International Journal of Scientific Research and Management (IJSRM)
||Volume||10||Issue||02||Pages||MP-2022-547-557||2022||
Website: www.ijsrm.in ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v10i02.mp03

Prevalence and transmission dynamics of hydatidosis in slaughtered animals in Dodoma municipality, Tanzania

Mangi J. Ezekiel[1], Miraji A. Mawaka[2], Donath S. Tarimo[3] & Idda H. Mosha[1*]

[1]Department of Behavioral Sciences, Muhimbili University of Health and Allied Sciences (MUHAS), Dar es Salaam, Tanzania
[2]Military College of Medical Sciences (MCMS), Lugalo, Dar es Salaam, Tanzania
[3]Department of Parasitology and Medical Entomology, Muhimbili University of Health and Allied Sciences (MUHAS), Dar es Salaam, Tanzania

Correspondence author: Idda Hubert Mosha
Department of Behavioural Sciences,
School of Public Health and Social Sciences, Muhimbili University of Health and Allied Sciences (MUHAS), Po Box 65015, Dar es Salaam, Tanzania

Abstract

Background

Cystic Echinococcosis has been reported to exist both in humans and animals affecting people with their livestock. This study examined the prevalence of Cystic Echinococcosis in slaughtered animals; practices facilitating transmission and perceived risk of human infection in Dodoma municipality, Tanzania.

Methods

A quantitative cross-sectional study was conducted. Prevalence of Cystic Echinococcosis was determined by physical examination of organs from slaughtered animals. Collected cysts were preserved in formalin, and then transported to Parasitology laboratory for establishment of fertility. A questionnaire was used to collect data. Data analysis was done by Statistical Package of Social Sciences software. Frequency tables on the prevalence of hydatidosis fertility rate of hydatid cysts, demographic characteristics, awareness, knowledge, risk perception and practices were tabulated. Chi square test was used to test relationship between variables related to awareness and knowledge on hydatidosis.

Results

Inspected animals for Cystic Echinococcosis in different organs were 1,485, among them700 were cattle, 430 goats and 355 sheep. Overall prevalence of Cystic Echinococcosis in all animals was 4.7%; and 7.6%, 2.1% and 2.3% for cattle, goats and sheep, respectively. Fertility rate was; 50.9% in cattle, 33.3% in goats, and 50% in sheep. The questionnaire involved 361 respondents. Majority 91.7% had low knowledge, 8.3% moderate on Cystic Echinococcosis. Backyard-slaughtering, free-range dogs and livestock keeping, feeding offal to dogs and close relationship between dogs, humans and livestock kept the community at risk of acquiring Cystic Echinococcosis.

Conclusion

Cystic Echinococcosis was high among ruminant animals in Dodoma. Majority of participants had limited awareness on modes of transmission and practices that put them at risk. Close proximity to dogs indicates the potential risk for human infection. Collaboration between medical and veterinary sectors is recommended to raise community awareness and address the problem.

Key words:*Cystic Echinococcosis, Hydatidosis, Prevalence, Ruminant animals, risk factors, Tanzania*

Background

Echinococcosis, often-referred to as hydatidosis, is a parasitic disease caused by tapeworms in the genus *Echinococcus* that affects both humans and livestock. It has therefore both economic and public health

significance [1]. There are three different forms of echinococcosis, each of which is caused by the larval stages of different species. The most common form found in humans is Cystic echinococcosis (CE) caused by *Echinococcusgranulosus* (EG) [2].

The lifecycle of these parasites involve two mammalian hosts, definitive (e.g. dogs) and intermediate (e.g. sheep). Adult worm resides in small intestine of definitive host. They produce eggs or gravid proglotids that contain infective oncospheres, which are passed in the faeces of definitive host to the environment. The egg is then ingested by intermediate hosts (e.g. cattle, sheep, goats or camel) when grazing and hatch in the small intestine. Oncospheres are releases and penetrate the small intestine wall to different organs where they develop especially in liver and lungs. Oncospheres develop into cyst, slowly enlarges creating protoscolices and daughter cysts. The definitive hosts are infected when they ingest offal from intermediate hosts that contain cysts. Protoscolices attach in small intestine and develop into adult worms and the cycle repeats all over again [1]. Human, is an aberrant intermediate host for the disease, gets infected following accidental ingestion of eggs in contaminated food, water, soil or physical contact with infected dog. Incubation period for all species of echinococcous range from months to years and even decades, depending on the location of the cyst in the body and how fast or slowly the cyst is growing [1], [2].

Ingestion of the eggs when they are passed out through the faeces leads to infection in the intermediate host like cattle, goat, sheep or human. When the embryos are released from the eggs, they develop as hydatid cyst, which grows slowly to about 5 to 10 cm within the first year. They can survive within organs for years. Cysts can grow to be large that after several years or decades they can harbour several litres of fluid [2], [4].

Principally, cystic echinococcosis cycle is maintained through dog – ruminant – dog. When human is infected, it is considered a dead end, simply because there is no human-to-human transmission and dogs cannot feed on humans. Dogs can also be infected through scavenging on the infected ruminant offal improperly thrown in streets. Direct contact with infected dogs and consuming foods, vegetables, water and handling soil contaminated with infected dog faeces are important modes of transmission to humans [3], [5].

Other risk factors identified for CE and AE includes; poor hygienic practices, female gender, low income, limited education and dog ownership [6]. Wahlers *et al*., stated that, the combination of people and dogs living in close proximity, scarce water resources, and conditions with poor hygiene provide the ideal environment for *Echinococcus species* [7].

Hydatidosis has less adverse effects to definitive host compared to intermediate hosts; a particularly human who is infected when accidentally ingest eggs through foods, water or direct contact with infected definitive host. Ingested eggs give rise to hydatid cyst, which slowly enlarges in the lodged organ. As the cyst grows, signs and symptoms begin which varies depending on the location and size in the body, duration of development and cyst type. For instance, patients with cyst in the lungs, will cough, shortness of breath and/or chest pain, whilst those with cysts in the liver, will suffer from abdominal pain and tenderness, hepatomegaly with abdominal mass, jaundice, fever and anaphylactic reaction [8].

Cystic Echinococcosis infection is chronic taking years for symptoms to develop, thus, its medical impact in late stages is usually significant, and morbidity and mortality in most cases are under reported. With human hydatidosis, clinical signs may occur at the age of 20 to 60 years, and include tissue fibrosis or necrosis in the affected organs. Due to the disease nature that makes diagnosis and treatment cumbersome, as well as the infection cycle to be maintained in domestic livestock and dogs, the disease is difficult to assess in terms of public health impact [4].

The disease receives very little attention from national and international community, though it is a worldwide zoonotic disease which poses a global burden of human hydatidosis, which is approximately one million and 600,000 Disability Adjusted Life Years (DALYs). In livestock, the economic loss has been estimated to be over $ 2 billion annually. Despite of these socio-economic consequences, Echinococcosis remains neglected zoonosis [9], [10].

In Sub-Saharan Africa, CE is considered endemic, with variable distributions in different countries. Nevertheless, for most countries, data on CE are scarce, poorly documented if any and little information on burden of the disease, despite the fact that available evidence shows that several species within E.*granulosus* complex are prevalent [5], [7], [11], [12]. Moreover, community awareness on practices that facilitate transmission and fertility status of hydatid cyst were also important epidemiological factors for Echinococcosis as it had been previously reported [12]. The study has provided an insight on the presence of

hydatidosis in the domestic food animals as well as the limited awareness among the community members about the disease.

In Tanzania, CE has been reported in Ngorongoro, Arusha, Tanga, Morogoro, Mbeya and some other few regions like Dodoma, of which no publish information so far is available. However, local slaughterhouse data and studies done in Dar es Salaam suggest the presence of Echinococcosis in domestic ruminants in Dodoma whereby most (>90%) of presented animals for slaughter were from Dodoma [13], [14], [15].

With Echinococcosis geographical distribution particularly in nomadic pastoralists where life cycle of its agent is well favoured, and evidences show that the prevalence of hydatidosis in farm animals are similar with the human rate of infection [5],[16], [17]. This study aimed to determine the prevalence of CE among slaughtered domestic ruminants in which the overall prevalence of CE in Dodoma region, Tanzania.

Materials and Methods

A quantitative cross-sectional study design was conducted in Dodoma municipality between May and June 2014. Dodoma region was chosen due to the fact that it represents areas in which indigenous human population and their livestock can be exposed to hydatidosis for some studies suggest the presence of the disease in animals [13], [15].

Study population

The study involved animals and human subjects. The target animals were ruminants which include cattle, goats and sheep in which most of them were originating from different localities (divisions, wards and villages) within Dodoma region and very few from neighboring regions. They were all brought for slaughtering at Dodoma municipal abattoir. All ruminants presented at Dodoma abattoir for slaughter during study period were included in the study. In case of human subjects, the study population involved heads of household (father or mother).

Sampling technique

Multistage random sampling procedure was used to select study participants from the households in the community. In case of meat inspection, all ruminants presented at Dodoma abattoir for slaughter during study period were included in the study.

Data collection tools

Observation check list

Observation findings from carcasses were recorded on the well-designed check-list and carefully handled. Hydatid cysts were carefully collected, preserved using formalin, packed in plastic containers and transported to MUHAS Parasitology laboratory for further investigations.

Questionnaire

A household questionnaire interview was carried out with 361 male or female head of household. The interview focused on determining community awareness, knowledge, perceived risk of human infection and practices potentially predisposing to CE transmission. The questions were translated into Kiswahili which is a common language used in Tanzania.

Meat inspection

During meat inspection, carcasses were carefully examined in accordance with the procedures of the Tanzania animal diseases Act (2003) and Veterinary Act (2003) of the Ministry of Livestock Development, for the detection of hydatidosis. Post-mortem examination was carried out on different organs of each of the slaughtered animals, particularly lung, liver, heart and the spleen. Each organ was carefully assessed macroscopically by visual inspection and palpation and where necessary one or multiple incisions were made to detect small hydatid cyst.

Cysts from each infected organ were carefully removed and preserved with formalin, thereafter transported to MUHAS Parasitology laboratory for further examination and fertility status were determined. In the laboratory, individual cyst was carefully opened and examined to identify whether it was a hydatid cyst and whether it was fertile or sterile (calcified). Cyst fluid was aspirated using a 10 or 5 ml syringe and a drop of the cyst fluid was placed on the microscope glass slide and observed for the presence of protoscolices on

compound microscope with X10 to X40 objectives [18]. All observations were carefully recorded on a well designated checklist for analysis. The number of hydatid cyst per infected organ was counted and recorded. Anatomical distribution of hydatid cyst was determined by recording the infected organ.

Ethical considerations

Ethical clearance was obtained from MUHAS Institutional Review Board. Further, permission from the General Manager, Tanzania Meat Company Limited- Dodoma and the Director Dodoma Municipal were sought prior conducting the study. Written informed consent was sought from each individual subject before commencement of the interview. For illiterate subjects, oral consent was obtained. Furthermore, permission was sought from study participants before taking photos which are used in this study.

Data process and analysis

After data collection, raw data were cleaned, coded, classified, edited to remove outliers and entered into a computer by investigator and analyzed using SPSS software version 15. Analysis was done by using Statistical Package of Social Sciences (SPSS) software. Frequency tables on the prevalence of hydatidosis in different species of animals, fertility rate of hydatid cysts, demographic characteristics, awareness, knowledge, risk perception and practices were tabulated. Proportions and 95% Confidence intervals were used to describe categorical variables whereas (standard deviation) were used to summarize numerical data. *Chi* square test was used to test relationship between different variables (sex, occupation, education level) in relation to knowledge on hydatidosis. P–Value of less than 0.05 was considered significant.

Results

Prevalence of CE among slaughtered animals

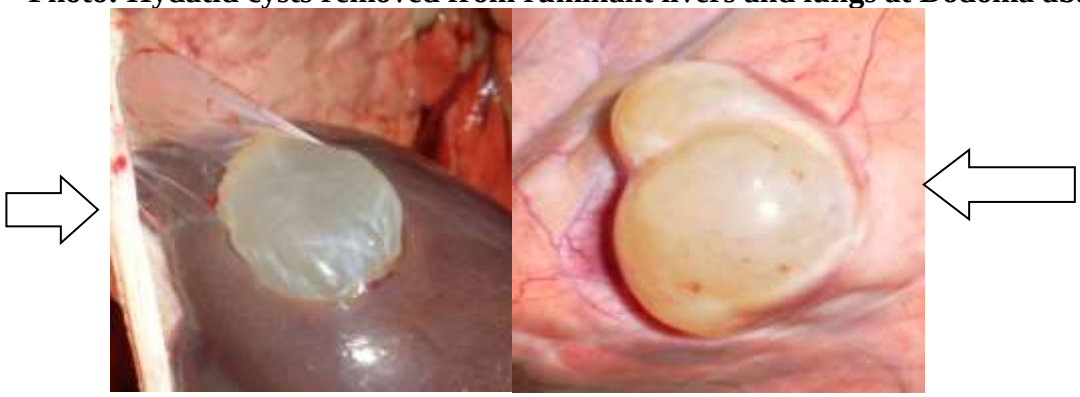
A total of 1,485 domestic livestock were slaughtered and inspected for CE as part of routine slaughter at Dodoma municipal council abattoir. All slaughtered animals were adults, and included 700 cattle, 430 goats and 355 sheep. Cattle and goats were the most commonly slaughtered animals.

The overall prevalence of CE was found to be 4.7% [95% CI: 3.6-5.8]. A highly significant ($p<0.000$) hydatid infection rate was recorded in cattle (7.6%) with 95% CI: 5.8 - 9.9 than in goats (2.1%) with 95% CI: 0.7 - 3.5 and sheep, 2.3% [95% CI: 0.7 – 3.9] Table 1 below:

Table 1: Prevalence of CE in ruminant animals and sex variation in prevalence of CE in cattle (n=1485)

Animal species	Number examined		Positive cases		Prevalence
	Male	Female	Male	Female	
Cattle	451	249	30(4.3%)	23(3.3%)	**7.6%**
Goat	430		9		**2.1%**
Sheep	355		8		**2.3%**
Total	**1485**		**70**		**4.7%**

Photo: Hydatid cysts removed from ruminant livers and lungs at Dodoma abattoir



Distribution of cysts in affected organs and fertility status

The lungs were the most affected organs in cattle 51(96.2%) and contribute to 72.9% of the total cysts found in all species of animals, with fertility rate of 50.9%, followed by liver; however, there was no recorded cyst infection in spleen and heart. Removed cysts from the liver were all sterile. Goats' and sheep's livers were more infected 8 (88.9%) and 8(100%) respectively, than cattle liver 2(3.8%), with fertility rate of 33.3%. Nevertheless, most of the cysts (65.7%) were sterile.

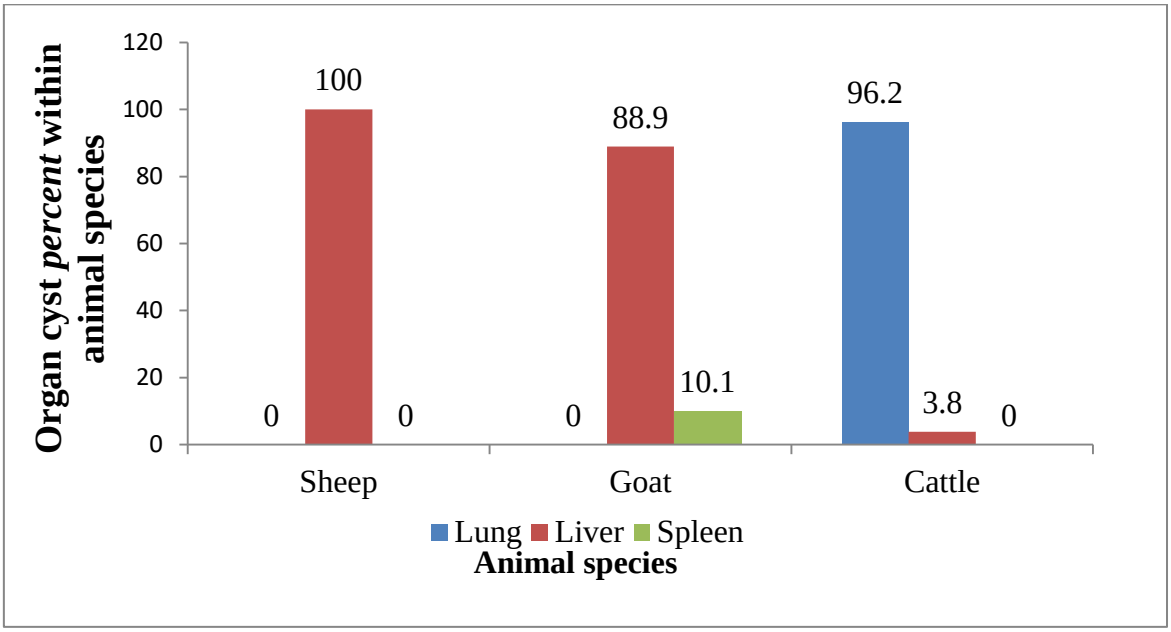


Figure: Distribution of cysts in organs in domestic animals slaughtered at Dodoma abattoir (the numbers are in %)

Household survey for risk factors for E. *granulosus* transmission

A total of 361 heads of household were interviewed in this study. Of these, males constituted 191 (52.9%) and their mean (SD) age was 43.6 (14.5) with the range of 65 (20-85) years. About 117 (32.4%) of participants were aged 50 and above years. Most of respondents 234 (64.8%) completed primary education and peasantry was the main occupation reported income generating activity, constituting 307 (85.0%) participants.

Table 2.Characteristics of survey participants (n=361)

Variable	Sex		Total	P-value
	Male	Female		
Age group(years)				
20 – 29	26(7.2%)	40(11.1%)	66(18.3%)	
30 – 39	44(12.2%)	49(13.3%)	92(25.5%)	
40 – 49	52(14.4%)	34(9.4%)	86(23.8%)	
50 +	69(19.1%)	48(13.3%)	117(32.4%)	**0.023**
Education				
No education	34(9.4%)	57(15.8%)	91(25.2%)	
Primary	135(37.4%)	99(27.4%)	234(64.8%)	
Secondary & above	22(6.1%)	14(3.9%)	36(10.0%)	**0.003**
Occupation				
Peasant	164(45.4%)	143(39.6%)	307(85.0%)	
Employed	9(2.5%)	8(2.2%)	17(4.7%)	

Businessman	9(2.5%)	13(3.6)	22(6.1%)	
Livestock keeper	9(2.5%)	6(1.7%)	15(4.2%)	**0.658**
Grand total	**191(52.9%)**	**170(47.1%)**	**361(100%)**	

There was a clear difference of education level between male and female, the former being more privileged in education compared to the later. The difference in education between sex is statistically significant (P-value =0.003). Apart from crop farming (peasantry), animals were also kept by community members which included cattle, goats, sheep, pigs and few donkeys.

Proportion of households that kept one (1) dog was 29.9%, and it decreased with increased numbers of dogs per household. The mean number of dogs per household was 2.8 ≈ 3.Almost all respondents (99.4%) reported to see the dogs roaming freely in the streets. Dogs owning is the major risk factor of contracting CE, and specifically when they are kept free of range. Dogs can contaminate environment by defecating everywhere they roam, and are often left to scavenge any dead animals. Table 3 shows the number of dogs kept per household.

Table 3: Number of dogs kept per household and management styles (n=127)

No. dogs/household	**No. of household**	**Household Percentage**	**Management style**	
			Free range	**Housed**
1	38	29.9		
2	33	26.0		
3	25	19.7		
4	13	10.2		
5	7	5.5		
6	4	3.1		
7	1	0.8		
8	1	0.8		
9	2	1.6		
30	1	0.8		
Total	**127**	**100.0**	**110**	**17**

Awareness and modes of its transmission

Results show that of 361 respondents who were asked whether they have ever heard or know about CE, 295 (81.7%) said they have never heard, i.e. they are not aware, only 66 (18.3%) reported to have heard about It. About 44.4% of study participants with secondary education and above reported to have heard about CE; whilst only 15.4% to who have either no education have heard about the disease. It shows that exposure to education at least from secondary and above has an influence on awareness of the disease (P<0.05).

Kind of occupation someone does had also an influence on someone's awareness, with employed people having higher awareness (47.1%) with p-value = 0.004. This also could probably be influenced by level of education. However, there was no statistical significance between awareness on CE against sex and age of respondents, where P-value >0.05 in both variables.

Practices related to transmission of Cystic Echinococcosis

Results revealed that 35.2% of respondents kept dogs, among them 86.6% left their dogs roam freely in the community. Almost all respondents 359 (99.4%) reported that there were many stray dogs in the community. Majority (78.7%) reported to feed their dogs with offal while 73.0% out of these are reported to consume raw offal. More than half 77(60.6%) of these dogs had never been dewormed and majority (97.6%) were reported to defecate within house premises. All these are transmission risk factors that predispose the community to CE infection to both humans and their animals.

Results show that 82.3% livestock keepers let their livestock move freely at a far distant on grazing. On addition, 59.1%dog keepers reported that their dogs went out to graze with their animals as guards. Moreover, 33.5% of all respondents in reported to practice backyard animal slaughter.

Table 4: Risk practices for CE infection and transmission in Dodoma

Questionnaire item	Responses	Number of respondents	Percent (%)
Dog owning(N=361)	Yes	127	35.2
Where dogs roam?(n=127)	Within house compound	77	60.6%
Dogs management (n=127)	Free range	110	86.6
Presence of stray dogs (n=361)	Yes	359	99.4
Dogs consume offal?(n=127)	Yes	100	78.7
Offal preparation (n=100)	Raw	73	73.0
Dogs defecation	Outside house premises	124	97.6
Livestock grazing system (n=282)	Free range	232	82.3
Home slaughter of livestock (n=361)	Yes	121	33.5
What you do with self-died livestock? (n=361)	Throw away	24	6.6
	Skin and eat	227	62.9
	Feed dogs	7	1.9
Do dogs go to graze with livestock? (n=127)	Yes	75	59.1
Do your children play with dogs? (n=361)	Yes	72	19.9

Perceived risk of CE infection to humans, ruminant animals and dogs

Most of respondents 274(75.9%) perceived high risk of CE infection on exposure to dog faeces, whilst 48 (13.3%) perceived no risk and the rest assumes that it has low to medium risk.

Free-range livestock keeping was perceived high risk factor by 264 (73.1%) and 16.3% said no risk at all. Free dog keeping was also perceived as high risk for CE infection by 71.7% of respondents and 15.8% of them believes that it has no risk. More than half (56.8%) ranked the risk of acquiring infections from your own dog as high risk. In the case of dogs posing health risks to other animals, 72.9% perceived to have high risk whilst 13.3% have the perception of having no risk. Generally speaking most of the risk factors for CE infection were perceived to have high risk by majority of respondents.

Table 5: Perceived risk of CE infection (n=361)

Variable for risk perception	Response of participants			
	No risk	**Low risk**	**Medium risk**	**High risk**
Disposed offal to dog CE infection	69(19.1%)	14(3.9%)	35(9.7%)	243(67.3%)
Dog faeces to CE infection	48(13.3%)	18(5.0%)	21(5.8%)	274(75.9%)
Free range livestock keeping	59(16.3%)	15(4.2%)	23(6.4%)	264(73.1%)
Dog risk to other animals	48(13.3%)	12(3.3%)	38(10.5%)	263(72.9%)
Infection from dogs	75(20.7%)	36(10.0%)	45(12.5%)	205(56.8%)

Free dog keeping	57(15.8%)	10(2.8%)	35(9.7%)	259(71.7%)

Discussion

Cystic Echinococcosis (CE) is an important public health problem globally [19]. This study examined the prevalence of CE in slaughtered domestic ruminants; transmission factors and perceived risk of human infection in Dodoma municipality. The findings revealed the existence of Cystic Echinococcosis in domestic ruminant food animals (cattle, goats and sheep) in Dodoma region. The findings are in corroboration with previous work done by Batamuzi*et al*., who reported a prevalence of 7.9% for cattle and 4.7% for goats and sheep in Dar es Salaam city [13].

Furthermore, during a routine meat inspection, a cumulative prevalence of CE in cattle was recorded to be 4.26% from January to October 2013, in Dodoma abattoir. This is slightly lower compared to findings in the current study which revealed 7.6% CE in cattle. The difference may be due to the method of data collection, where by 4.26% was obtained retrospectively (recorded data) whilst 7.6% was obtained prospectively (active data collection) whereby investigator and meat inspectors were keen to detect CE cases.

However, a higher prevalence of CE has been previously reported by different authors in different parts of Tanzania and Africa ranging from 48.7%, 34.7% and 63.8% for cattle, goats and sheep respectively, by Ernest *et al*. to 19.6% in cattle, 12.8% in sheep and 9.8% in goats by Kebede *et al*.[18], [20], [21], [22], [23]. The observed discrepancies in prevalence of CE above are attributed by some epidemiological reasons including differences in environmental contamination/conditions of different localities, livestock stocking intensity and cross-border migration of livestock. Higher prevalence in Ngorongoro and Turkana compared to this result could be explained by environmental conditions that are conducive for the perpetuation of the parasite in these areas which are absent in Dodoma municipal. Dodoma is a semi-desert region with high temperatures on average (25°**C** to 32°**C**) and very low humidity averaging 3mm, with seasonal variations where it is highest (up to 100mm) during rainy seasons (January – March). Ngorongoro average temperature ranges 8° **C** to 20° **C** with high humidity ranging 15mm to 187mm. E. *granulosus* eggs remain infective for months at lower temperatures +4° C to +15° C. With these and other factors, E. *granulosus* can thrive well in Ngorongoro and other areas of that kind compared to Dodoma. In a study to determine the transmission dynamics of cystic echinococcosis, it has been found that eggs of E. *granulosus* can survive only for a few hours under the high ambient temperatures. When exposed to sunlight and high temperatures, they become desiccated and do not hatch even when consumed by intermediate hosts [24]. Thus most eggs die in nature because they cannot withstand dryness and extreme temperatures.

Density of dogs and livestock populations together with humans and their close relationship, backyard/home slaughter customs, improper disposal of dead animals on grassland/environment, feeding dogs with animal viscera, feeding/grazing behaviour of livestock/host and human awareness are key factors that facilitate transmission of E. *granulosus* from animals to humans, thus maintaining domestic lifecycle of the disease parasite [17], [18], [21], [24].

The differences of observed prevalence of CE between the three animal species, i.e. 7.6%, 2.1% and 2.3% for cattle, goats and sheep respectively in this study, could probably be due to the different strains of infecting parasites, feeding behaviour, and animal husbandry practices in these three species of animals [17], [21], [25]. The differences may also be due to age of the animal during slaughter, with cattle being slaughtered relatively at older age. The more aged animals are, more likely to have been exposed to infection compared to younger ones. It has been reported that, animals become at increased risk to become infected or exposed as they live longer [14], [17], [25], [26].

The most affected organs were lungs and liver. Liver and lungs are the first organs with large capillaries network that a migrating parasite must come across and encounter a filtering mechanism before coming into peripheral organs where they can settle. According to Ernest *et* al. and Fromsa & Jobre, in older cattle the hepatic sinusoides allows onchospheres to cross through and reach the lungs. Thus the migrating hexacanth embryo passes with ease in the liver and are trapped within lung tissues [17], [18].

The results are in fundamental agreement with literature which states that; hydatid cysts are mostly found in lungs and liver of ungulate i.e. hoofed animals [17], moreover, they agree with previous works by Ernest *et al*., Kebede*et al*., Lahmar *et al*. [18], [21], [25] respectively, and many others.

As the study has shown that 81.7% of the community had never heard about CE, which means they are not aware of the disease. This reflect that majority of the people were not familiar with the disease in this

community (both agro-pastoralists and pastoralists per se). These results concur with previous works done by Ernest *et al*., who reported that 82.8% were not aware of hydatidosis and none of them had knowledge on transmission of the disease, in Ngorongoro district [18]. Gebremichael *et al*. reported that knowledge about hydatidosis is very low among the people in Ayssaita district in Ethiopia and Turkana in Kenya [19]. Macpherson *et al.,*found that there is high prevalence of hydatidosis among Maasai people, yet they are not aware and had no knowledge of hydatid disease in respect to its transmission and control [27].Current results have shown that awareness was statistically significant with levels of education of respondents whereby $p<0.05$. This means that the higher education levels a person acquires the more he/she becomes aware on CE. Nomadic and agro-pastoralists are the ones who do not go to school, as mostly they are engaged in animal keeping and agriculture activities throughout the life. As a result, they end up in ignorance of diseases that affect their health and livestock in particular. So they need be empowered by health education to create awareness since they are most exposed communities and victims of CE and other zoonoses. Low level of awareness and knowledge is very likely to expose people in this area to hydatidosis infection as they are unlikely to take precautions against the disease [28].

Regarding community practices, the study revealed a number of practices that predisposes this commurity to CE infection. The practices reported in this study includes; free range of dog and domestic animal keeping, undeworming dogs, feeding dogs with offal, unhygienic disposal of visceral, backyard animal slaughter, consuming died carcases and close interaction with dogs to children. Roaming undewormed dogs may carry infections that can transfer to ruminant animals and humans through close interactions. Dogs fed with raw offal can contract the disease and contaminate environment which in turn animals can acquire them when feeding/grazing, then the cycle continues. Dogs are definitive hosts of echinococcus species, they therefore play a vital role in spreading CE infections if the population at risk does not take precautions in their practices against it. These practices pose risks to human health, as well as that of dogs and other domestic animals.

The findings are in the same line with Ernest *et al*. who reported 89.1% of households in Ngorongoro do keep dogs and that the dogs were not given drugs to remove worms, additionally, the dogs were kept free. They also found that inhabitants were practicing backyard laughter for domestic animals and instead of disposing of raw condemned organs they offer them raw to their dogs. All these practices were also observed in this study. These may lead to the increased environmental parasite load, making easy transmission of the disease among humans and animals [18].

Most of respondents held the perception that keeping dogs and ruminant food animals under free range, health risks of dogs to other animals, exposure to dog faeces and feeding offal's to dogs are important risk factors for the transmission of CE. Despite of the general perception score of respondents, still the community is at risk of contracting CE due to the fact that there some people who perceives no or low risks of infections to most of the factors that pose risks to their health.

Conclusion

This study provides baseline information and an insight on CE in this particular zone (Dodoma municipal), filling the previous knowledge gap which existed. In respect to this study, it is now evident that CE exists in domestic animals in Dodoma municipal. This clue might be the case in humans too, as some literatures report that, prevalence of hydatidosis in domestic animals in a particular area, are in line with prevalence of human hydatidosis in that area. With this regard and owing to the presence of socio-economic factors that favour CE; it merits further studies to detect dog and human cases that might be going undetected.

Majority of the community members are neither aware of CE nor knowledgeable about it. Community practices and perceptions related to CE provide evidences that CE is a public issue that goes undetected in this community. It is likely that people suffer from the disease and even die because the disease is chronic and unfamiliar to many people. The findings from this study provide a significant insight on this neglected zoonotic disease, for better planning on prevention and control of the disease for betterment of animal and humans beings particularly in Dodoma and Tanzania at large.

Competing Interests

We declare that they have no competing interest.

Author's contributions

MAM carried out proposal development, data collection in the field, laboratory work, analysis of the data, report and manuscript writing. DST provided guidance in proposal and report writing, technical guidance in laboratory investigation and main supervisor of the work. MJE gave the guidance in proposal development (behavioural questionnaire and technical language construction), analysis, report writing and guidance on manuscript writing. IHM reviewed the manuscript. All authors read and approved the final manuscript.

Acknowledgements

This work was a result of field work made possible through support provided by Wellcome Trust through Afrique One Consortium. This research is part of a project carried out within the consortium Afrique One "Ecosystem and Population Health: Expanding Frontiers in Health". Afrique One is funded by the Wellcome Trust (WT087535MA).The authors would like to thank the research assistants and district authorities in Dodoma municipality for their support during data collection and for granting permission to carry out this study. Finally, we are grateful to the individuals who devoted their time to participate in this study.

References:

1. Debas, E. and Ibrahim, N., 2013. Prevalence and Economic Importance of Hydatidosis in Cattle Slaughtered at North GonderElfora Abattoir. *European Journal of Applied Sciences*, 5(1), pp.29–35.
2. World-Health-Organization, 2013. Echinococcosis: Fact sheet N°377. *Fact*, p.1. Available at: http://www.who.int/mediacentre/factsheets/fs377/en/
3. Bristow, B.N., Sun, L., Shira, S. and Sorvillo, F., 2012. Human Echinococcosis Mortality in the United States, 1990–2007. *PLoS Neglected Tropical Diseases*, 6, p.e1524.
4. Antoni Soriano Arandes and Frederic Gómez Bertomeu (2012). Echinococcosis/Hydatidosis, Current Topics in Tropical Medicine, Dr. Alfonso Rodriguez-Morales (Ed.), ISBN: 978-953-51-0274-8, InTech, Available from: http://www.intechopen.com/books/current-topics-in-tropical-medicine/echinococcosis-hydatidosis.
5. Grosso, G., 2012. Worldwide epidemiology of liver hydatidosis including the Mediterranean area. World Journal of Gastroenterology, 18, p.1425.
6. Yang, Y.R, TaoLi, Z., Zhang, J., Teng, J., Liu, X., Liu, R., Zhao, R., Jones, M.K., Wang, Y., Wen, H., Feng, X., Zhao, Q., Zhao, Y., Shi, D., Bartholomot, B., Vuitton, D.A., Pleydell, D., Giraudoux, P., Ito, A., Danson, M.F., Boufana, B., Craig, P.S., Williams, G.M., and McManus, D.P., 2006. Community surveys and risk factor analysis of human alveolar and cystic echinococcosis in Ningxia Hui Autonomous Region, China. *Bulletin of the World Health Organization*, 84(9), pp.714–21. Available at: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2627473&tool=pmcentrez&rendertype=abstract.
7. Wahlers, K., Menezes, C.N., Wong, M.L., Zeyhle, E., Ahmed, M.E, Ocaido, M., Stijnis, C., Romig, T., Kern, P. and Grobusch, M.P., 2012. Cystic echinococcosis in sub-Saharan Africa. *The Lancet Infectious Diseases*, 12(11), pp.871–80. Available at: http://www.ncbi.nlm.nih.gov/pubmed/23099081 [Accessed February 23, 2014].
8. World-Health-Organization, 2011. *Neglected Zoonotic Diseases (NZD)*, Geneva. Available at: http://www.who.int/neglected_diseases/zoonoses/en/
9. Swai, E. and Schoonman, L., 2012. A survey of zoonotic diseases in trade cattle slaughtered at Tanga city abattoir: a cause of public health concern. *Asian Pacific Journal of Tropical Biomedicine*, 2(1), pp.55–60.
10. Otero-Abad, B. and Torgerson, P.R., 2013. A Systematic Review of the Epidemiology of Echinococcosis in Domestic and Wild Animals H. H. Garcia, ed. *PLoS Neglected Tropical Diseases*, 7(6), p.e2249.
11. Ahmed, M.E., Abdelrahim, M.I. & Ahmed, F. M., 2011. Review Article Hydatid disease , a morbid drop needs awareness. , 47(1), pp.4–8.

12. Kouidri, M., Khoudja, F., Boulkaboul, A. and Selles, M., 2012. Prevalence , fertility and viability of cystic echinococcosis in sheep and cattle of algeria. Bulgarian Journal of Veterinary Medicine, 15(3), pp.191–197.
13. Batamuzi, E.K, Monrad, J &Bittegeko, S.B.P., 1989. The Prevalence of hydatid cyst infection in ruminants slaughtered in Dar es Salaam region (Tanzania). Tanz. Vet. Bull Vol. 9(4) 1989.
14. Nonga, H. and Karimuribo, E. 2009. A retrospective survey of hydatidosis in livestock in Arusha, Tanzania, based on abattoir data during 2005-2007. *Tropical Animal Health and Production*, 41(7), pp.1253–7.
15. Mkupasi, E. M., Ngowi, H. A., & Nonga, H. E. (2011). Prevalence of extra-intestinal porcine helminth infections and assessment of sanitary conditions of pig slaughter slabs in Dar es Salaam city, Tanzania. *Tropical Animal Health and Production*, *43*, 417–423. doi:10.1007/s11250-010-9708-x
16. Omar, M., Sultan, K., Haridy, M. and Omran, A. 2013. Prevalence of cystic echinococcosis in slaughtered ruminants in different abattoirs , upper egypt. *American Journal of Animal and Veterinary Sciences*, 8(3), pp.117–121.
17. Fromsa, A. and Jobre, Y., 2011. Infection prevalence of hydatidosis (Echinococcusgranulosus, Batsch, 1786) in domestic animals in Ethiopia: A synthesis report of previous surveys. *Ethiopian Veterinary Journal*, 15(2). Available at: http://www.ajol.info/index.php/evj/article/view/67691.
18. Ernest, E. Nonga, H. E., Kassuku, A. A., Kazwala, R.R., 2009. Hydatidosis of slaughtered animals in Ngorongoro district of Arusha region, Tanzania. *Tropical animal health and production*, 41(No 7), p.pp 1179–1185. Available at: http://link.springer.com/article/10.1007/s11250-008-9298-z?no-access=true.
19. Gebremichael, D., Feleke, A., Tesfemaryam, G., Awel, H. and Tsigab, Y., 2013. Knowledge , Attitude and Practices of Hydatidosis in Pastoral Community with Relation to Public Health Risks in Ayssaita , Northeastern of Ethiopia. *Global Veterinaria*, 11(3), pp.272–279.
20. Kern, P., Zeyhle, E. C.M., Elmahadi, I. and Ahmed, M. R.O., 2013. Cystic echinococcosis in sub-Saharan Africa: clinical disease and genetic diversity of Echinococcus. , p.2296. Available at: https://www.escmid.org/escmid_library/online_lecture.../material/?mid
21. Kebede, N., Mitiku, A. &Tilahun, G., 2009. Hydatidosis of slaughtered animals in Bahir Dar Abattoir, Northwestern Ethiopia. *Tropical Animal Health and Production*, 41(1), pp.43–50. Available at: http://www.ncbi.nlm.nih.gov/pubmed/19052901 [Accessed June 29, 2014].
22. Mellau, L.S.B., Nonga, H.E. and Karimuribo, E.D., 2010. A slaughterhouse survey of lung lesions in slaughtered stocks at Arusha, Tanzania. *Preventive Veterinary Medicine*, 97, pp.77–82.
23. Tilahun, A. and Terefe, Y. 2013. Hydatidosis : Prevalence , Cyst Distribution and Economic Significance in Cattle Slaughtered at Arbaminch Municipality Abattoir , Southern Ethiopia. *Global Veterinaria*, 11(3), pp.329–334.
24. Bour E, P., 2001. Hydatidosis: Dynamics of Transmission. *World Journal of Surgery*, 25(1), pp.4–9. Available at: http://link.springer.com/10.1007/s002680020001 [Accessed June 29, 2014].
25. Lahmar, S., Trifi, M., Ben Naceur, S., Bouchhima, T., Lahouar, N., Lamouchi, I., Maamouri, N., Selmi, R., Dhibi, M. and Torgerson, PR. 2013. Cystic echinococcosis in slaughtered domestic ruminants from Tunisia. *Journal of Helminthology*, 87(3), pp.318–25. Available at: http://www.ncbi.nlm.nih.gov/pubmed/22967724 [Accessed December 19, 2013].
26. Al-Khalidi, N.W., 1998. Cystic Echinococcosis (Hydatidosis) in Sheep , Goats , Cattle and Camels in Shahat Abattoir , Al- Jabal , Libya. *Proceedings of the Third Annual Meeting for Animal Production Under Arid Conditions, United Arab Emirates University*, 1, pp.143–149.
27. Macpherson CN, Craig PS, Romig T, and Zeyhle, E. 1989. Observations on human echinococcosis (hydatidosis) and evaluation of transmission factors in the Maasai of northern Tanzania. , pp.489–97. Available at: http://www.ncbi.nlm.nih.gov/pubmed/2694980
28. Swai, E.S., Schoonman, L. and Daborn, C., 2010. Knowledge and attitude towards zoonoses among animal health workers and livestock keepers in Arusha and Tanga, Tanzania. *Tanzania Journal of Health Research*, 12, p.8.