International Journal of Research Studies in Biosciences (IJRSB)
Volume 3, Issue 3, March 2015, PP 177-182
ISSN 2349-0357 (Print) & ISSN 2349-0365 (Online)
www.arcjournals.org

Prevalence and Economic Loss due to Hydatidosis in Slaughtered Animals in Juba South Sudan

Erneo B. Ochi

Directorate of Research and Development
M L F I, Juba South Sudan
ajjuerneo59@yahoo.com

David A. Akol, Serafino M. Augustino

College of Natural Resources and Environmental Studies
University of Juba, Juba South Sudan

Abstract: *A 3-month cross-sectional study was conducted at the Gumbo slaughter place, South Sudan to determine prevalence rate and assess economic loss due to hydatidosis. Routine pre-slaughter examinations and meat inspection of a total 4,989 animals was carried out.199 various visceral organs of slaughtered animals were infected with Hydatidosis forming a prevalence of 3.99 %. The mean prevalence showed 3.94%, 6.99% and 2.74% for cattle, sheep and goats, respectively. The relative prevalence of hydatid cysts in liver, lungs, spleen, heart and kidneys was 53.27%, 44.22%, 1.51%, 1.0% and 0.0%, respectively. Hence, liver and lungs showed the highest rate of organ condemnations. Nilotic indigenous cattle showed a prevalence of 5.74% compared to 2.0 % in the exotic Ankole cattle breed. This might be due to grazing on free range and intimate association with domestic dogs. No significant differences (P>0.05) was shown in the prevalence of hydatidosis in November (4.3%), December (4.4%) and January (3.2%). The sex-based prevalence showed higher rate in male cattle (4.11%) than in female cattle (3.65%). Similarly, male sheep and of goats showed no significant differences rate of 5.31 and 3.97% (P>0.05) compared to female sheep 4.88 and of goats 2.96 %, respectively. Age-based results showed higher prevalence rate in adult cattle 3.93 % than in young ones 2.39%. Similarly, adult sheep and of goats showed the prevalence of 5.26 % and 3.83% compared to young ones of 4.72 and 2.64%, respectively. The economic loss due to condemnation of 199 organs of cattle, sheep and goats using retail market price during the study period amounted to 6,032 South Sudanese pound (SSP) equivalent to US$ 2,035.77 (One American dollar = 2.963 SSP). Hydatidosis is highly prevalent in sheep causing economic losses in animals in South Sudan. Development of socio-economic and cultural conditions of community based-control strategies is imperative. Key stakeholders are urged to prevent the access of dogs to fresh offal and to impose hygienic disposal of condemned organs. Further studies are needed to determine genotypic characteristics of Echinococcus granulosus local strains in livestock, assess the indirect economic loss and investigate public health implication of hydatidosis in South Sudan.*

Keywords: *Prevalence; Economic Loss; Hydatidosis; Cattle, Sheep and Goats; South Sudan*

1. INTRODUCTION

Hydatid cyst is a larval stage of *Echinococcus granulosus* which causes economic loss in livestock due to organs condemnation (Ahmed et al., 2011) and decrease in the quality and quantity of meat, milk and wool production (Craig et al., 2007; Abebe and Yilma, 2012). Hydatidosis is still a problem posing a threat to livestock production, productivity and marketability throughout the country. It is one of the neglected diseases of public health importance (Ahmed et al., 2011) and of considerable economic loss (Budke and Torgerson, 2003; Ahmadic and Meshkerkar , 2011).

In Sudan, hydatidosis was first reported in dogs in 1962 where the prevalence rate reached 8.64% (Eisa et al, 1962) and in 1987, another study showed a prevalence of 12% and 10.3% in sheep and goats, respectively. However, poor hygienic disposal of condemned organs remains problematic in the epidemiology of hydatidosis. The risk factors governing the prevalence of hydatidosis are associated with prevailing specific social, cultural, environmental and epidemiological situations.

However, human behaviours play significant roles in the epidemiology and dynamic of the disease.

Recent studies have shown that the camel genotype (G_6) of *E. granulosus* is the most prevalent strain endemic in camels, goats, and cattle as well as human, while cattle strain (G_5) is confined to cattle in the Sudan. Moreover, the common sheep strain (G_1) is suspected to be the principal genotype affecting human in Sub-Saharan Africa. However, G_6 strain of *E.canadensis* has been previously identified from human patient all over the world (Ahmed et al., 2011).

So far, little or no studies have been carried out to determine the prevalence and assess the economic losses of organ condemnations in livestock at slaughter houses in South Sudan. The purpose of this paper was to provide key stakeholders with baseline data and information on prevalence and economic losses due to hydatidosis in cattle, sheep and goats such that control strategies are developed for sustainable development of livestock in South Sudan.

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted at the Gumbo slaughter place in Juba County, Central Equatoria State, South Sudan. Gumbo Boma (village) is located about 8km in the south-east of Juba Town on Juba-Nimule road. It lies at the latitude 4° 50' 60 N and longitude 31° 37' 0 E with an altitude of 550 m. The annual ambient temperature ranges from 24.7 °C to 34.5 °C with an annual rainfall of 1000 mm. Mean relative humidity stands at 55%.

2.2. Study Animals and Sample Size

A total of 4,989 animals of which 1, 141 heads of cattle, 1,145 sheep and 2,703 goats were inspected from November 2014 to January 2015. These include indigenous Nilotic and exotic Ankole cattle breeds. The sample size was determined by 95% confidence interval at a desired level of 5% (Thrusfield, 1995) and purposive sampling method was used.

2.3. Study Design

A cross-sectional study was designed and daily pre-slaughter examinations of animals were carried out to determine animal species, breed, age group, sex and origin of animals. During the post-mortem examinations, different visceral organs including liver, lungs, kidneys, heart and spleen were systematically inspected. Visual observation, palpation and systematic incision of each organ were made for the presence or absence of hydatid cysts. All the condemned organs were counted and recorded.

2.4. Determination of prevalence rate

The overall prevalence rate (PR) was computed by dividing the number of animals inspected positive with hydatid cyst by total number of animals examined and expressed as a percentage as follows:

$$\mathbf{PR} = \frac{\mathbf{No.\ of\ animals\ positive}}{\mathbf{No.\ of\ animals\ examined}} \mathbf{X\ 100}$$

Similarly, the specific prevalence rate due to animal breed, age group and sex during the 3-month study was determined. Moreover, relative prevalence rate for each organ was computed by dividing number of organs inspected positive with hydatid cyst by total number of organs examined and expressed as percentage as follows:

$$\mathbf{PR} = \frac{\mathbf{No.\ of\ organs\ positive}}{\mathbf{No.\ of\ organs\ examined}} \mathbf{X\ 100}$$

2.5. Assessment of Economic Losses

Direct economic loss was estimated by recording the total number of organs condemned and the current market prices per condemned organs. Then, the economic loss was computed by the

summation of number of condemned organs multiplied by the current retail market price per organ as follows;

$$\mathbf{EI} = \sum \{\mathbf{N_{Lu}} * \mathbf{PX_{Lu}} + \mathbf{N_{Li}} * \mathbf{PX_{Li}} + \mathbf{N_{Hrt}} * \mathbf{PX_{Hrt}} + \mathbf{N_{Sp}} * \mathbf{PX_{Sp}} + \mathbf{N_{Ki}} * \mathbf{PX_{Ki}}\}$$

Where, **EL** = Economic Losses, $\mathbf{N_{Lu}}$ = Number of lungs, $\mathbf{PX_{Lu}}$ = Price of lungs, $\mathbf{N_{Li}}$ = Number of liver, $\mathbf{PX_{Li}}$ = Price of liver, $\mathbf{N_{Hrt}}$ = Number of heart, $\mathbf{PX_{Hrt}}$ = Price of heart, $\mathbf{N_{Sp}}$ = Number of spleen, $\mathbf{PX_{Sp}}$ = Price of spleen, $\mathbf{N_{Ki}}$ = Number of kidneys, $\mathbf{PX_{Ki}}$ = Price of kidneys.

- Economic loss in cattle due to condemned organs was calculated as follows:

$$\mathbf{EI} = \sum \{\mathbf{N_{Lu}} * \mathbf{PX_{Lu}} + \mathbf{N_{Li}} * \mathbf{PX_{Li}} + \mathbf{N_{Hrt}} * \mathbf{PX_{Hrt}} + \mathbf{N_{Sp}} * \mathbf{PX_{Sp}} + \mathbf{N_{Ki}} * \mathbf{PX_{Ki}}\}$$

Where, N_{Lu} = 21, N_{Li} = 21, N_{Hrt} = 0, N_{Sp} = 3 and N_{Ki} = 0 and PX_{Lu} = 30 SSP, PX_{Li} = 120 SSP, PX_{Hrt} = 25 SSP, PX_{Sp} = 20 SSP and PX_{Ki} = 12 SSP

EL = ∑ {21x30 + 21x120 + 0x25 + 3x20 + 0x12}, EL = ∑ (630 + 2520 + 0 + 60 + 0) = 3,210 SSP

- Economic Loss in Sheep due to condemned organs:

Where, N_{Lu} = 27, N_{Li} = 53, N_{Hrt} = 0, N_{Sp} = 0 and N_{Ki} = 0 and PX_{Lu} = 4 SSP, PX_{Li} = 30 SSP, PX_{Hrt} = 2 SSP, PX_{Sp} = 2 SSP and PX_{Ki} = 3 SSP

EL = ∑ {27 x 4 + 53 x 30 + 0 x 2 + 0 x 2 + 0 x 3}, EL = ∑ (108 + 1590 + 0 + 0 + 0) = 1,698 SSP

- Economic Loss in Goats due to condemned organs:

Where, N_{Lu} = 40, N_{Li} = 32, N_{Hrt} = 2, N_{Sp} = 0 and N_{Ki} = 0 and PX_{Lu} = 4 SSP, PX_{Li} = 30 SSP, PX_{Hrt} = 2 SSP, PX_{Sp} = 2 SSP and PX_{Ki} = 3 SSP

EL = ∑ {40 x 4 + 32 x 30 + 2 x 2 + 0 x 2 + 0 x 3} EL = ∑ (160 + 960 + 4 + 0 + 0) = 1,124 SSP

Total Direct Economic Loss = 3,210 + 1,698 + 1,124 = 6,032 SSP

2.6. Data Management And Analysis

Data was managed and recorded in tabular form and charts and statistically analyzed using computer programme of the MS Excel and statistical packages (SPSS Version 18). Probability at the significance level of $P < 0.05$ and insignificant at level of $P > 0.05$ was used.

3. RESULTS

3.1. Prevalence of Hydatidosis

Table1. *Prevalence of hydatid cyst in cattle, sheep and goats from November 2014 to January 2015 at the Gumbo Slaughter place, Juba County, South Sudan*

Animal species	No. of Animals examined	No. of Positive cases	Prevalence (%)
Cattle	1,141	45	3.94
Sheep	1,145	80	6.99
Goats	2,703	74	2.74
Total	4,989	199	3.99

The overall prevalence rate due to hydatid cyst among the inspected livestock at Gumbo slaughter place was 3.99% (199/4,989). Of which cattle, sheep and goats showed the prevalence of 3.94%, 6.99% and 2.74 %, respectively (table 1). Organs relative prevalence rate in liver, lungs, spleen, heart and kidneys was 2.13% , 1.76% , 0.06% , 0.04 % and 0%, respectively in a total of incised 210 hydatid cysts (table 2). The prevalence of hydatidosis was significantly higher ($P<0.05$) 5.7% in indigenous compared to 2.0 % in exotic cattle breeds and no significant differences ($P>0.05$) was shown due to hydatidosis in November (4.3%), December (4.4%) and 3.2% of January (table 3). Sex-based result showed higher prevalence rate in male cattle 4.1% than in females 3.6%.Similarly, the prevalence was high in male sheep 5.3% compared to females 4.9% as well as in male goats 4.0% than female 3.0%. Age-based result showed higher prevalence rate in adult cattle 4.7% than in young ones 2.4%.Similarly, the prevalence was high in adult sheep 5.3% compared to young ones 4.7% whereas in adult goats it was 4.0% compared to young ones 3.0 % (fig.1)

Table2. *Prevalence of Hydatidosis in visceral organs of cattle (C), sheep(S) and goats (G) from November 2014 to January 2015 at the Gumbo Slaughter place, Juba County, South Sudan.*

Organs Inspected	No. of infected organs per animal species	No. of infected Organs	Relative prevalence (%)	Total number of hydatid cysts
Liver	C=21, S=53, G=32	106	2.13	108
Lungs	C=21, S=27, G=40	88	1.76	95
Spleen	C=3, S=0, G= 0	3	0.06	5
Heart	C=0, S=0, G=2	2	0.04	2
Kidneys	C=0, S=0, G=0	0	0.00	0
Total		199	3.99	210

Table3. *Prevalence of Bovine hydatidosis in indigenous and exotic cattle breeds examined from November 2014 to January 2015 at the Gumbo Slaughter place Juba County South Sudan.*

Months	Post-mortem Examinations						
	No. of cattle examined	Ankole cattle breed	No. of positive cases	Relative Prevalence (%)	Nilotic cattle breed	No. of positive cases	Relative Prevalence (%)
November	472	194	7	3.61	278	16	5.76
December	356	220	3	1.36	136	10	7.34
January	313	135	1	0.74	178	8	4.49
Total	**1,141**	**549**	**11**	**2.00**	**592**	**34**	**5.74**

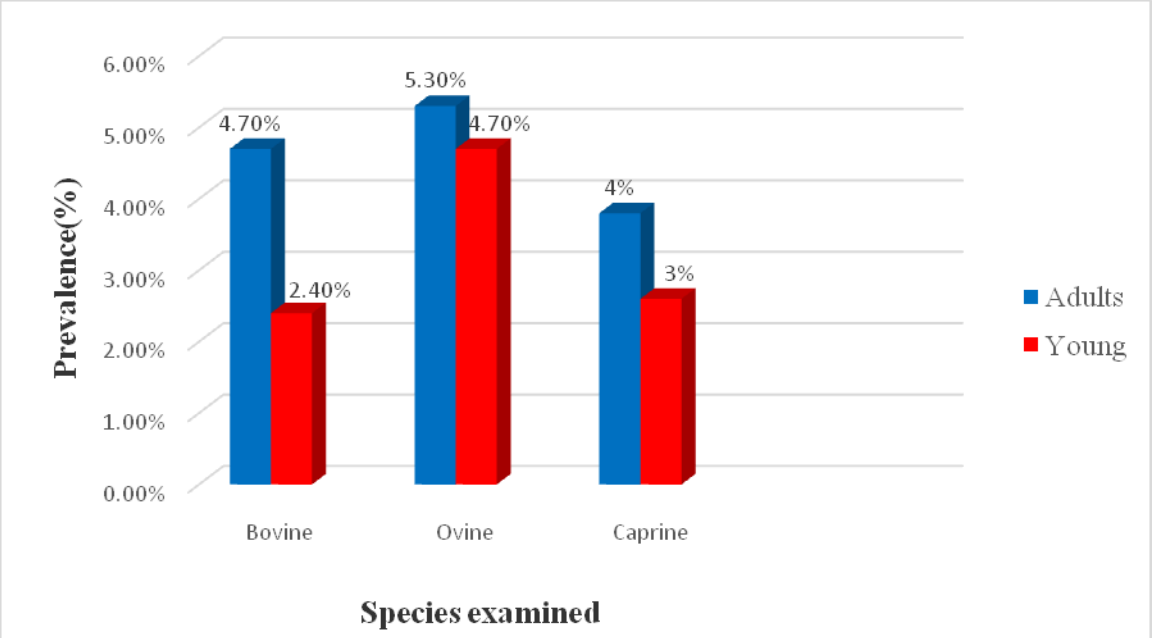

Fig1. *Prevalence rate of hydatidosis in adult and young bovine/cattle, ovine/sheep and caprine/goats from November 2014 - January 2015 at the Gumbo slaughter place, South Sudan*

3.2. Economic Loss

The direct economic loss due to condemnation of 199 visceral organs of cattle, sheep and goats amounted to 6,032 South Sudanese pound (SSP) which is equivalent to US$ 2,032.77.This amount is based on retail market price during the study period. No indirect losses from carcass weight and milk yield included in this study.

4. Discussion

The higher prevalence rate of hydatid cyst in sheep than other animal species is in line with similar studies conducted in Iran (Azami et al., 2013) and in Saudi Arabia (Toulah et al., 2012).This might be due to the negative behavioral pattern of sheep in grass selection. Goats mostly graze on branches of trees which hang above the ground that are less likely to be infected by fecal material from dogs. The significantly high prevalence of bovine hydatidosis in indigenous Nilotic compared to exotic Ankole cattle breed might be due to inadequate veterinary services in the past three decades, besides an inadequate disposal of condemned organs in South Sudan. High incidence of hydatidosis was reported to coincide with a large population of dogs

and increased sheep production (Khuror, 2002). The significantly low prevalence (P>0.05) among the Ankole cattle could be due to de-worming regimens undertaken in Uganda for imported livestock. Generally speaking, variation in prevalence among different geographical locations could be due to different strains of *E. granulosus* that exist in various geographical locations.

The high prevalence of the hepatic and pulmonary hydatidosis is justifiable as liver and lungs possess the first greater capillary fields compared to other peripheral organs (Mohamed, 1985). Report of infection and prevalence of hydatidosis in domestic animals in Ethiopia showed that lungs and liver were the most commonly affected organs by hydatid cyst in cattle, sheep and goats (Tappe et al., 2011). Bizuwork et al. (2013) showed that the infection rate due to hydatid cysts were 50.5%, 40.6%, 1. 98%, 4.95% and 1.98 % inflicted lungs, liver, spleen, heart and kidneys, respectively. Furthermore , Melaku et al. (2012) showed that the distribution of hydatid cysts in cattle organs as 68.67% in the lungs,14.46% in the liver ,6.02 % in the kidneys,1.2 % in the heart and 9.64% in both lungs and liver. In our study no cysts were detected in kidneys and this might be due to the time length of study. The high prevalence in adults compared to young animal was due to higher possibilities of exposure to infection than young ones in addition to social norms of slaughtering old ages. Sex-based prevalence showed no statistical significant difference (P>0.05) which might be related to the same patho-physiology of both sexes. Furthermore it appears that there is no sex specificity in hydatidosis. The higher number of slaughtered goats than other animals was observed and this might be related to the norms and traditions of South Sudanese in consumption of goat meat compared to other neighbouring countries or nations.

The direct economic losses of the condemned organs appeared to be considerable. This may reflect the erratic veterinary and extension delivery services to key stakeholders in the country. Melaku et al. (2012) revealed that the economic loss of carcass weight and organ condemnations was estimated at 39,157.12 US$. Getaw et al. (2010) showed an annual economic losses in animal due to hydatidosis to be 5,869.8 US$ .However, the differences in monetary values could be explained by the variations in retail market price, the size of each organ and the exclusion of carcass weight loss in our study.

5. CONCLUSION

Hydatidiosis is highly prevalent in sheep in Juba County causing considerable economic losses. Development of control strategy for dogs and proper hygienic disposal of condemned organs is imperative. Further epidemiological studies are needed to determine the estimated indirect economic loss from carcass weight and milk yield loss besides the genotypic characteristics of *E. granulosus* local strains in livestock and the public health importance of hydatidiosis in South Sudan.

ACKNOWLEDGEMENTS

We would like to acknowledge the State Ministry of Animal Resources and Fisheries Central Equatoria State for administrative collaboration and technical cooperation. University of Juba is indebted for enhancing this study.

REFERENCES

[1] Abebe F. and Yilma J. (2012). Estimated annual economic loss from organs condemnation, decreased carcass weight and milk yield due to bovine hydatidosis in Ethiopia. Ethiop. Vet. J; 16(2):1-14.

[2] Ahmadic N.M and Meshkerhar M. (2011). An abattoir- based study on the prevalence and economic losses due to Cystic Echinococcosis in slaughtered herbivores in Ahwaz, south-western Iran. J. Helminthol., 85, 33-39

[3] Ahmed M. E, Mohamed I. Abdelrahim and Fatima M. Ahmed (2011). Hydatid disease, amorbid drop needs awareness, Ann. Suadi Med. J; 122, 56-64.

[4] Azami , M., Anvarinejad , M., Ezatpour,B., Alirezaaei, M.(2013).Prevalence of slaughtered Animals in Iran. Turkiye Parasitol.Derg.,37(2):102-106.

[5] Bizuwork A.,Nigatu K.,Tariku T.,Getachew T. and Tesfu K.(2013).Occurrence and financial significance of bovine cystic echinococcosis in Southern Wollo, Northeastern Ethiopia. J.Vet. Med. Anim. Hlth., 5 (2):51-56.

[6] Budke and Torgerson (2003). Global socio-economic impact of Cystic Echinococcosis. Emerging Infect. Dis., 12, 296-303.

[7] Craig, P.S., McManus, D.P., Lightowlers, M.W., Chabalgoity, J.A.,Garcia, H.H., Gavidia, C.M., Gilman, R.H., Gonzalez, A.E., Lorca M., Naquira, C., Nieto, A. and Schantz, P.M.(2007).Prevention and control of cystic echinococcosis.Lancet Infect.Dis.,7,385-394.

[8] Eisa, A.M, A.A Mustafa and K.N. Soliman (1962). Preliminary Report on cysticercosis and hydatidosis in South Sudan. Sud. J. Vet. Sci.3:97-108.

[9] Getaw, A., Beyene, D., Ayana, D.,Megersa ,B., Abunna, F.(2010).Hydatidosis : Prevalence and its economic importance in ruminants slaughtered in Adama Municipal Abattoir Central Oromia , Ethiopia. Acta Trop., 133(3):221-225.

[10] Khuror M.S (2002). Hydatid disease: A current status and recent advances,

[11] Melaku, A., Lukas, B., Bogale, B.(2012). Cyst Viability, Organ Distribution and Financial Losses due to Hydatidosis in cattle slaughtered at Dessie Municipal Abattoir, North–eastern Ethiopia. Vet. World, 5(4): 213-218.

[12] Mohamed A.A (1985). Prevalence of *Echinococcus granulosus* among Domestic Animals in Libya. Trop. Anim. Hlth. Prod. 17, 169-170 Sudan Med. J; 47(1): 4-8

[13] Tappe K.A, Mousavi J. S and Barazesh A. (2011). Prevalence and fertility of hydatid cyst in slaughtered livestock of Urmia city, Iran.

[14] Thrusfield M (1995). Veterinary Epidemiology, 2nd Ed. Edinburgh, Black well science Ltd., UK. pp 182-198.

[15] Toulah, F.H., El-Shafaei, A.A., Alsolami, M.N.(2012).Prevalence of Hydatidosis among slaughtered animals in Jeddah, Kingdom of Saudi Arabia.J. Egypt. Soc.Parasitol.,42 (3):563-572.

AUTHORS' BIOGRAPHY

Erneo B. Ochi (PhD, PGC)

- South Sudanese
- Director of Research and Development Ministry of Livestock and Fisheries
- Main author and responsible for research
- Supervision of the junior co-author proposal, approval and exection. David A. Akol in pre-slaughter examinations and meat inspection and data management.

David A.Akol(BSc.Hon)

-Born in Tonj Warrap State South Sudan in 1988 Research oriented candidate, College of natural resources And Environmental Studies, University of Juba.

Serafino M. Augstino (M.Sc)

- South Sudanese
- Lecturer and Head Department of Animal Production, University of Juba
- Senior coauthor and responsible for the study design and statistical analysis.
- Senior Researcher