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Study on Prevalence of Small Ruminants Hydatidosis and Its Economic Importance at Gindhir Municipal Abboittar

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Abstract: A cross-sectional study was conducted from November, 2015 to March, 2016 to determine the prevalence and economic importance of small ruminants hydatidosis at Gindhir Municipal Abattoir. Routine meat inspection, at ant-mortem and post-mortem was performed on a total of 384 randomly selected slaughtered sheep and goats. Of this total examined, 36 (9.4%) of them had harboured hydatid cysts in one or more of their offal's. Species, sex, age, body condition score and origin of animals were taken into consideration as rik factors.The age, sex, species and origin of animal as a risk factors were statistically significant ($P < 0.05$), but no significant variation was observed with regarding to body condition score of animals ($P>0.05$) on prevalence of the disease. Out of the total infected animals 7 (19.4%) and 5 (13.9%) of them had hydatid cysts on their lung and liver alone, respectively while 24 (66.7%) animals had hydatid cysts on both liver and lung. The prevalence among different organs involved in harboring of the cyst was (51.7%) and (48.3%) in lung and liver respectively. From 158 cysts examined for fertility status 69 (43.7%), 45 (28.5%) and 44 (27.8%) were found fertile, sterile and calcified, respectively. A total of 69 fertile cysts originating from lung and liver and were tested for viability, 37 (53.6%) viable and 32 (46.4%) nonviable. The estimated annual financial loss due to direct organ condemnation and indirect carcass weight loss from small ruminants hydatidosis in the area was estimated to be 58,755.1ETB. In conclusion, this study indicated that hydatidosis is an important disease of small ruminants that causes great economic losses due to organ condemnation and weight loss in the study area. The high fertility and viability rate of hydatid cysts obtained indicates that the presence of high possibility of circulation of the parasite between the intermediate host and the final host. Due to these, the awareness of the communities about the disease, restrict meat inspection and condemnation of infected offal and regular treatment of the dogs to eradicate the disease are highly recommended.

Key words: Economic Impact · Gindhir · Hydatidosis · Prevalence · Small Ruminants.

INTRODUCTION

Ethiopia has the largest livestock population in Africa, with an estimated 52 million of cattle, 63 million sheep and goats, 7.55 million equines and 2.3 million camels [1]. However, the contribution from these huge livestock resources to the national income is disproportionately small, owing to several factors. Among them, parasitic diseases are considered as a major obstacle in the health and product performance of livestock. These parasitic diseases are distributed throughout the world and affect animal health resulting into a low working potential and reduced productivity. Amongst these parasitic diseases, hydatidosis is one of the most important parasitic diseases, which affects the efficiency of both animals and human being [2, 3]. The disease occurs throughout the world and causes considerable economic losses and public health problems in many countries. Hydatidosis causes decreased livestock production and condemnation of offal containing hydatid cysts in slaughter houses [4].

Hydatidosis caused by the larval stage (Metacestode) of *Echinococcus granulosus* is the most widespread parasitic zoonoses [5]. Dogs are the usual definitive hosts while a large number of mammalian species are intermediate hosts, including domestic ungulates and man. It is a cosmopolitan zoonotic infection [6]. Despite the large efforts that have been put into the

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research and control of echinococcosis, it still remains a disease of worldwide significance. In some areas of the world, Cystic echinococcosis caused by *E. granulosus* is a re-emerging disease in places where it was previously at low levels [7, 8].

*Echinococcusgranulosus*infection is endemic in East and South Africa, Central and South America, South Eastern and Central Europe, Middle East, Russia and China. The highest incidence is reported mainly from sheep and cattle rearing areas [9]. The disease is most important in livestock production which is based mainly on extensive grazing system. Several reports from different parts of Ethiopia indicate that hydatid cyst is prevalent in livestock population of the country [8, 10]. Its distribution is higher in developing countries especially in rural communities where there is close contact between dogs (definitive host) and various domestic animals intermediate hosts [11]. By affecting many different species animals, intermediate animal hosts and humans, hydatid cyst causes tremendous economic losses worldwide and specially in those areas where the parasite is endemic [7].

Knowledge about the prevalence of the diseases together with associated risk factors as part of the epidemiology of the disease is crucial for any attempt of prevention and control of the disease in question.

Moreover, determination of the economic significance of the disease is important for decision making, planning, development and implementation of local control strategies. It is also important to study the fertility of hydatid cysts as it will help to understand the risk of spreading of the disease both to domestic animals and humans. Even though there were several works done in bovine species, little attention is paid to investigate the prevalence and economic significance of hydatidosis in small ruminants in Gindhir. In view of addressing the problem, the objectives of the present research is to bridge the information on prevalence and economic importance of hydatidosis of small ruminant slaughtered at Gindhir municipal abattoir; so as to generate base line data that may assist for control of the disease. Therefore, the objectives of this study were:

- ✓ To estimate prevalence of Hydatidosis and assess the associated risk factors in Small ruminants slaughtered at Gindhir Municipal abboittar
- ✓ to compare liver and lung involvement with hydatid cyst and to assess fertility and viability of the cysts
- ✓ To assess the economic significance of the disease in small ruminants.

MATERLS AND METHODS

Study Area and Period: The study was conducted from November, 2015 to March, 2016 in Gindhir town, in Bale zone, in Oromia regional state 565 km to the South East of Addis Ababa. Gindhir town geographically located at an elevation of 2500 meters above sea level (m.a.s.l). The area has midland and lowland climatic zones. About 75% mid-land (1800-2500m) and 25% is lowland (<1800m) with in $6^0$59'and $8^0$49' latitude and $40^0$44'East longitude while the climatic condition of the area is "Weynadega". The area receives an annual range of rain fall from 1500-2500 mm and annual average humidity ranging from 43-60%. The area has a biomodal rainfall occurring from March to April (A short rainy season) and from July to October (long rainy season). The annual temperature range is 12-35 ^{0}c. It has a daily maximum temperature that can reach up to 35^0c and minimum temperature of 10^0c. The area is known to have three different soil types: black soil, clay soil and sandy soil. Livestock estimate of the year 2010/11 given by the agricultural bureau of Gindhirworedaindicates that the woreda has 412526 bovines, 24143 equines, 22733 ovines, 70717caprines and 98769 poultry. There is mixed farming of crop production and animal breeding.

Sample Size Determination: The sample size for the study was calculated using the formula given byThrusfield [12] with 95% confidence interval and 5% absolute level of precision as follows:

$$N = \frac{1.96^2 p_{\exp}(1 - p_{\exp})}{d^2}$$

where: n=Sample size, P_{exp}= Expected prevalence (50%) and d = desired level of precision (5%).

Since there was no study conducted in this area on small ruminant hydatidosis, 50% expected prevalence was taken.Accordingly, the sample size was determined to be 384.

Study Methodology: Cross-sectional study, through simple random sampling method was conducted at Gindhir Municipal abattoir to determine the prevalence of small ruminants hydatidosis and its economic importance. The following methods were followed to undertake the study:

Ante and Post Mortem Inspections: During ant-mortem examination, age, sex, origin and body condition score (BSC) of the animals identified for post-mortem examination was recorded. The age was determined by dentition formula according to the method described by

Sanchez-Andrade *et al.*[13] and animals categorized into two age groups (≤1years =young and >1years=adult). Body condition of animals was classified into three as lean (Score 1-2), medium (Score 3) and fat (Score 4-5) a according to Thompson and Meyer [14]. In the abattoir, organs inspection was carried out on different organs of each of the slaughter animals particularly lung, liver, heart, spleen and kidney. Each organ was assessed macroscopically by visual inspection and palpation.

Cyst Characterization: After the post mortem results, cysts were collected from the infected organs and cyst harbored by a particular organ was counted. Individual cysts were grossly examine for evidence of degeneration or calcification and was transported to Gindhirworeda Veterinary Laboratory in ice box for fertility and viability tests. The content of the fluid was aspirated using 18G needle and 20ml syringe into sterile cylinder container to reduce pressure and risk of entering the eye. After being punctured, the pressure was reduced and the cysts were incised using scalpel blade and the whole content was transfered into beaker. Then about 10 ml was poured to the test tube and centrifuge at 500rpm for 5 minutes to separate the contents clearly from the liquid part. The supernatant is discarded and the sediment with some fluid is left in the test tube. The contents will examine under a microscope (40 xs) for the presence of protoscolices in the cyst.Thecysts which contain no protoscolices as unfertile cysts [15].

The viability of the protoscolices is assessed by ease of staining with 0.1 % aqueous eosin solution and examine under light microscope.Livedprotoscolices did not take the dye up whereas the dead ones take up the dies [16].Sterile cysts are characterized by their smooth inner lining usually with slight turbid fluid in its content. Calcified cyst produce a gritty sound feeding up on incision [17].

Determination of Economic Losses Due to Hydatid Cyst: An attempt was made in order to estimate economic significance of small ruminants hydatidosis from the cost of condemned offals and carcass weight loss. To calculate the economic loss, the following parameters were taken into consideration: The mean market price of lung, liver, heart, kidney and spleen and cost of one kilogram sheep and goats meat were estimate based on information gathered from hotels and restaurants in the area. Average annual slaughter rate of small ruminants at Gindhir was estimate based on observation during study period together with the judgment of meat inspector of the area. Average carcass weight sheep was 15 kg estimated [16] and a 5% estimated carcass weight loss due to hydatidosis would be taken into account [18].

Direct Loss: All organs namely lung, liver, heart, spleen and kidney which were positive for hydatidosis were totally condemned. The economic loss due to condemnations of organ was assessed using the following formula developed [19]:

Direct los (DL) = (NAS x PH x PHlu x CPlu) + (NAS x PH xPHli x CPli) + (NAS x PH x PHs x CPs) + (NAS x PH x PHk x CPk) + (NAS x PH x PHh x CPh). Where NAS- average number of animals slaughter annually, PH- prevalence of hydatidosis, PHlu- percentage of lung condemnation due to hydatidosis, CP- current average price of lung, PHli- percentage of liver condemnation due to hydatidosis, CPli- current average price of liver, PHs - percentages of spleen condemnation due to hydatidosis, CPs- current average price of spleen, PHk- percentage of kidney condemnation due to hydatidosis, CPk- current average price of kidney, PHh- percentage of heart condomnation due to hydatidosis and CPh- current average price of heart [16].

Indirect Loss: A 5% carcass weight loss due to hydatidosis in animals has been described [18]. So the annual economic loss due to carcass weight reduction because of hydatidosis was calculated as: IL=5% x NAS x CPB x 15kg. Where IL- indirect loss, 5%- estimate carcass weight loss due to hydatidosis, NAS- average number of animal slaughter annually, PH- prevalence of hydatidosis, CPB- current average price of 1kg of sheep and goat, 15kg- average carcass weight of sheep and goats.

Total Economic Loss: Total economic loss due to hydatidosis was the sum of direct and indirect loss.

Total economic loss (TL) = direct loss (DL) + indirect loss (IL).

Data Analysis: The data collected from ante-mortem, post-mortem and laboratory findings were entered in to MS Excel spread sheet and analyze by using SPSS statistical soft ware package version 16. Chi-Square (x^2) was used to measure the association among different risk factors contributing to the prevalence of hydatidosis and any result with $P< 0.05$ was considered as statistically significant difference and influence of organ nature on cyst distribution was also analyzed with same statistical method.

RESULTS

Over All Prevalence: From the total of 384 small ruminants examined 36 (9.4%) of them were found harboring hydatid cysts in one or more of their offals. Prevalence was determined based on species, age, sex, origin and BCS of the study animals. Prevalence of hydatidosis between two species show statistically significant ($P<0.05$, $X^2=6.084$). It was higher in ovine (10.8%) than caprine (0%).Rate of infection in different age groups (young and adult) was assessed and age prevalence has shown statistically significant ($P<0.05$, $X^2=7.356$) with adult group having higher infections. The prevalence was also assed in terms of sex and it was found that female have higher infection (12.9%) than male (2.9%). It was statistically significant variation ($P<0.05$, $X^2=10.446$).There was no significant difference revealed between body condition scores with regard to cyst detection ($P>0.05$, $X^2=3.802$). Rate of infection based on origin was assessed and has shown statistically significant ($P<0.05$, $X^2=6.477$) as summarized in Table 1.

Organ Involvement and Distribution of Cysts: From the total of 384 small ruminants examined during post-mortem inspection, 60 different visceral organs were found to be affected by hydatid cysts and from these organs, 158 cysts were obtained. In line with their distribution among the infected visceral organs, 84(53.2%) and 74(46.8%) cysts were obtained from liver and lung resp-ectively. The distribution of hydatid cysts by organs affected is presented in Table 2.

Out of the total infected animals 7(19.4%) and 5(13.9%) of them had hydatid cysts on their lung and liver alone, respectively while 24(66.7%) animals had hydatid cysts on both liver and lung.

From the total of 158 cysts characterized for their fertility status, 69(43.7%), 45(28.5%) and 44(27.8%) were found fertile, sterile and calcified respectively. Summary of the fertility status of the cysts obtained from the different offal is shown in Table 4.

A total of 69 fertile cysts originating from lung and liver and were tested for viability, 37(53.6%) viable and 32(46.4%) nonviable and its described (Table 5).

Economic Loss Estimation: The average mean annual small ruminants slaughter rate was estimate to be 4914 and the average market price of lung and liver was 20 and 25 birr respectively. In addition, the price of 1kg of sheep and goat meat was 140 birr in Gindhir. So direct and indirect losses were calculated as follows:

Table 1: Overall prevalence of small ruminants hydatidosis

Variable	No. examined	No. positive	Prevalence (%)	95%CI	χ^2	P-Value
Species						
Ovine	333	36	10.8	7.9-14.6	6.084	0. 014
Caprine	51	0	0	0-7		
Age						
Young	60	0	0	0-6.02	7.356	0. 003
Adult	324	36	11.1	8.13-15		
Sex						
Female	247	32	12.9	9.33-17.72	10.446	0.001
Male	137	4	2.9	1.14-7.27		
BCS						
Lean	68	10	14.7	8.9-25	3.802	0.149
Medium	213	20	9.4	6.16-14.06		
Fat	103	6	5.8	2.7-12.14		
Origin						
Raitu	286	24	8.4	5.7-12.18	6.477	0. 021
Beltu	28	2	7.1	1.98-22.64		
Sawena	70	10	14.3	7.95-24.34		
Total	384	36	9.4	6.85-12.7		

Table 2: Distribution of hydatid cyst by organs affected (N = 158)

Organ	Nº obtained	% obtained
Liver	84	53.2
Lung	74	46.8
Total	158	100.0

Table 3: Hydatid cysts distribution with single and multiple organs infected (N = 36)

Organ	Nº. of animal affected	% affected
Liver only	5	13.9
Lung only	7	19.4
Lung + liver	24	66.7
Total	36	100.0

Table 4: Type and distribution of the hydatid cysts obtained

	Organ Distribution		
Cyst Condition	Liver (%)	Lung (%)	Total
Sterile	19(22.6)	26(35.1)	45(28.5)
Fertile	28(33.3)	41(55.4)	69(43.7)
Calcified	37(44.1)	7(9.5)	44(27.8)
Total	84(100)	74(100)	158(100)

Table 5: Association between number of viable cysts and organ involvement

Organ	No and Viability Status of Fertile Systs		
	Viable (%)	Non-viable (%)	Total
Lung	24(58.5)	17(41.5)	41(100)
Liver	13(46.4)	15(56.7)	28(100)
Total	37(53.6)	32(46.4)	69(100)

Table 6: Number of organs condemned, percentage involvement and their current average price of organs

Organ Condemned	No. of Organ Examined	No. of Organ Condemned	Percentage Involvement	Average price oforgan(ETB)
Lung	384	31	51.7%	20
liver	384	29	48.3%	25

Direct Economic Loss: Both infected lung and liver were totally condemned. So the direct loss due to organ condemnations is calculated as:

DL= (NAS x PH x PHlun x CPlu) + (NAS x PH x PHli x CPli).
DL= (4914 x 9.4% x 51.7% x 20) + (4914 x 9.4% x 48.3% x 25)
DL= 4711.5 + 5542.9
DL= 10,253.99ETB

Indirect Loss: The average price of sheep and goat was thus the annual economic loss from carcass weight reduction due to hydatidosis is calculated as

IL= 5% x NAS x PH x CBP x 15kg
IL= 5% x 4914 x 9.4% x 140 x 15
IL= 48,501.2ETB
Total Economic Loss

Total economic loss due to hydatidosis was the sum of direct and indirect loss.

TL= direct loss + indirect loss
TL= 10,253.9ETB + 48,501.2ETB
TL=58,755.1ETB

Therefore, the annual loss due to hydatidosis was estimate as 58,755.1ETB. The result implies that loss due to carcass weight reduction was greater than loss due to organ condemnation.

DISCUSSION

In the present study the overall prevalence of small ruminant hydatidosis in Gindhir municipal abattoir was found to be 9.4% which is comparable with the findings in Mekele,11.6% [20] 8.6% in Addis Ababa abattoir [21] 7.7% in Luna export abattoir, central Ethiopia[22]10.6% in Morroco [6] and 7.2% from Turkey sheep in New Taif abattoir Saudi Arebia [23]. However; it was lower than studies undertaken in Ambo municipal abattoir 26.7 %[24] and19.9%in Addis Ababa abattoir[25].The occurrence of such a low prevalence in the current site might be due to reduced backyard slaughter practice and decrease in the population of stray dogs. Much higher prevalence (83%) was reported [26] in Sardinia. The discrepancy and similarity in the prevalence between the various areas might be attributed principally to strains difference and relationship in *E. granulosus* that exist in different geographical situations [9]. Moreover, additional reasons could be the difference in the level of awareness of the community with regard to methods of its transmission as people used to slaughter small ruminants at home and throw the offal's to the dogs around their villages. Furthermore, difference in culture, social activity and attitude to dog in different regions might have contributed to such inconsistency [27].

Prevalence of small ruminants hydatidosis according to age of animal was 0% and 9.4%, in young and adult respectively and Animals with more than one years of age were found to be highly infected that statically significant (P value =. 003). Similar to the present finding, it was reported that cystic Echinococcosis infection was higher for older animals [6,28]. This could be mainly due to the fact that aged animals have longer exposure time to *Echinococcus granulosus*eggs [29].

With regarding to sex it was significant (P value=.001). It was higher in female.A similar finding has been reported [3]. The reason might be associated with keeping of female longer than males for reproductive purposes.

Infection rate in sheep was 10.8% while it was 0% in goats. Accordingly sheep were seen to suffer high risk of infection compared to goats. Perhaps this could be attributed the browsing nature of goats [30].

During the study, the body condition score of the studied animals were also included in the risk factors which show statistically non-significant (P value > 0.05). The prevalence of hydatidosis by origin of slaughtered cattle was assessed and statistically significant difference (P value =.021) was indicating the geographical regions play an important role in distribution of the cysts. This could be due to the difference in the socio-economic status and animal husbandry practices of community in all areas from where animals were brought for slaughter.

The prevalence of hydatidosis among different organs involved in harboring of the cyst was (51.7%) and (48.3%) in lung and liver respectively. In present study number of cysts collected from liver is greater proportion (53.2%) than lung (46.8%). This finding was similar to the findings byAzlaf and Dakkak [6], Yitbarek *et al*. [20], Ripoche *et al.* [26], Zelalem [31] and El-Ibrahim [32] who reported larger number of cysts from liver compared to other organs. The liver infection may be a reflection of the route of parasite entry and seems to support the hypothesis of hepatic portal distribution of the onchospheres leading to the liver infection [7].

The majority of infected sheep (66.7%) had hydatid cysts in both liver and lungs, as reported[33]. This could be due to the fact that lungs and livers posses the first great capillaries of sites encountered by migrating *Echinocooccus* onchosphere (Hexacanthembryo) which adopt the portal vein route. The first large capillaries encountered by migrating blood borne onchospheres and primarily negotiate pulmonary and hepatic filtering system sequentially before any other organ is involved. However, development of hydatid cysts occur occasionally in other organs like spleen, kidney and heart and other organs and tissues when onchosphers escaped into general systemic circulation [7].

Liver harbored highest number (44.1%) of calcified and this could attribute to relatively high reticulo-endothelial cells and abundant connective tissue reaction of the liver [34]. The overall percentage of fertile cysts in this study was 69% which is substantially higher compared to what has been observed17%, in Palestine [32] 38.1% in Jordan [35] 46.8%in Yemen [36] and 52.5%in Ethiopia [22]. The variation in fertility rates among different species and in different geographical zone could be due to difference in strain of *Echinococcusgranulosus* [37]. Strain of the parasite and the host can modify the infective pattern of the parasite [34].

In comparison of the fertility of the cyst from different organs, it was higher for lung (41%) than liver (28%). This may be due to the softer consistency of the lung tissue that allows the easier development of the cyst hence providing good environment for the fertility of hydatid cysts [29]. The variation between tissue resistances of the affected organs may also influence the fertility rate of cysts, in the liver hosts reaction may limit fertility rate of hydatid cysts. The variation in fertility, sterility and calcification in different areas were also described as strain difference [38].

The overall prevalence of viable protoscolices was 53.6% and greater number of viable protoscolices (58.5%) was found in lung and followed by liver (46.4%). this indicates small ruminants are an important intermediate host for the perpetuation of the life cycle of the parasite.

In the current study, it was emphasized to carry out an assessment on annual economic loss due to small uminantshydatidosis at Gindhir municipal abattoir. Losses from offal condemnation and carcass weight loss (Meat production loss) in infected small ruminants were assessed and estimated at 58,755.1ETB. The current estimate was comparable with 52,828 ETB that estimatedinAdama[5]. However, it is lower than 77,587.02ETBthat estimated[16] in Nekemte and 90,646.95ETB [39] in Gondar. The difference in economic loss estimates in various abattoir/regions may be due to the variations in the prevalence of disease, mean annual number of shoat slaughtered in different abattoirs and variation in the retail market price of organs.

CONCLUSION

The overall prevalence of small ruminants' hydatidosis in the study area is low; however, it is an important disease of economic causing organ condemnation and weight loss in area. The high fertility and viability rates of hydatid cysts obtained from the study area together with the existing socio-economic situations of the community makes hydatidosis an important parasitic disease in the area. These warrant preservation and control of the parasite. Based on these facts, the following recommendations are forwarded:

- Public education on means of transmission, prevention and control strategies of *E. granulosus*is crucial.
- Disposal of affected offal freely for dogs and wild canids (the usual practice in the community) should be prohibited and all the condemned organs should be either buried or incinerated.
- Backyard and road side slaughtering practices should be prevented by putting the law and regulation of meat inspection into action.

- Regular testing and treatment of dogs should be practiced throughout the country and avoid stray dogs are important.

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