بسْمِ اللهِ الرّحْمنِ الرّحِيمِ

Sudan University of Science and Technology

College of Graduate Studies

Prevalence and Risk Factors of Goats Hydatidosis in West Darfur State-Sudan

الانتشار وعوامل الخطر لمرض الاكياس العدارية في الماعز بولاية غرب دار فور- السودان

A thesis Submitted to the College of Graduate Studies in Partial Fulfillment of the Requirements for the Degree of Master of Preventive Veterinary Medicine (MPVM)

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May 2017

بسْمِ اللهِ الرّحْمنِ الرّحِيمِ

(وَلَوْلَا فَضْلُ اللَّهِ عَلَيْكَ وَرَحْمَتُهُ لَهَمَّتْ طَائِفَةٌ مِنْهُمْ أَنْ يُضِلُّوكَ وَمَا يُضِلُّونَ إِلَّا أَنْفُسَهُمْ ۖ وَمَا يَضُرُّونَكَ مِنْ شَيْءٍ ۚ وَأَنْزَلَ اللَّهُ عَلَيْكَ الْكِتَابَ وَالْحِكْمَةَ **وَعَلَّمَكَ مَا لَمْ تَكُنْ تَعْلَمُ** ۚ وَكَانَ فَضْلُ اللَّهِ عَلَيْكَ عَظِيماً **(النساء 113)**

Dedication

- **To my lovely father**

- **To my kind unfailing support, my mother**

- **To my wife and my sons**

- **To my brother**

- **To my colleagues and friends**

- **To all who have helped *me***

Acknowledgements

I thank Allah who gave me the full patience to conduct and finish this work. With a great touch of pleasure and gratitude, I would like to express my thanks to my Supervisor: Professor Siham Elias Suliman Mohammed for her interest in this work, advice, guidance and constructive criticism reviewing the dissertation. My thanks are extend to the laboratory staff of the Ministry of Agriculture and Animal Resources, and slaughterhouse staff and butchers of Elgeneina and Krenik slaughterhouse for assistance during collection of samples. My appreciation is extended to all people who helped me during this study.

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ABSTRACT

An abattoir survey was conducted on 300 goats slaughtered at El-geneina and Krenik abattoir, West Darfur State, Sudan, during the period 20 September to 20 November 2016. The objective of the survey was to estimate the prevalence of hydatid cysts in goats and to investigate the risk factors associated with the disease. Routine meat inspection procedures were employed to detect the presence of hydatid cysts in visceral organs (liver, lung, and spleen). The goats selected for this study originated from seven areas: Elgeniena, Krenik, Serba, Jabal moon, Habella, Umtajok and Azrni. The overall prevalence was 1.7%. The prevalence of hydatid cysts infection according to localities was 2.5% in Elgeneina locality and 0.71% in Krenik locality. The prevalence of hydatid cysts infection according to age of the goats was 0% in young animals and 5.3% in old animals . Regarding distribution by sex, the prevalence of hydatid cysts was 1.7% in males and 1.6% in females goats. Regarding distribution by breed, the prevalence of hydatidosis was 1.7% in desert goats and 0% in Nubian goats. The distribution of the hydatid cysts according to the origin of goats was {15.3%} in Jabal moon,{ 1.8 %} in Elgeneina,{ 1.3%} in Krenik . Not found any infection in Umtajok , Habella Azrni and Serba . There were no Significant difference between the prevalence of hydatidosis and the potential risk factors except in age of goats (P Value =.0001) and origin of animals (P Value =0.01) . The results showed the most infected organ was the liver {3 cysts} then lung { 1 cyst} and spleen{1cyst}. All cysts were fertile except one was sterile. From the result obtained in this study, it can be concluded that hydatidosis is less encountered disease in goats in West Darfur State . Therefore no needed for further Studies to determine more risk factors .

ملخص البحث

أجري مسح للمذابح على 300 ماعز ذ بحت في مجزرة الجنينة وكرينيك بولاية غرب دارفور بالسودان خلال الفترة من 20 أيلول / سبتمبر إلى 20 تشرين الثاني / نوفمبر 2016. وكان الهدف من الدراسة الاستقصائية تقدير مدى انتشار الاكياس المائية في الماعز وإلى التحقيق في عوامل الخطر المرتبطة بهذا المرض. وقد استخدمت إجراءات تفتيش اللحوم الروتينية للكشف عن وجود الاكياس المائية في الأجهزة الحشوية (الكبد والرئة والطحال). أما الماعز المختار لهذه الدراسة فقد نشأت من سبع مناطق هي: الجنينة، كرينيك، سيربا، جبل مون، هابيلا، أمتجوك وأزرني. وكان معدل الانتشار الإجمالي 1.7٪. وكان معدل انتشار عدوى الاكياس المائية وفقا للمحليات 2.5٪ في محلية الجنينة و 0.71٪ في محلية كرينيك. كان انتشار عدوى الاكياس المائية وفقا لعمر الماعز 0٪ في الحيوانات الصغيرة و 5.3٪ في الحيوانات الكبيرة. وفيما يتعلق بالتوزيع حسب الجنس، كان انتشار الاكياس المائية 1.7٪ لدى الذكور و 1.6٪ في الماعز الإناث. وفيما يتعلق بالتوزيع عن طريق السلالة، كان معدل انتشارمرض الاكياس المائية 1.7٪ في الماعز الصحراوي و 0٪ في الماعز النوبي. وكان توزيع الاكياس المائية وفقا لأصل الماعز {15.3٪} في جبل مون، {1.8٪} في الجنينة، {1.3٪} في كرينيك. لم يتم العثور على أي عدوى في أمتجوك، هابيلا أزرني

وسيربا. لم يكن هناك فرق معنوي بين انتشارمرض الاكياس المائية وعوامل الخطر المحتملة ماعدا في عمرالماعز قيمة(P= 0.001)واصل الحيوان قيمة(P= 0 .01)

وأظهرت النتائج أن الجهاز الأكثر إصابة هو الكبد {3 الاكياس} ثم الرئة {1كيس} والطحال {1 كيس}. وكانت جميع الاكياس خصبة باستثناء واحد كان معقما. من النتيجة التي تم الحصول عليها في هذه الدراسة، يمكن أن نستنتج أن مرض الاكياس المائية هو أقل واجه في الماعز في ولاية غرب دارفور. لذلك لا حاجة لمزيد من الدراسات لتحديد المزيد من عوامل الخطر

Introduction

Cystic echinococcosis is the name given to the condition caused by the zoonotic dog tapeworm, *Echinococcus granulosus*. This tapeworm spends most of its adult life in the intestine of definitive hosts (canids) and in particular the dogs and wolves. The tapeworm eggs become voided in the canids' faeces and as a result of ingesting the eggs, infection passes to the intermediate hosts, commonly herbivores while grazing. However, human can become accidentally infected and hydatid cysts may develop throughout his body. Cystic hydatidosis is a disease caused by the metacestode stage of Echinococcus. The disease is not apparent to farmers but is of considerable economic and public health importance (Ahmadi and Meshkehkar, 2011). In farm animals, it causes considerable economic losses due to condemnation of edible organs, decreased meat and milk production, reduced hide and fleece value and decreased fecundity (Sariozkan and Yalcin, 2009). The incidence of human hydatid. disease in any country is closely related to the prevalence of the disease in domestic animals and is high where there is a large dog population and high sheep production (Khuroo , 2002). The most frequent strain associated with human cystic echinococcosis appears to be the common sheep strain (G1) (Wani *et al* ., 2007). Hydatidosis is considered a serious problem for public health and the livestock economy (Abebe and Yilma,2011).

Around 0・3–0・5 million cases (all in the northern hemisphere). Fewer than 150 cases of polycystic echinococcosis have been described, all In Central and South America. The global burden for HE was recently estimated to be more than that for onchocerciasis and almost the same as that for African trypanosomiasis. Until 2005, only four Echinococcus species were recognized (Craig *et al.,* 2007). *E. granulosus* has little specificity with regard to the definitive hosts, only few species of canids are involved in the cycle. On contrary hydatid cysts have been seen in a wide range of mammals, including domestic ruminants , cattle, sheep, goats, camels, giraffes, pigs, equines, elephants, hippopotamuses, marsupials and different types of deer as well as humans. Man becomes infected accidentally by ingestion of the eggs of the parasite through contaminated hand, foods, drink or other materials with dog's feces. The adult cestode inhabits the small intestine of definitive hosts and produces eggs containing infective oncospheres which are released into the environment with feces. After the ingestion of eggs by an intermediate hosts the larval

stage, metacestod or hydatid cyst, in the liver and lungs and also develop in the kidneys, spleen, heart and other organs (Eckert and Deplazes, 2004). This different localization of cysts determines the pathology of *E.granulosus* infection (White *et al*., 2004). In Sudan, hydatidosis was first reported in dogs in 1962 (David *et al.,*2015). The disease previously investigated in Sudan showed that the prevalence of camel hydatidosis in Nyala and Tampoul was 16.1% , 29.1% respectively ,(Elmahdi *et al.*, 2013), other study showed the infection rate (0.12%) (0.01%) in cattle , sheep but no infection detected in goats, (Shadia and Abderahim, 2014) .

Objectives:

1/ To estimate the prevalence of goats hydatidosis in western Darfur state.

2/To investigate the risk factor associated with the disease.

Chapter one

Literature review

1.1. **Classification of Echinococcus:**

Echinococcosis is caused by several species of *Echinococcus*, tiny cestode parasites in the family *Taeniidae*. At present, four species of the genus *Echinococcus* are recognized and regarded as taxonomically valid, these are *Echinococcus granulosus* (cystic hydatidosis), *multilocularis* (multivesicular hydatidosis), *vogeli* (polycystic hydatidosis) and *oligarthus* (Soulsby, 1982).

These four species are morphologically distinct in both the adult and the larval stages. The major morphological difference among different species of echinococcus is the length of the tapeworm. *E. granulosus* is approximately 2 to 7 mm while *E. multilocuralis* is often smaller and is 4 mm or less (Eckert, 2004). In addition, there are differences in the hydatid cysts structure. For instance, in *E. multilocularis*, the cysts have an ultra thin limiting membrane and the germinal epithelium may bud externally. Furthermore, *E. granulosus* cysts are unilocular and full of fluid while *E. multilocularis* cysts contain little fluid and are multilocular. For *E. vogeli*, its hydatid cysts are large and are actually polycystic since the germinal membrane of the hydatid cyst actually proliferate both inward, to create septa that divide the hydatid into sections, and outward, to create new cysts. Like *E. granulosus* cysts, *E. vogeli* cysts are filled with fluid (John *et al.*, 2006).

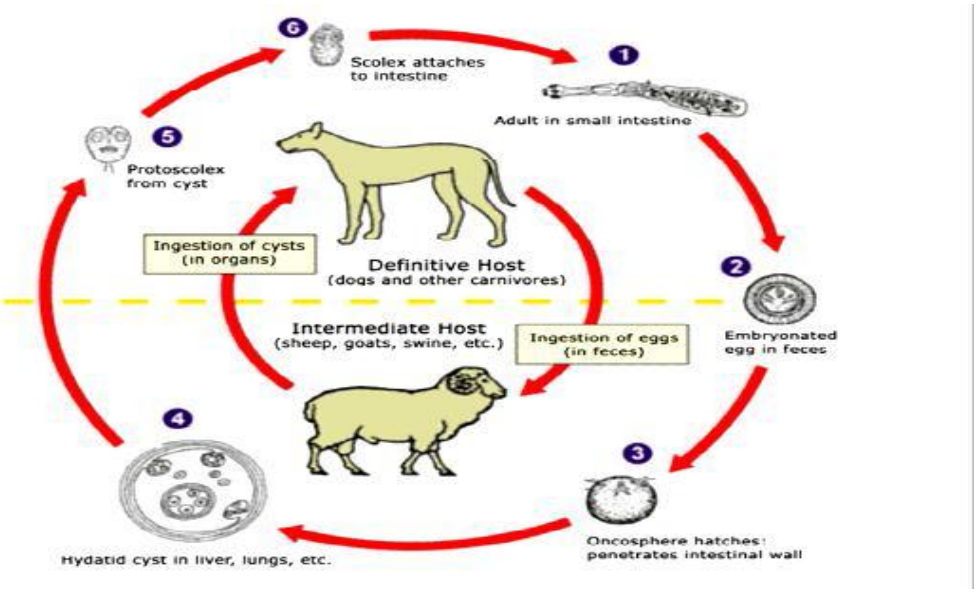
E. granulosus species have traditionally been divided into strains, named G1 to G10, which have a degree of host adaptation, and may be maintained in distinct cycles. A common feature of all strains (except the lion strain) is the utilization of dogs and other canids as definitive hosts, but the strains exhibit several differences in intermediate host spectrum, geographic distribution, adult and metacestode morphology, maturation time in definitive hosts, organ localization of metacestodes, and protoscolex production (Eckert *and* Thompson, 1997). It has to be emphasized that at least seven of ten *E. granulosus* genotypes are infective to humans. Globally, most human cases of cystic echinococcosis are caused by the sheep strain (G1) of *E. granulosus*. The G5 cattle strain appears to be distinct, and has been designated as *E. ortleppi*. It is the major cause of cattle hydatidosis but also affected other animals and humans (Eckert and Deplases, 2004).

1.2.The life cycle of Echinococcus granulosus

E. granulosus life cycle in domestic animals involves dogs as definitive host and ungulates, mainly sheep and cattle, as intermediate hosts. However, wild canids can also be involved in the transmission of the parasite in some areas (Jenkins and Morris, 2003; Jenkins and Macpherson ,2003). This transmission is responsible for the sylvatic echinococcosis cycle. The outcome of infection in livestock is hydatid cysts developing in the lung, liver or other organs (Jenkins *et al.*, 2005). Each cyst is filled with fluid and is surrounded by a fibrous laminated outer membrane and an inner membrane called the germinal layer (figure 1.1). Brood capsules develop from the germinal membrane. Each brood capsule contains several invaginated heads (protoscoleces) that can develop into an adult worm if they are ingested by the definitive host. Some protoscoleces float freely and are known as "hydatid sand".

The hydatid sand has the potential of developing into new cysts. Some cysts are sterile and either never produce brood capsules, or they become sterile after bacterial infection or calcification. The percentages of sterile cysts vary with the intermediate host and play a vital role in transmission of the disease. Sheep and numerous ungulates (goats, swine, and cattle) are intermediate hosts of cystic hydatidosis, harbouring the hydatid cyst (Euzeby, 1991; Garippa *et al.*, 2004). Pigs are infected by different genotypes of *E. granulosus* (Bowles and McManus, 1993; Eckert *et al.*, 1993). Studies on the strain specificities of *E. granulosus* in Tunisia showed that the sheep strain (G1 genotype) was present in sheep, cattle, camels and humans (Lahmar *et al.*, 2004) and that the camel strain (G6 genotype) was only present in camels (M'Rad *et al.*, 2005) with fertile ovine, bovine and cameline cysts being a reservoir for dogs and other canids. These protoscoleces in the hosts may remain viable for up to 36 days depending on ambient temperatures and relative humidity (Dikel *et al.*, 2007). Accidentally, eggs ingested by humans and other "aberrant" hosts may not play a role in the natural cycle. Whereas the infection of carnivores with immature or mature intestinal stages does not cause morbidity, the invasion of various organs mainly liver and lungs of the intermediate or aberrant hosts by metacestodes can cause severe and even fatal echinococcosis (Eckert and Deplazes *et al.*, 2004). An important factor influencing the persistence and spread of *E. granulosus* infection is the infection of dogs by ingestion of the viscera of infected sheep. Larval/hydatid cyst stage (the embryo)

released from an egg develops into hydatid cyst, which grows within the first year and is able to survive within organs for years (Borji *et al*, 2012). Cysts sometimes grow to be so large that by the end of several years or even decades, they can contain several litres of fluid. Once a cyst has reached a diameter of 1 cm, its wall differentiates into a thick outer, non-cellular membrane, which covers the thin germinal epithelium. From this epithelium, cells begin to grow within the cyst. These cells then become vacuolated and are known as brood capsules, which are the parts of the parasite from which protoscoleces bud. Often, daughter cysts will also form within cysts (David and Petri *et al*., 2006). *Echinococcus* adult worms develop from protoscoleces and are typically 6mm or less in length and have a scolex, neck and typically three proglottids, one of which is immature, the second is the mature and the third of which is the gravid one containing eggs (David and Petri *et al.*, 2006). The adult worm only develops to maturity in the definitive host. The scolex of the adult worm contains four suckers and a rostellum that has about 25-50 hooks.



Figure{1.1}: Life cycle of *Echinococcus species* (Source:CDC http.www.dpd.cdc.govldpdx)

1.3 Transmission of Echinococcosis

Various factors perpetuate the transmission and endemicity of echinococcosis. They can be biological, demographic and culture risk factors that are facilitated by husbandry systems. This is the reason why the disease has been associated with sheep production systems mainly in South America. Lack of drinking water and utilities, combined with low levels of education and poor sanitary conditions increases the transmission of the disease (,Ferreira and Irabedra 2007). The disease is maintained by the dog-sheep-dog transmission cycle indicting home slaughtering as risk factor. Dogs never show any clinical signs, so they are perfect carriers since they remain completely healthy. The eggs are mainly located on the surface of the feces and can accumulate in the perennial regions of the dog where they can be carried to any parts of the body of the dog . Hence direct contact with dog is high risk factor as well as consumption of vegetables and water contaminated with infected dog feces. People are also infected after the consumption of contaminated fruits or by hand-to-mouth transfer of tapeworm eggs from dog feces. The eggs can also be inhaled, causing primary lung disease (Morar and Feldman 2003). Sheep, goats, bovines and pigs are usually infected after the consumption of grass containing eggs of the parasite. The well known factor in transmission of the disease is the feeding of infected material cotanining hydatid cysts to dogs by pastoral communities and other rural communities where backyard slaughtering (home slaughtering) is done. In endemic areas, dogs are often fed the raw viscera of backyard slaughtered animals (Jenkins *et al.*, 2005, , Ferreira and Irabedra 2007; Craig *et al*., 2007; Bisaro and Bouree 2007). Dogs scavenging on the carcasses of intermediate hosts are also important in the transmission of the parasite (Jenkins *et a.l*, 2005). Predator- prey associations play an important role in the transmission of the disease as well as human behavior and traditional animal husbandry practices. As dogs can get infected with the wild trains, they constitute a grater reservoir for echinococcosis (Craig *et al*., 2007). *E. granulosus* has got both sylvatic cycle involving domestic dogs and wild rodents as well as domestic cycle . Echinococcus eggs can be scattered in the environment by wind, water and insects where they are ingested by various hosts. The eggs survive several days outside depending on the temperature, but numerous eggs die in nature because they cannot resist desiccation and extreme temperatures (Bisaro, 2007). Eggs passed out in the feces can stick to the animal's fur or to grass. These eggs can survive for at least a year in the outside,

during which time they are widely dispersed. Flies help to spread the eggs, as does the wind (Morar, 2003)

1.4. Epidemiology of *E. Granolusus*:

Cystic echinococcosis is globally distributed and particularly economically and medically important in rural pastoralist societies (Eckert, *et al*, 2001). The disease poses important public health challenges in most parts of the world (WHO, 2001). The ability of the parasite to adapt wide variety of hosts contributes to the global distribution of the disease. Although the disease is globally distributed, it is most prevalent where livestock farming is practiced.

A study was conducted in order to determine the prevalence of hydatidosis and the fertility/sterility rates of hydatid cysts in cattle and sheep slaughtered in Addis Ababa abattoir, Ethiopia. Postmortem examination, hydatid cyst characterization and questionnaire survey were conducted. In the study, 19.7% cattle and 13.47% sheep were found harboring hydatid cyst (Fikire *et al.*, 2012).

cattle brought from Harar 36%, northern Shewa 28%, Nazareth 22%, Arsi 10% and others 4% were infected. Difference in prevalence rates were highly significant ($p < 0.005$) between cattle and sheep. According to the location of cysts in cattle , 48%, 31.3% ,16.3% ,1.7% ,and 2.4% of cysts were found in Lung , Liver, Kidneys , Spleens and hearts respectively. For Sheep, the loction was 41.7% , 56.7% ,0.8% , 0.8% , in these organs, respectivey Of the total of 1479 hydatid cysts in cattle , 38.2%, 29.8% , 7.3% , and 24.7% of the cysts were found to be small , medium , large and calcified , respectively where as in sheep these characters were 64% , 11.4% ,1.7% ,and 22.9% , respectively(Fikire et al.,2012). Among the hydatid cysts, 55.4%, 19.3% and 25.3% in cattle (n = 1479) and 22.5%, 59.1% and 18.5% in sheep (n = 175) were sterile, fertile and calcified, respectively. Viability rates of 60.5% in cattle and 78.3% in sheep were observed. The rate of calcification was higher in the liver than in the lung while fertility rate was higher among the cysts of the lung for both cattle and sheep (Fikire *et al.*, 2012).

Cross sectinal astudies conducted in North Africa have showed wide significant variation in infection of cattle and sheep depending on the location . The variation in infection is as a result of several factors which aid transmission of *Echinococcus spp*. The

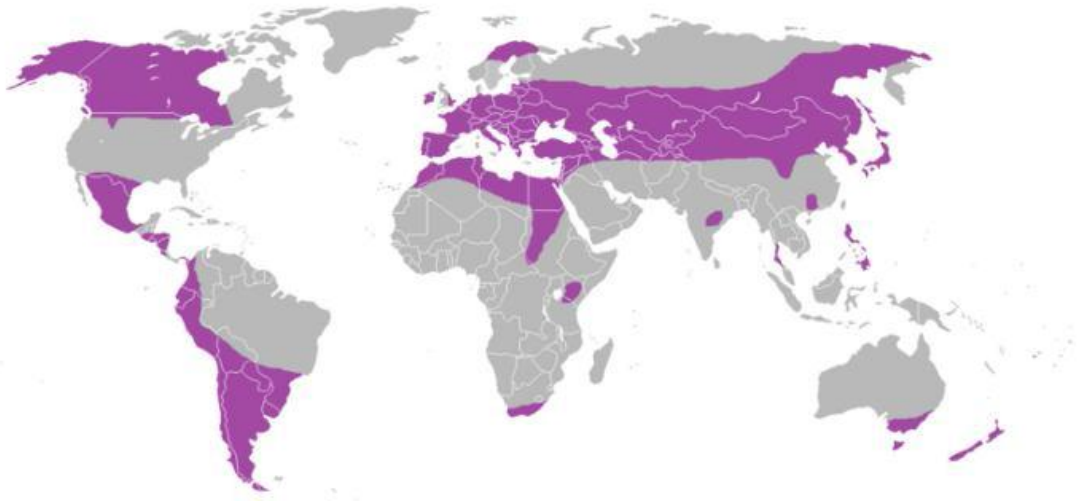
infection rates in cattle are especially high in Middle Atlas (8.72%) and in the Loukkos (37.61%) (Azlaf and Dakkak, 2006). A recent study in Ngorongoro District of Tanzania showed an overall prevalence of 47.9% and species prevalence of 48.7%, 34.7% and 63.8% in cattle, goats and sheep respectively (Kazwala, 2008). Countries around the Mediterranean region, have exhibited high prevalence of cystic echinococcosis in both humans and livestock. Egypt has recorded human cases between 1.34- 2.6 cases per 100,000 people through hospital surveys and 6.4% prevalence in cattle and buffalo through abattoir surveys (Kazwala, 2008). A three year (2005-2007) retrospective study was carried out to investigate the occurrence of cystic echinococcosis in cattle and sheep slaughtered at Arusha municipal abattoir, Tanzania. A total of 115,186 cattle and 99,401 sheep and goats were slaughtered. Cattle livers, lungs, spleens and hearts condemnation rate was 16.35%, 13.04%, 2.09% and 3.06% respectively, while 17.63%, 7.63%, 0.38% and 0.04% of sheep and goats livers, lungs, spleens and hearts were respectively condemned. Highly significant ($P<0.001$) cystic echinococcosis infection rate was recorded in cattle (40.2%) than in goats (6.05%) probably because of differences in grazing patterns. Cattle lungs were more affected by CE (22.5%) than liver (19.7%) (Nonga and Karimuribo , 2007). A study was conducted to estimate the infection rate of hydatidosis caused by *E. granulosus* in cattle and sheep as intermediate hosts in slaughterhouses of Khartoum State (Mohamadin and Abdelgadir *et al*., 2011).

An abattoir survey was carried out in 849 cattle and 3850 sheep slaughtered in the Study area. during January 2010 to June 2010.(Mohamadin and Abdelgadir, 2011). The highest infection rate was found in cattle (2.8%) followed by sheep (1.4%). The most affected organs in cattle were the lung and liver (37.5% for each). In sheep, the liver was the most infected organ (65.2%), followed by mesentery (21.7%). The records of abattoirs in Khartoum state indicated that hydatidosis was one of the most frequently encountered parasites during the last six months in Khartoum State (Mohamadin and Abdelgadir, 2011) . A study was designed to detect the prevalence and fertility of hydatid cyst in different states of Sudan. A total of 18571 carcasses of sheep, 1876 goats, 2806 cattle and 250 camels were examined for the presence of hydatid cysts in the central and southern Sudan. The study revealed an infection rate of 0.01% in sheep with fertility rate of 50%and 0.12% in cattle with fertility rate of 50% and 22% in camel high fertility rate of cysts {20%}. No infection

was detected in goats. None of the goats examined in Khartoum State slaughterhouses were found infected. The high prevalence observed in camels and cattles suggests that these animals clearly have an important role in the continuation of the *Echinococcus granulosus* life cycle in Sudan (Shadia and Abdelrahim, 2014).

1. 5. Geographical distribution *E. granolusus:*

Hydatidosis occurs allover the world and responsible for huge economic losses and health problems in endemic countries(Yacob *et al.,* 2016) . The prevalence of the {CE} is higher in developing countries especially in rural communities where there is close contact between dogs (definitive host) and livestock products which based mainly on extensive grazing system (Debela *et al.,2014).* The echinococcosis has a worldwide distribution and endemic in many countries of the Mediterranean basin, North and East Africa, Western and Central Asia, China, South America and Australia.(Maysara *et al.,* 2014)



Figure{1.2} : Global distribution of *Echinococcus granulosus* (black) (Omer, 2013)

1. 6. Diagnosis of *E. granulosus* in intermediate hosts:

Infections with *E. granulosus* cysts in intermediate hosts (sheep, goats,cattle, horses, etc.) are typically asymptomatic, except in few cases of longstanding and heavy infections. There are no reliable methods for the routine diagnosis of the infection in living animals, but in rare cases cysts have been identified by ultrasonography alone or in conjunction with serum antibody detection (Eckert *et al.,* 2001). A new ELISA with a high specificity and a

sensitivity of 50 to 60% might be useful for detecting *E. granulosus* cysts in sheep on a flock basis but cannot be used for reliable diagnosis of infected individual animals (Kittelberger *et al.*, 2002).

Cysts classified as fertile and infertile by the presence or absence of brood capsules containing protoscoleces in hydatid fluid according to the method described by (soulsby 1982). Infertile cysts were further classified as sterile (fluid filled cyst without protoscoleces) or calcified (Soulsby, 1982). To test the viability, the cyst wall was punctured by a needle and opened and the contents were examined microscopically (40x) for the amoeboid-like peristaltic movements of protoscoleces according to the standard procedure. In doubtful cases, a drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices on a microscope slide with the principle that viable protoscolices completely or partially exclude the dye while the dead ones take the stain (Miheret *et al.*, 2011).

1. 7. Treatment and control of echinococcosis:

Chemotherapy is apparently more effective among young rather than older of animals. Small cysts that have thin walls are most susceptible to chemotherapy. Chemotherapy may, however, be less effective for thin-walled daughter cysts within a mother cyst. Some of the treated animals exhibit relapses, but these are usually sensitive to retreatment in a high proportion of cases (up to 90%). The rate of relapses after chemotherapy is relatively high (14%-25%) Chemotherapy is indicated for inoperable animals with primary liver echinococcosis and for animals with multiple cysts in two or more organs. Cysts localised in bones are less susceptible to chemotherapy. (e.g. cyst localization in spine or pelvis), long-term chemotherapy may be needed. Another important indication for chemotherapy is the prevention of secondary echinococcosis. The pre-surgical use of benzimidazoles (ABZ or MBZ) may reduce the risk of recurrence of CE and/or facilitate the operation by reduction of intracystic pressure, but this is not well documented. Two benzimidazoles have been extensively evaluated using animal models and used on over 2,000 animals: (Bekcci., 2012).

• Albendazole (ABZ) (Eskazole®, Zentel®; 400 mg tablets and 4% suspension, SmithKline Beecham, England)

• Mebendazole (MBZ) (Vermox®; 500 mg tablets, Janssen Pharmaceutica, Belgium).

These drugs show definite efficacy against CE, and are generally well tolerated. In animals, prevention and control of echinococcosis is achieved by sanitary disposal of slaughterhouse waste to prevent access by dogs and also regular de-worming of dogs.

Ruminants acquire infection by grazing on contaminated pastures. as a result of using dogs for herding cattle and sheep. Therefore, limiting the use of dogs in herding these animals can help in the control of CE. Fencing off of the grazing area can also help in prevention of transmission of CE to cattle and other ruminants by preventing dogs from defecating on their pastures. Control of hydatidosis in animals will result in reduced risk of human exposure. Children are particularly at risk of zoonotic infections because of their close and regular contact with dogs and these also require regular de-worming (Hegglin and Deplazes, 2008).

Diagnosis and treatment of CE is very difficult and the disease can be asymptomatic in many animals. Because of this, the disease is under reported and can take up to 5 to10 years for the cysts to cause problems. Treatment of CE in humans is through medical and surgical means and also puncture and aspiration, injection and reaspiration (PAIR). Medical treatment is cheaper and is done by administration of dewormers to the infected humans. Medical treatment is usually used when surgery is not possible due to anatomical location which can cause difficulties in the removal of the cysts. Medical treatment is used even in surgical treatment as a pre-surgical chemotherapy to reduce the possibility of rescinding of scoleces and thus reoccurrence of the cyst(Hegglin *et al.,* 2008)

Chapter two

Materials and Methods:

2.1 . Study area:

West Darfur State is located near the border in western Sudan. It has got national borders with Central Darfur State to the south east and North Darfur State to the north, it also shares international borders with Republic of Chad to the west. It has an area of 75,000 km2 and a total human population of 757,000 mostly engaged in agriculture and livestock rearing. Elgeniena is the capital town of the state , 13º27"0"N 22º27"0"E .The climate varies in Western Darfur State, the difference between the mean daily maximum temperature 40-38 ºC in May and the mean daily minimum temperature 12-16 ºC in February is about 25.2 ºC. The rainy season occurs between June and October, but the peak of rainfall in the desert is 800 mm in the southern parts where the lowland is covered with broad leaves wooded savanna trees and grass. In summer (March to June) the climate is dry and hot, while in Autumn (July-October) it is wet and warm. During winter (November – February), the climate is cool and dry.

2. 2: Sampling methods and sample size calculation:

Across sectional study was conducted from October to December (2016) . Random sampling method was carried out. Tow localities slaughterhouses were selected from eight localities of the state, Elgeneina and krenik. The animal which were examined came from seven areas including Elgeniena ,Krenik, Azrni, Habella ,Jabal moon, Umtajok and Serba, and the animals were selected randomly from abattoir. The prevalence was calculated using the formula described by Thrusfield (Thrusfield 2007), as follows.

$$\text{Prevalence rate} = \frac{\text{No. of diseased goats with hydatidosis x100}}{\text{Total of goats at particular point in time}}$$

The sample size was calculating by the formula

$N = 1.96^2 x\ p_E\ (1-p_E)/d^2$

N = sample size

P_E = expected prevalence

d = desired absolute percision

x = multiply mark (Thrusfield 2007) .

sThe expected prevalence of caprine hydatidosis for calculation sample size was taken from the study in sudan in which the prevalence of hydatidosis in goats was 2% (Omer. *et al.*,2010) . According to this study the sample was $N=1.96^2x0.02x(1-0.02)/0.0025=30$

the number calculated was (30) . The goats which examined were 300 goats so as to increase precission of the results .

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2. 3: Questionnaire and ante-mortem examination

Regular visits was made to Elgeneina and Krenik abattoirs . During these selected days animals were shosen at antemortem inspection according the age , sex ,breed and origin The age of animal was determine by incisors of teeth .

2. 4 : Post- mortem examination

During post-mortem examination , visual inspection, palpation and systemic incision of visceral organ were performed particularly the liver ,lung , kidney, heart and spleen in parallel and the following data were recorded, size of cyst , number of cyst , infected organ . Alse to, counting of cysts, size, fertility and viability of protoscoleces were done.

Laboratory examination :

2. 5:Examination of the cyst:

During inspection, carcasses and their respective organs were carefully examined. Infected organ was kept in aseptic and clean container with properly labeled information necessary for analysis and brought to the laboratory of Elgeniena Veterinary Hospital for further analysis. The fertility of cyst was examined microscopically. Each cyst is opened with scissor and the content of the cyst were poured into clean petri dish . A drop of cystic fluid is put in clean slide and then examined under the microscope(40x) for presence of Protoscolices . The vialibilty of protoscolices was determined by Flame Cell Motility. The cyst which contained no Protoscolices as well as suppurated material, calcifical or degenerated material is considered none fertile. The shrunked, evacuated , pus formated cysts were be classified as degenerative cysts, while the solid one that contained sands were considered as calcified cysts , Whereas The cysts filled with fluid without protoscolices were considered sterile by direct microscope examination .

25.2 Volume measurement:

Cyst Volume was measured by aspirating hydatid fluid from the cysts. The volume of fluid of all cysts were estimated by using strile syringes .

2. 6 Statistical analysis:

Results of the study were analyzed using statistical package of social science(SPSS) .

Descriptive statistical analysis was displayed in frequency distribution and cross tabulation tables. Univariate analysis using the chi-square for qualitative data(P-Value ≤ 0.25 was considered as significant association and the risk factor was then selected to enter the multivariate analysis. Multivariate analysis: backward stepwise. Logistic regression was used to analysis the data to investigate association between hydatidosis and risk factors and P value ≤ 0.002 considered as Significant

Chapter three

Results

Among the total of 300 goats inspected, 5 (1.7%) animals were positive to hydatidosis, and the rest were negative(table 3.1).

Table 3. 1. Distribution of hydatidosis infection among 300 goats examined in Elgeneina and Krenik abattoirs in Western Darfur .

	Frequency	Percent	Valid Percent	Cumulative Percent
+ve	5	1.7	1.7	1.7
-ve	295	98.3	98.3	100.0
Total	300	100.0	100.0	

Acording to location of cyst the liver was most inficted organ {3 cysts} then the lung and the spleen { 1 cyst} only(Table 3.2). All cysts were fertile except 1 cyst was sterile.

Table 3.2 . Summary of frequency of hydatid cysts in 300 goats examined in Elgeneina Veterinary Hospital Western Dar fur.

Location of cyst:	Frequency	percent %	Acumlative percent%
Liver	3	1	1
Lung	1	0.3	0.3
Spleen	1	0.3	0.3
Fertility			
Fertile	4	1.3%	1.3%
sterile	1	0.3%	0.3%

3.1 :Localities:

The distribution of 300 goats according to locality was 160 {53.3 %} in Elgeneina locality, and 140 (46.7 %) in Krenik (Table 3.3). Among 160 animals examined in Elgeneina locality 4 were infected and the rate of infection was (2.5%) and among 140 animals examined in krenik locality one animal was infected and the rate of infection was (0.71%). By using crostabulate and Chi square test (table 3.5) there were no significant assocation between hydatidosis and localities (P=.228)

3.2: Age of animals:.

The distribution of the 300 goats according to age was 207 (69%) for young animals and 93 (31%) for old animals (Table3.3:). Among the 207 young animals examined, no one was infected, while in the 93 animals in old age 5 animals were infected, the rate of infection was {5.4 %} the crosstabulate and Chi square test (Table 3.5) revealed positive association (P= 0.001) between hydatidosis and age of examined goats.

3.3: Sex of animals:

Table 3.3 shows the distribution of 300 goats examined for hydatidosis according to sex. The total number of male goats examined was 179 (59.7%), while the total number of females examined was 121(40.3%). Among total number of males, 3 animals were found infected. The rate of infection within males was {1.7%} while among the total number of females examined, 2 animals were found infected and the infection rate was 1.65%. As shown in (Table 3. 5) the Chi-square test showed no significant association between hydatidosis infection and sex of animals (P-value =.988).

3.4: Breed:

The distribution (Table 3.3) of hydatidosis infection in Krenik and Elgeneina slaughterhouses according to breed in desert goats 286 (95.3%) Nubian 14 (4.7%), 5 animals from desert goats were positive, and no infection in Nubian goats The rate of infection was (1.7%) % in desert breed . As showed in (table 3.5) the Chi-square test showed no significant association between hydatidosis and breed (P-value =.618).

3.5 Origin of animals:

Among the 300 local goat breeds inspected, 109 (36.3%) animals were from Elgeniena area, 76(25.3%) animals from Krenik, 16(5.3%) animals from Serba, 13 (4.3%) animals Form Jabal moon, 67(22.3%) from Umtajok , 4 (1.3%) animals from Azrni and 15(5%)

from Habella (Table 3. 3). Two goats out of the 109 animals examined in Elgeneina were infected, one animals out of the 79 goats examined from Krenik were infected, also two goats among the 13 animals examined from Jabal moon was infected,. No infected among the animals which cames from rest areas. The rate of infection was {1.8 %} in Elgeniena, {1.3%} in Krenik, {15.3%} in Jabal Moon. There is significant association between hydatidosis an origin of animal, P value =0.01 at the univirate level

Table 3. 3. Summary of frequency tables for potential risk factors of hydatidosis in 300 goats examined in ElGeniena slaughterhouses.in westrn Darfur .

Risk Factors	**Frequency**	**Relative Frequency %**	**Cumulative Frequency %**
localities:			
Elgeneina	160	53.3	53.3
krenik	140	46.7	100
Total	300	100	
Age:			
Young	207	69	69
Old	93	31	100
Total	300	100	
Sex			
Male	179	59.7	59.7
Female	121	40.3	100
Total	300	100	
Breed:			
Desert	286	95.3	83.3
Nubian	14	4.7	100
Total	300	100	
Source:			
Elgeneina	109	36.3	36.3

Krenik	79	25.3	25.3
Serba	16	5.3	5.3
Jabal Moon	13	4.3	4.3
Umtajok	67	22.4	22.4
Azrni	4	1.3	1.3
Habella	15	5	5
Total	300	100	

Table 3. 4: Summary of cross tabulation for potential risk factors of hydatidosis in 300 goats examined in ElGeniena slaughterhouses in western Darfur stste.

Risk Factors		**Number Inspected**	**Number Affected (%)**
locality	Elgeneina	160	4(2.5%)
	krenik	140	1(.71%)
Age	Young	207	0(0 %)
	Old	93	5(5.4 %)
Sex	Males	179	3(1.7 %)
	Females	121	2(1.65 %)
Breed	Desert gooats	286	5(1.74%)
	Nubian goats	14	0(0%)
Origin of animal	ElGeneina	109	2(1.8 %)
	Krenik	76	1(1.3%)
	Serba	16	0 (0 %)
	Jabal Moon	13	2(15.3)

	umtajok	67	0 (0 %)
	Azrni	4	0(0 %)
	Habella	15	0(0%)

Table 3. 5: Summary of univariate analysis for potential risk factors of hydatidosis in 300 goats examined at algeneina slaughterhouse western Darfur state using the Chi- square test

Risk factors	**categiories**	**Examined no**	**Infected no (%)**	**X^2**	**P value**
localities	**Elgeniena**	**160**	**4(2.5)**	**1.453**	**.228**
	krenik	**140**	**1(0.71)**		
breed	**Desert**	**286**	**5(1.7)**	**.249**	**.618**
	Nubian	**14**	**0(0)**		
Age	**young**	**207**	**0(0)**	**11.318**	**0.001**
	old	**93**	**5(5.4)**		
sex	**male**	**179**	**3(1.7)**	**.000**	**.988**
	female	**121**	**2(1.7)**		
Origin Of animal	**Elgeniena**	**109**	**2(1.8)**		
	Krenik	**76**	**1(1.3)**		

	Umtajok	**67**	**0(0)**	**16.732**	**.010**
	Habella	**15**	**0(0)**		
	Jabal moon	**13**	**2(15.3)**		
	Azrni	**4**	**0(0)**		
	Serba	**16**	**0(0)**		

Multivariate analysis of hydatidosis and potential risk factors in 300 goats examined at slaughterhouses using logistic regression there is no significant Assosiciation found in multivariate analysis.

Table3.6: Multivariate analysis of hydatidosis and potential risk factors in 300 Goats examined at Elgeneina and Krenik slaughterhouse using logistic

Regression:

Risk factors	**No. inspected**	**No. affected (%)**	**d.f**	**Exp (P)**	**p-value**	95% CI for	
						Lower	**Upper**
Origin							
Elgeneina	107	2(1.8)		0		0	0
Krenik	76	1(1.3)					
Jabal	13	2(15.3)			.817		
moon			6				
Habella	15	0(0)					
Serba	16	0(0)					
Umtajok	67	0(0)					
Azrni	4	0(0)					

Age Old young	 93 207	 5(1.7) 0(0)	 1	0	.995		

Chapter four

Discussion

The prevalence of hydatid cyst in this study was higher (1.7%) than the prevalence in other studies in Sudan, Khartoum State, which was .0 % (Shadia *et al* ,2014) and in Ethiopia which was, 0% (Tahir *et al.*, 2015) This result is an agreement with the result of Omer *et al* (2010). On the other hand the prevelance of hydatid cyst recorded during this study is lower than the results in other studies which was 29.43% in Iran (Alireza *et al* .,2010) , 9% in Turkey (Yasar *et al* ., 2007) , 2.88% Tunisia (Lamhar *et al* .,2013) , 6.245% in Iraq (Azad and Areshad,2012) , *2.74%* in South Sudan (David *et al* .,2015) , 2.13% in Yemsen (Baswaid,2007) and 2.02% in Kenya (Joseph *et al* .,2015). This might be due to the variation in environmental condition in different counries because it is known that *Echinococcuc granulosus* eggs survive for only short periods of time if they are exposed to direct sunlight and dry conditions (OIE, 2005), and under ideal conditions, *E. granulosus* eggs remain viable for several months in pastures or gardens and on household fomites. Also the eggs survive best under moist conditions and in moderate temperatures (OIE, 2005). In addition, the difference in hydatidosis prevalence rate between countries could be associated with different factors like control measures applied in place , the level of community awareness created about the disease, education and economic status of the population, variation in the temperature, environmental conditions, the nature of the pasture and the way of raising these animals ,levels of exposure (Ethar *et al.*, 2015).. The prevalence rate (1.7%) in this study was lower. This might be due to no frequent contact between the infected intermediate and final hosts and also due to slaughtering of young animal more than adults. In the current study the prevalence of hydatidosis is less than the values recorded by other workers. This proved the environmental conditions in West Darfur State is not encouraging egg survival for a long period of time. The prevalence of hydatid cyst infection according to source (origin) of examined animals showed that there was significant association between the hydatidosis and origin of the animals (p value = 0.010). This result disagrees with other study of ovine hydatidosis (p value = .049) (2015) in Elgeneina (madiha , 2015). No different in rate of infection between male and female and there was no significant association between hydatidosis and sex of animals (p-value = 0.988). The rate of hydatid cyst infection recorded in this study showed that the prevalence of

hydatidosis was 0% in young animals and 5.3 % in old animals. The results obtained showed a significant association between hydatid cyst infection and age of animals examined (p-value = 0.001). These results were consistent with previous studies who regarded that young animals have low rate of infection than adult ones (Kebebe *et al*., 2009). This difference in infection rate could be attributed mainly to the fact that adult animals have longer exposure time to *E. granulosus* than young ones. This finding supports the finding of Madiha (2015) who attributed more prevalence of infection in adult animals to longer exposure to *E. granulosus*., *E. granulosus* eggs require 6-12 months before the hydatid cyst stage grows Sufficiently large to produce Protoscolices . Thherefore the chances of detecting cysts at meat inspection are higher due to the increased size of the cyst. These findings agree with some workers(Dawit *et al.,* 2013; Debela *et al.*, 2014; Elsair *et al*., 2016). The prevalence of hydatid cyst infection as related to the breed of animals was 1.7% in desert goats and, 0 % in Nubian goats. There was no significant association between breed and hydatid cyst infection (p-value = 0.618). This could be due to the fact that both breeds are local breeds and are probably of relatively equal susceptibility.

The occurrence of hydatid cyst infection in relation to the location of cyst in animals was high in the liver than in other organs.. This finding is consistent with the observations reported by many workers in different countries (Ibrahem and Craig, 1998; Ibrahim , 2010; Tappe *et al*., 2010; Abdullahi *et al*., 2011; Mohamadin and Abdelgadir, 2011; Salem *et al.,* 2011,). The higher prevalence of hydatid cysts in the liver could be attributed to the fact that the liver is the first organ that the blood flows through after leaving the intestine and is filtered in it with more chances of infection and only the ova that are not trapped in the liver pass to the lungs and then to other organs (Soulsby, 1982).

The fertility of the cyst is an important factor that can affect the stability of *E. granulosus* cycle depending on the geographical conditions, infected host and size of cyst. Most cysts in this study were fertile, viable in four cases and only in one case the cyst was sterile. This result agreed with a study conducted in Jordan (Kamhawi *et al.,* 1995) and in Northern Iran (Daryani *et al*., 2009)

CONCLUSIONS

The output of this study indicates that the overall prevalence of hydatid cyst was 1.7% .

The distribution of prevalence of hydatid cysts infection by age showed that the prevalence in old animals is higher than in young animals. Significant association was observed between hydatid cyst infection and age of animal(p-value=0.001) and origin of animals (P value =0.01). For the location of hydatid cyst in carcas organs, the liver was found to be the most affected organ (60%). Microscopic examination of hydatid cyst showed that one cyst was sterile (20%) , 4 cysts were fertile (80%)

RECOMMENDATIONS

More studies must be done on *Echinococus granulosus* to elucidate on:

1-Prevention of the disease in the intermediate host by finding a suitable drug to destroy or render the hydatid cyst sterile, proper methods for destroying stray dogs and wild carnivores and conduct extensive research programs on the best drug to be used for deworming dogs.

2-Teaching people about dangerous of the disease and affect resulting from the disease.

3-Conduct extensive research programs to finding the public health problem associated with economic losses resulting from the disease.

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Appendice1

Questionnaire

DATE……

……

Locality……

Animal ID……..

Age……..

Sex……

……

Breed…

……..

Origin of animal……

……

Post mortem examination

Infected organ……

No of cysts……

Appendix II

Crosstabulation

Locality

			hydatidosis		
			+ve	-ve	Total
locality	Elgenienа	Count	4	156	160
		% within locality	2.5%	97.5%	100.0%
		% within hydatidosis	80.0%	52.9%	53.3%
	krenik	Count	1	139	140
		% within locality	.7%	99.3%	100.0%
		% within hydatidosis	20.0%	47.1%	46.7%
Total		Count	5	295	300
		% within locality	1.7%	98.3%	100.0%
		% within hydatidosis	100.0%	100.0%	100.0%

Age

			hydatidosis		
			+ve	-ve	Total
age	youn g	Count	0	207	207
		% within age	.0%	100.0%	100.0%
		% within hydatidosis	.0%	70.2%	69.0%
	old	Count	5	88	93
		% within age	5.4%	94.6%	100.0%
		% within hydatidosis	100.0%	29.8%	31.0%
Total		Count	5	295	300
		% within age	1.7%	98.3%	100.0%
		% within hydatidosis	100.0%	100.0%	100.0%

Breed

			hydatidosis		Total
			+ve	-ve	
breed	desert goats	Count	5	281	286
		% within breed	1.7%	98.3%	100.0%
		% within hydatidosis	100.0%	95.3%	95.3%
	nubian goats	Count	0	14	14
		% within breed	.0%	100.0%	100.0%
		% within hydatidosis	.0%	4.7%	4.7%
Total		Count	5	295	300
		% within breed	1.7%	98.3%	100.0%
		% within hydatidosis	100.0%	100.0%	100.0%

Sex

			hydatidosis		
			+ve	-ve	Total
sex	male	Count	3	176	179
		% within sex	1.7%	98.3%	100.0%
		% within hydatidosis	60.0%	59.7%	59.7%
	female	Count	2	119	121
		% within sex	1.7%	98.3%	100.0%
		% within hydatidosis	40.0%	40.3%	40.3%
Total		Count	5	295	300
		% within sex	1.7%	98.3%	100.0%
		% within hydatidosis	100.0%	100.0%	100.0%

Origin of animal

			hydatidosis		Total
			+ve	-ve	
original of animal	Elgeniena	Count	2	107	109
		% within original of animal	1.8%	98.2%	100.0%
		% within hydatidosis	40.0%	36.3%	36.3%
	Krenik	Count	1	75	76
		% within original of animal	1.3%	98.7%	100.0%
		% within hydatidosis	20.0%	25.4%	25.3%
	Umtajok	Count	0	67	67
		% within original of animal	.0%	100.0%	100.0%
		% within hydatidosis	.0%	22.7%	22.3%
	Habella	Count	0	15	15
		% within original of animal	.0%	100.0%	100.0%
		% within hydatidosis	.0%	5.1%	5.0%
	Jabal moon	Count	2	11	13
		% within original of animal	15.4%	84.6%	100.0%
		% within hydatidosis	40.0%	3.7%	4.3%
	Azrni	Count	0	4	4

		% within original of animal	.0%	100.0%	100.0%
		% within hydatidosis	.0%	1.4%	1.3%
	Serba	Count	0	16	16
		% within original of animal	.0%	100.0%	100.0%
		% within hydatidosis	.0%	5.4%	5.3%
Total		Count	5	295	300
		% within original of animal	1.7%	98.3%	100.0%
		% within hydatidosis	100.0%	100.0%	100.0%

Appendice 11

Chi Square

Locality

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.453(b)	1	.228		
Continuity Correction(a)	.567	1	.451		
Likelihood Ratio	1.573	1	.210		
Fisher's Exact Test				.376	.230
Linear-by-Linear Association	1.448	1	.229		
N of Valid Cases	300				

.

breed

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.249(b)	1	.618		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.482	1	.488		
Fisher's Exact Test				1.000	.786
Linear-by-Linear Association	.248	1	.618		
N of Valid Cases	300				

Age

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11.318(b)	1	.001		
Continuity Correction(a)	8.275	1	.004		
Likelihood Ratio	11.902	1	.001		
Fisher's Exact Test				.003	.003
Linear-by-Linear Association	11.280	1	.001		
N of Valid Cases	300				

Sex

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.000(b)	1	.988		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.000	1	.988		
Fisher's Exact Test				1.000	.678
Linear-by-Linear Association	.000	1	.988		
N of Valid Cases	300				

Origin of animal

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.732(a)	6	.010
Likelihood Ratio	9.093	6	.168
Linear-by-Linear Association	.302	1	.583
N of Valid Cases	300		