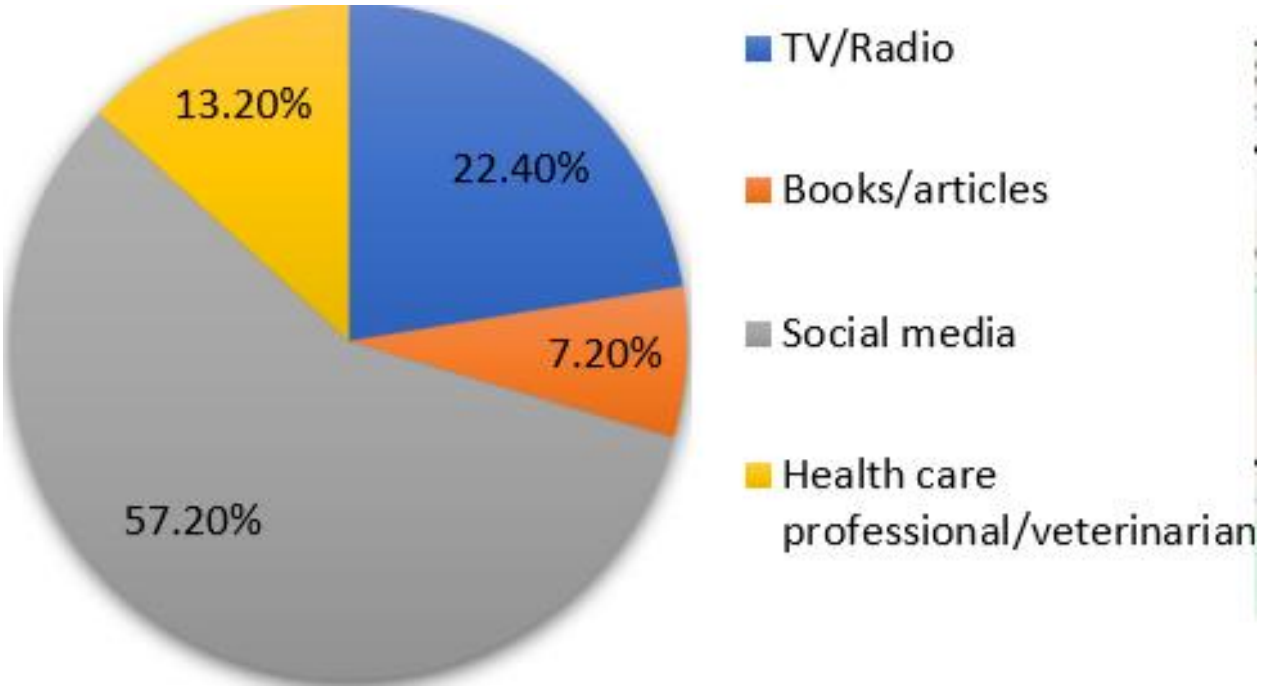

Figure 2: sources of information regarding cystic echinococcosis among abattoir workers in the Eastern Cape, South Africa (n=152)