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Study on Prevalence and Monetary Loss Attributed to Hydatidosis in Cattle Slaughtered at Jimma Municipal Abattoir, Southwestern Ethiopia

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Keywords: *bovine,hydatidosis,prevalence,monetary loss jimma, abattoir.*

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Study on Prevalence and Monetary Loss Attributed to Hydatidosis in Cattle Slaughtered at Jimma Municipal Abattoir, Southwestern Ethiopia

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I. Introduction

Hydatidosis caused by the larval stage (metacestode) of Echinococcus granulosus is the most widespread parasitic zoonoses (Ibrahim, 2010; Getaw et al., 2010). Dogs are the usual definitive hosts while a large number of mammalian species are intermediate hosts, including domestic ungulates and man. It is a familiar with many different countries (cosmopolitan) zoonotic infection (Azlaf and Dakkak, 2006).

Despite the large efforts that have been put into the 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 (Urquhart *et al.,* 1996; Kebede *et al.,* 2009a).

Echinococcus granulosus 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 (Arene, 1995). 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 (Jobre *et al.,* 1996; Kebede *et al.,* 2010).

According to Abebe and Yilma (2011) a prevalence of 72.4%, 37.72%, 33.78% and 13.7% in cattle slaughtered in Asella, Adama, Gonder, and Dire Dawa was documented respectively indicating its importance in the livestock industry. 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 (Eckert and Deplazes, 2004). By affecting many animal species, intermediate animal hosts and humans, hydatid cyst causes tremendous economic losses worldwide and specially in those areas where the parasite is endemic (Urquhart *et al.,* 1996).

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, and implementation of local control strategies. The present study were, therefore, conducted in the area with objective of determining the prevalence of Hydatidosis, its associated risk factor in cattle slaughtered at Jimma municipal abattoir and to estimate the economic significance of the disease in cattle.

II. Material and Method

a) Study area

The study was conducted in Jimma town which is located at about 352km south west of Addis Ababa. The area receives a bimodal rain fall with an average annual rain fall of 1530mm. The long rainy season occur during the months of June to September while the short rainy season occurs during the months of March to May. The climatic condition of the town is "Weynadega" and the town is located at an altitude of 1915masl. The annual maximum and minimum temperature ranges from 24-30C◦ and 7-14C◦ respectively. According to the statistical data obtained (CSA, 2009), Jimma district has a livestock population of 2,016,823 cattle, 288,411 goats, 942,908 sheep and 74574 horses, 49,489 donkey, 28,371 mules and 1,139,735 poultry.

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b) Study animals

The study animals were local breeds of cattle coming from different wereda of the Jimma zone to Jimma municipal abattoir. Only male cattle and sheep were slaughtered, but majority of animals slaughtered in the abattoir were male cattle. The majority of slaughter animals came from seven weredas, this are Agaro, Asandabo, Bilida, Dedo, Jimma, Sarbo and seka. The body condition score was classified into poor, medium and good (fat), (Nicholson and Butter worth, 1986). The age was determined by dentition formula according to the method described by De Lahunta and Habel (1986), and animals categorized into three age groups (< or = 5, 5 – 8, and > 8 years).

c) Sample size and sampling method

The study animals were selected from the slaughter line using simple random sampling technique. The required sample size was determined based on prevalence of 61% (Koskei, 1998) using the formula given by (Thrusfield, 2005). The study considered 95% confidence interval and 5% precision level. Accordingly a total of 384 animals were calculated, but to increase precision, the number of examine animals were reached to 400. For this study sex, age, origin and body condition of animals were considered as risk factors.

d) Study Design

A cross sectional study was conducted from November 2015 to June, 2016 by collecting data on events associated with hydatidosis in cattle slaughtered in Jimma municipal abattoir. This study was conducted to determine update information on the prevalence and economic impact on bovine hydatidosis at Jimma municipal abattoir. (Two slaughtering days per week) visits were made to abattoir.

e) Study Methodology

i. *Ante mortem inspections*

Pre-slaughter examinations of cattle were conducted in the lairage in order to determine the sex, age, body condition and origin of animals. Identification number was given for each animal to examine after evisceration. During ante-mortem examination, animals were clinically examined for any sign of illness while standing and moving according to (Urquhart *et al.,* 1996). And following the judgments passed by (FAO, 1994).

ii. *Post mortem inspection*

During post mortem examination organs especially liver, lung, spleen, kidney and heart as a whole were systematically inspected for the presence of hyatid cyst by applying the routine meat inspection procedure of primary examination followed by secondary examination. The primary examination involves visualizations and palpation of organs, were as secondary examination involves further systemic incision of each organs into pieces and whenever evidence of hydatid cyst was found, it was classified as live or calcified and the cyst distribution into organs was recorded.

iii. *Examination of cysts for fertility and viability*

Based on the presence or absence of brood capsules containing protoscolices in hydatid fluid, cysts were identified and classified as fertile and infertile according to the method described by Macpherson (1985). Individual hydatid cysts were carefully incised and examined for protoscolices, which resembled white dots on the germinal epithelium; such cysts were characterized as fertile cysts.

Fertile cysts were subjected to viability test. A drop of the sediment containing the protoscolices were placed on the microscope glass slide and covered with cover slip and observed for amoeboid like peristaltic movements with 40x objective. For clear vision, a drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in hydatid fluid on microscope slide with the principle that viable protoscolices should completely or partially exude the dye while the dead ones absorb it (Macpherson *et al.,* 1985). Furthermore, infertile cysts were further classified as sterile or calcified. Sterile hydatid cysts were characterized by their smooth inner lining usually with slightly turbid fluid in their content. Typical calcified cysts produce a gritty-sound heard at incision (Soulsby, 1982).

iv. *Determination of Monetary losses due to hydatid cyst*

An attempt was made to estimate the annual economic losses from hydatidosis in cattle taking into account losses from cost of organ condemnation and from carcass weight.The retail market price of average size offal (lung, liver, kidney, heart and spleen) and the cost of one kg beef were obtained from information gathered from local butchers. Annual economic loss due to organ condemnation was determined by considering annual slaughter rate of cattle and prevalence of hydatidosis per organ and an estimated 5% carcass weight loss (Getaw et al., 2010) was considered. Average carcass weight of Ethiopian local breed cattle is estimated as 108 kg (Negassa et al., 2010). The total economic loss was calculated as the summation of cost of offal condemned plus the cost of carcass weight losses (Kebede et al., 2009a; Getaw et al., 2010).

$$LOC = (NAS \times ph \times plu \times cplu) + (NAS \times ph \times phr \times cphr) + (NAS \times ph \times pli \times cpli) + (NAS \times ph \times psp \times cpsp) + (NAS \times ph \times pkid \times cpkid);$$

Where NAS –Average number of cattle slaughtered annually

Loc-loss of organs condemned

Ph-prevalence rate of hydatidosis

Plu-percent involvement of lung

Cplu-current mean retail price of lung

Phr- percent involvement of heart

Cphr- current mean retail price of heart

Pli- percent involvement of liver

Cpli - current mean retail price of liver

Psp- percent involvement of spleen

Cpsp - current mean retail price of spleen.

Pkid- percent involvement of kidney

Cpkid - current mean retail price of kidney

N: B-All prices are determined from the price at Jimma town.

v. *Total Monetary Loss Estimation*

Total economic loss was evaluated by considering both loss from organ condemnation and loss from carcass weight loss. Total loss = direct loss (loss from organ condemnation) + indirect loss (loss from carcass weight loss).

f) Data Analysis and Management

The data obtained was coded in Microsoft excel sheet 2007 and subjected to descriptive statistics and chi-square in order to assess the magnitude of the difference of comparable variables using SPSS version 20.0 software. Statistically significant association between variables is considered to exist if the p-value is less than 0.05.

III. Results

a) Prevalence and Risk Factors

i. *Age group*

Out of the total 400 heads of cattle slaughtered and examined, 218 (54.5%) were infected with hydatid cyst, more cysts involving different visceral organs (lung and liver). Rate of infection in different age groups (<5 and, 5-8 and >8 years) was assessed and described in (Table 1). Prevalence in age groups have shown as statistically highly significant variation ($P<0.05$, $\chi2 = 16.615$) with young group having higher infections.

ii. *Body condition score*

Prevalence was also assessed in terms of body condition score (Table 2). It was found that cattle having poor body condition had the highest prevalence (74%) followed by medium (46.6%) and good (52.5%). There was highly significant difference revealed between body condition scores ($P<0.05$, $\chi2=28.332$) with poor animals groups having higher infections.

iii. *Origin of animals*

Prevalence of Hydatidosis in cattle slaughtered at Jimma Municipal abattoir in origin of animals at Bilida (61%) was higher infected but, at Sarbo 43.5% was less infected (Table 3).

b) Cyst Distribution

Overall distribution of cysts in different organs of cattle slaughtered at Jimma Municipal abattoir was described (Table 4). Of the 223 cattle positive, 200 (89.7%) had cysts merely in lungs, 20 (8.9%) in liver, 1 (0.45%) in kidney, 1(0.45%) in spleen, whereas, the rest of 1(0.45%) in heart infections involved organs.

c) Characters of hydatid cyst in different organs

Out of 98 organ infected by cysts to tested for fertility, 50(17.3%) cysts of lung, 45(54.87%) cyst of liver, 1(100%) cysts of kidney,1(100%) cysts of spleen, and 1(100%)cysts of heart origins had protoscolices detected and hence, fertile. Out of the total cyst counts, 98(26.2%) cyst counts are fertile, 216(57.8%) are sterile and 60(16%) calcified. Fertility status of cysts from different organs has shown, but the cysts of lung origin being highly fertile (Table 5).

d) Estimated Monetary loss incurred by hydatidosis

Due to aesthetic value and to break the life cycle of the Echinococcus parasites infected organs are condemned. A total of lung, liver, kidney, spleen and heart were condemned due to hydatidosis with an economic loss of 89249.2ETB, 22312.3 ETB, 676.89 ETB, 225.63ETB and 676.89 ETB respectively. The direct and indirect economic loss was about 133140.91 ETB and 3249072 ETB respectively. The total annual financial loss due to bovine hydatidosis was estimated to be 3362212.9 ETB, (Table 6).

Table 1 : Prevalence of hydatidosis in different age groups of cattle slaughtered at Jimma Municipal abattoir

Age group (years)	Number of cattle examined	Infected	Infected Prevalence
Group 1 (< 5years (young)),	38	23	62.2%
Group 2 (5-8 years (adult))	303	159	52.3%
Group3 (>8years (old))	39	36	61%
Total	400	218	54.5%

$\chi2 = 16.615$, $P = 0.034$

Table 2 : Prevalence of Hydatidosis in cattle slaughtered at Jimma Municipal abattoir on body condition basis

Body condition score	Animals		Animals
	Examined	Infected	Prevalence
Poor	77	57	74%
Medium	146	68	46.6%
Good	177	93	52.5%
Total	400	218	54.5%

$\chi 2 = 28.332$, $P = 0.00$

Table 3 : Prevalence of Hydatidosis in cattle slaughtered at Jimma Municipal abattoir on origin of animals

Origin of animals	Number of examined	Number of infected	Total % of infected
Agaro	48	28	58%
Asandabo	45	26	57%
Bilida	94	58	61%
Dedo	59	30	50%
Jimma	48	25	52%
Sarbo	79	35	43.5%
Seka	28	16	56.5%
Total	400	218	54.5%

$X^2 = 64.742$, $p = 0.000$

Table 4 : Distribution of Hydatid cysts in different organs of positive cattle at Jimma Municipal abattoir

Organs affected		
	Number of cases	Percentage
Lung only	200	89.7%
Liver only	20	8.9%
Kidney only	1	0.45%
Spleen	1	0.45%
Heart	1	0.45%
Total	223	100%

Table 5 : Fertility, sterility and viable of cysts collected from different organs of cattle slaughtered at Jimma Municipal abattoir

Organ	Fertile cyst (%)	Sterile cyst (%)	Calcified (%)	Total cyst counts%
Lung	50(17.3)	180(62.28)	59 (20.4)	289(77.27)
Liver	45(54.87)	36(43.9)	1(1.2)	82(21.9)
Kidney	1(100)	-	-	1(0.26)
Spleen	1(100)	-	-	1(0.26)
Heart	1(100)	-	-	1(0.26)
Total	98(20)	216(57.75)	60(16)	374(100)

Table 6 : Direct economic losses associated with CE in infected cattle in Jimma municipal abattoir. organs condemned and their price in ETB during study period

Organs	No.of organs condemned	% of condemned	price per organs	Total price in ETB
Lung	200	89	20	4000
Liver	20	8.9	50	1000
Kidney	1	0.45	30	30
Spleen	1	0.45	10	10
Heart	1	0.45	30	30
Total	223	100	140	5070

Direct economic loss from loss of organs condemned=NAS X ph [(plu x cplu) +(pli x cpli) +(psp x cpsp) +(phr x cphr) + (pkid x cpkid).

NAS=Number of animals slaughtered annually in Jimma municipal abattoir were=9600

Loc=9600 x 0.545[(0.89 x20) + (0.089 x 50) + (0.0045 x 30) + (0.0045 x 10) +(0.0045 x30)] = 5014[(17.8) +(4.45) + (0.135) + (0.045) + (0.135)

=5014[(22.565)] =113140.91 ETB

*1USD=20 ETB

=2262818.2 USD

In direct Monetary loss

Loss from carcass wegheit loss= NAS X ph X CPB X 5% X 108Kg

1 Kilo gram of beef meat in Jimma town is 130ETB

LCWL=9200 X 0.545 X 120 X 0.05 X 108

=3249072 ETB

=64981440 USD

Total Monetary loss=direct loss + in direct loss

= 113140.91 + 3249072

= 3362212.9ETB

= 67244258 USD

IV. Discussion

In the present study the prevalence of Bovine hydatidosis in Jimma Municipal abattoir was found to be 54.5% which was comparable with the results of other works conducted, this study was much higher compared to the prevalence reported at Jimma 31.44% (Tolossa *et al,.* 2009) and 22.4% (Moges, 2003), Konso 22.57% (Fikre, 1994), Adigrat 20.3% (Kebede, *et al.,* 2009b) and Nekemte 31.19% (Feyissa, 1987). Much lower prevalence was also reported by Kebede, 2009b (7.5%) in Shire and Tsehaye, 1995 (7.2%) in Debre Birhan and also high in Asella 61.0% (Koskei, 1998), 62.96% around Bale Robe (Woubet, 1988), and 59.9% Bahirdar (Nebiyou, 1990).

The present prevalence rate was high (54.5%). This might be due to the abundance and frequent contact between the intermediate and infected final hosts. It could also be associated to slaughtering of aged cattle which have had considerable chance of exposure to the parasitic ova, backyard slaughtering of small ruminants and provision of infected offal's to pet animals around homesteads. Moreover, poor public awareness about the disease and presence of few slaughter houses could have contributed to such a higher prevalence rate.

Generally, variation among the prevalence of hydatidosis at different geographical location could be associated to the strain difference of *Echinococcus granulosus* that exist in different geographical locations (McManus, 2006). Additionally variation could be with age factors of the animals and other factors like difference in culture, socio-economical activities and attitudes to dogs and their population. Similar to the present finding, it was reported that cystic Echinococcosis infection was higher for older animals (Azlaff & Dakkak, 2006; Fayesa *et al.,* 2010). Animals with more than eight years of age were found to be highly infected that stastically significant (P value < 0.05). This could be mainly due to the fact that aged animals have longer exposure time to *Echinococcus granulosus* eggs. In addition, older animals might have weaker immunity to combat against infection (Himonas, 1987). This finding is similar to the finding of Fikre Lobago (1994), Hagos Yihdego (1997), Umur (2003), Azlaf and Dakkak (2006) and (Esatgil and Tuzer, 2007).

The prevalence of hydatidosis by origin of slaughtered cattle was assessed and statistically significant difference (P value < 0.05) was found indicating that 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 and frequent contact of animals with infected definite host.

The prevalence of hydatidosis among different organs involved in harboring of the cyst showed that lung was found to be the most commonly affected organ (50%) followed by liver (43%) and this was equivalent with Bizuwork (2013), 50.5% for lung and 40.6% for liver and also similar result of 54.5% and 43.5% was reported by Debas and Ibrahim (2013) on lung and liver respectively. This finding was higher than finding of Abunna *et al.,* (2012) who reports 12.5% and 4.25% prevalence for lung and liver respectively while 92.7% in lung and 53.2% in liver which is higher than this study was also reported by Abera *et al.,* (2013).

In this study number of cysts collected from lung 200(89.7%) was greater than that collected from liver 61(8.9%) and that of spleen, heart and kidney in which 1(0.45%) was recorded. Comparable results were reported by (Alemu and Yitagele, 2013), 47.04% and 44.2% for lung and liver respectively and 9.41% for spleen, heart and kidney. This might be due to the fact that cattle are slaughtered at older age, during the time the liver capillaries are dilated and most oncospheres directly pass to the lung; additionally, it is possible for the hexacanth embryo to enter the lymphatic circulation

and be carried via the thoracic duct to the heart and lungs in such a way that the lungs may be infected before or instead of liver (Arene, 1985).

Additionally, the lung and liver which are most commonly infected organs, this could be due to the fact that lungs and livers posses the first great capillaries of sites encountered by migrating Echinocooccus onchosphere (hexacanth embryo) 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 (Urquhart *et al.,* 1996).

Lung harbored highest number of calcified cysts (20.4%) followed by liver (1.2%). This finding is comparable with finding of Mesele *et al. (*2013) 60.2% ,22.6% and 4.3% respectively for lung, liver and spleen and higher than the report of Bizuwork *et al.(*2013) with the prevalence's of 36.8% for lung,14.6% for liver and 0% for spleen. This can be due to the host defence mechanisms of killing more efficiently the parasitic larvae at the early stage of development (Himonas, 1987).

The percentage of fertile cysts in this study was 26.2%. This is higher compared to the fertility rate of 26.9%, 24.4% and 19.3% reported by Fayesa *et al.* (2010), Solomon (2011) and Zelalem (2008) respectively from different parts of Ethiopia. But the present study was quite lower compared to the 96.9% reported from South Africa (Arene, 1985). Yet much lower fertility record such as 1.76%, 9.85% and 6.2% were reported in cattle from Wolayita Soddo (Nigatu, *et al.,* 2009), Nekemt (Bersissa, 1994) and Bahir Dar (Nebiyou,1990) respectively. The variation in fertility rates among different species and in different geographical Zones could be due to difference in strain of *Echinococcus granulosus* (McManus, 2006). Strain of the parasite and the host can modify the infective pattern of the parasite (Gemmel *et al.,* 2002).

Comparison of fertile cyst from different organs was found to be lower for lung (17.3%) than liver (54.87%). This finding was agreement with finding of (Debele *et al.,* 2014) 66.7 and 40.7% for lung and liver respectively and the present finding was higher than Debas and Ibrahim(2013) 25% and 7.5% for lung and liver respectively.

Out of a total 400 cattle carcasses, 218(54.5%) were infected with hydatid cysts. Of these cysts 98 (20%) fertile, 216(57.75%) sterile and 60(16%) were calci fied. Higher infected when compare with (Tolossa *et al,.* 2009) in Jimma out of a total 512 cattle, 161(31.44%) were infected with hydatid cysts. a total of 1171 hydatid cysts being collected from the infected animals. Of these cysts, 223(19.4%) were fertile, 505(43.13%) were sterile and 349(29.80%) calcified. These indicate that cattle are an important intermediate host for the perpetuation of the life cycle of the parasite in Jimma and its surroundings.

The annual economic loss incurred by hydatidosis was calculated to be 3362212.9 ETB. The result was relatively comparable with the report of (Zelalem, 2008) 5,544,591.74 ETB in Addis Ababa abattoir and lower than that of the Terefe *et al.* (2012) 19,847,704.5ETB at Addis Ababa abattoir enterprise and higher than that of Belina *et al.* (2015) and Zewdu *et al.* (2010) with annual economic loss of 841,419.3 and 160,032.23 respectively. The economic losses was different from the reports of others studies in the country which may be due to the variation in prevalence of the disease and mean annual number of cattle slaughtered in different Abattoirs and variation in retail market price of organs (Polydorus, 1981).

As described above Hydatid disease is generally considered to be a rural disease because of its way of transmission cycle, which involves domestic herbivorous animals (cattle, sheep, pigs and so on) and dogs. However, it is possible that urban residents may have been in contact with *Echinococcus granulosus* eggs, in this matter backyard slaughtering and inappropriate disposal affected organs plays major role for the continuity of parasite life cycle.

V. Conclusion

The overall prevalence observed in the study indicated relatively high and an important zoonotic disease in the area and this could be due to several factors of which keeping dogs in close association with cattle. Hydatidosis also causes substantial visible and invisible economic losses in cattle of the study area as a result of condemnation of edible offal and carcass weight loss. The most preferred predilection sites of hydatid cyst in cattle like liver, kidney, heart and lungs and condemnations of these important organs having a single or multiple hydatid foci is really a huge loss. From the result obtained in the present study and considering the reality in Jimma municipal abattoir and its surrounding, it is mandatory for launching a control program proper disposal of affected offal's freely for dogs and wild canids (the usual practice in the community) should be stopped and all the condemned organs should be either buried or incinerated. Moreover, further studies are needed on genotyping, epidemiology and public health importance of *Echinococcus granulosus* in the study area

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