

Prevalence of Hydatidosis in Liver and Lungs and its Economic Impact in Slaughtered Ruminants in Sidi-Bel-Abbes, Algeria

Ahmed Reda BELMAMOUN^{1*}, Abdelkader AMMAM², Imene BERRABAH³

¹Djillali Liabes University, Department of Agronomy, Faculty of Nature and Life Sciences.
Sidi- Bel-Abbes-22000- Algeria.

²Moulay Tahar University, Laboratory of Pharmacognosy Bbiotoxicology and Biological Valorisation of Plants.
Saida-20000- Algeria.

³Ahmed Ben Bella University, laboratory of Hydro-bromatology, Department of Pharmacy,
Faculty of Medicine. Oran-31000- Algeria

Received: February 22, 2017

Accepted: May 23, 2017

ABSTRACT

The hydatid disease is one of the most important zoonotic diseases in the Mediterranean region and known for their high endemicity. Wherefore, this original study was conducted to determine the prevalence of hydatidosis in lungs and liver of slaughtered ruminants in Sidi- Bel-Abbes (north-western part of Algeria) during 10-year (2001–2010) and to estimate economic losses due to this disease. For this purpose, retrospective study was carried out in the municipal abattoir of Sidi-Bel-Abbes. A total of 7409 domestic Ruminants (sheep, cattle and goats) slaughtered, both sexes, were examined carefully by visual inspection, palpation and incisions for hydatid cysts in visceral organs (livers and lungs), according to guidelines recommended by (WHO/OIE, 2002). The prevalence of the hydatid disease in lung was more than that in liver with 32.51% and 24.45% respectively ($p>0.05$) but the seizure was higher in liver with 7234 Kg than lungs with 7063 Kg. In the present study an economic loss due to hydatid cysts with an amount of 759980.00 DA [10368.1612 USD] is calculated over the ten years included. In the present study, an economic loss due to hydatid cysts of 75,9980.00 DA [10368,1612 USD] is calculated over the ten years included. This survey provides that hydatidosis is considered a real financial problem in the meat industry and a risk to public health in the northwestern part of Algeria.

KEYWORDS: Hydatid cyst, Ruminants, Prevalence, Economic loss, Algeria.

INTRODUCTION

Hydatidosis is a zoonosis caused by the larvae of the *Echinococcus granulosus* parasite [2]. The Adult cestode inhabit the small intestine of canids as permanent hosts, while larval stages or hydatid cysts occur in herbivorous intermediate hosts and sometimes in humans [6]. The eggs produced by the adult cestode, contain infective oncospheres and can be ingested by domestic herbivores such as sheep, goats and cattle [36]. After ingestion, oncospheres cross the intestinal wall and gain the liver, pass in circulation and reach lungs and all organs of animals and humans [15]. *Echinococcus granulosus* is one of the most important zoonotic diseases in the Mediterranean [42]. The golden jackal has been reported to be a definitive host for *E. granulosus* in Algeria [34]. The distribution of *Echinococcus granulosus* is higher in rural communities [21]. However, dogs represent the main source of infection for farm animals and humans. Despite the socio-economic impact of hydatidosis that remains important [8]. In some countries [16], it is considered an emerging disease. The major economic loss incurred by hydatidosis is caused by the direct condemnation of offal from infected animals [30,33]. Although being a major zoonotic problem, few reports are available on the prevalence and economic importance of hydatidosis in Algeria. Indeed, cyst detection during post-mortem inspection is the most reliable method and, therefore, the abattoir is the best place to study hydatidosis in livestock. From this perspective, this study was conducted to determine the prevalence of hydatidosis in slaughtered ruminants in the Sidi Bel-Abbes municipal abattoir and to estimate the economic loss due to the condemnation of organs (liver and lungs) affected by hydatid cysts between 2001 and 2010. Such studies have been developed to help develop strategies for the prevention and control of the disease.

METHODS

The retrospective survey in the slaughterhouse covers a period of 10 years, from January 2001 to December 2010, the data of organs diagnosed with hydatid cyst in the official register of the municipal abattoir of Sidi-bel-Abbes (north-western region of Algeria) were reviewed. The study was conducted in three species of ruminants (cattle, sheep and goats). The exact origin of animals is impossible to determine. The animals arrive early morning on the day of slaughter or the day before to make the ante mortem. The slaughtering of animals is done

*Corresponding Author: Ahmed Reda BELMAMOUN, Djillali Liabes University, Department of Agronomy, Faculty of Nature and Life Sciences. Sidi- Bel-Abbes-22000- Algeria. E Mail: vetsba@gmail.com
TEL: +213 552 120 235

according to Islamic method of ritual slaughter then post-mortem inspection of offal and carcasses is performed under the responsibility of two veterinary inspectors. Slaughtered animals were examined carefully by visual inspection, palpation and incisions for hydatid cysts in visceral organs (livers and lungs), according to guidelines recommended by [54]. During the ten years included in the study a total of 7409 ruminants were slaughtered. The prevalence of the liver and lungs hydatid cysts infection is determined for each year; we considered that each animal has one liver and two lungs. To calculate the economic losses, we used data on the annual rate of rejection (due to hydatid cysts) of liver and lungs by the abattoir, and then we calculated the loss based on the price of the retail market through a year at Sidi-Bel-Abbes. The price average is estimated in Algerian dinars and U.S. dollars. The data of our study were analysed using the Sample percentages and Student's t-test, by the SPSS statistical software Version 17.0: (Statistical Package for the Social Sciences, IBM Corporation), p value is considered as statistically significant if $p \leq 0.05$.

RESULTS

In our study, a retrospective analysis data of hydatid cyst during 10 years (2001 to 2010) showed a total of 7409 slaughtered livestock (both sexes) at the abattoir of Sidi-Bel-Abbes. The frequency and percent of hydatid cysts in slaughtered animals and the localisation of this cysts in liver and lungs are shown in Table 1. In the current study, the comparison of liver and lung involvement with hydatid cysts according to different years indicate that, in studied ruminants, the condemnation rate in lung infected was more than that in liver (32.51% and 24.45% respectively). Concerning the seizure of the sick organs, it can be total or partial according to the decision of the veterinarian in charge of the abattoir. In our sample, for all years, the frequency of seizure of organs affected by hydatid cyst was much more raised on the liver than on the lungs (7234 Kg *vs.* 7063 Kg) although lungs are generally the most affected (Figure 1). We have also try to estimate the direct annual economic losses resulting from the condemnation of the infected organs, were calculated on the basis of the average weight and the market price of the liver and lungs during the inspection of the meat, and this in Algerian Dinar and in United States Dollars and the results are summarized in Table 2. An amount greater than 7500000.00 Algerian Dinar is considered as economic losses during the ten years included in the study and the average annual losses are estimated at 759980.00 DA [10368.1612 \$].

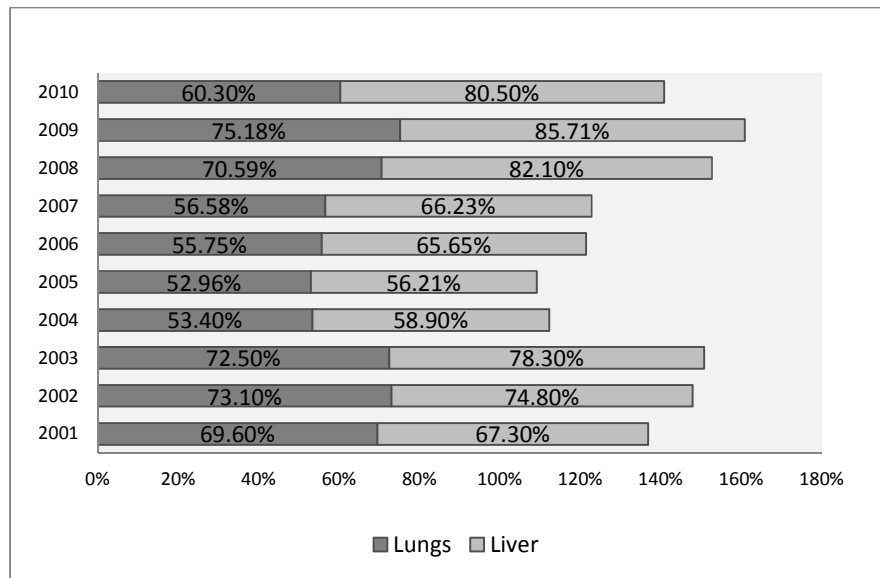


Figure 1: The frequency of seizure of lungs and liver according to the extent of the lesions

Table 1: Prevalence of hydatid cysts in liver and lungs in ruminants slaughtered in the abattoir of Sidi-Bel-Abbes from 2001 to 2010

Year	Number of animals slaughtered	Number and frequencies of organs affected with hydatid cysts	
		Liver (%)	Lungs (%)
2001	744	149 (20.02%)	277 (37.23%)
2002	856	184 (21.49%)	291 (33.99%)
2003	631	195 (30.90%)	266 (42.15%)
2004	449	106 (23.60%)	137 (30.51%)
2005	521	113 (21.68%)	143 (27.44%)
2006	712	130 (18.25%)	170 (23.87%)
2007	759	153 (20.15%)	202 (26.61%)
2008	924	312 (33.76%)	365 (39.50%)
2009	696	252 (36.20%)	303 (43.53%)
2010	1117	206 (18.44%)	226 (20.23%)
Total	7409	1800 (24.45±6.63 %)	2380 (32.51±8.01 %)

Table 2: Economic loss due to hydatidosis in ruminants estimated in Algerian dinar and United States dollar

		Number of organs seized	Total weight of the organs seized (kg)	Average cost estimated by Algerian Dinar (DA)	Average cost estimated by U.S. Dollar (\$)	Total loss Algerian Dinar DA [U.S. Dollar \$]
2001	Liver	169	676	540800	7377.9594	707000 [9645.3722]
	Lungs	277	831	166200	2267.4128	
2002	Liver	184	721	976800	13326.1663	1148200 [15664.521]
	Lungs	291	857	171400	2338.3547	
2003	Liver	195	749	599200	8174.6914	746600 [10185.6219]
	Lungs	266	737	147400	2010.9305	
2004	Liver	106	424	339200	4627.5958	421400 [5749.0238]
	Lungs	137	411	82200	1121.4280	
2005	Liver	113	452	361600	4933.1918	447400 [6103.7334]
	Lungs	143	429	85800	1170.5416	
2006	Liver	130	520	416000	5675.3534	518000 [7066.9064]
	Lungs	170	510	102000	1391.5530	
2007	Liver	153	612	489600	6679.4544	610800 [8332.9467]
	Lungs	202	606	121200	1653.4923	
2008	Liver	312	1248	998400	13620.8481	1217400 [16608.5942]
	Lungs	365	1095	219000	2987.7461	
2009	Liver	252	1008	806400	11001.4543	988200 [13481.6928]
	Lungs	303	909	181800	2480.2385	
2010	Liver	206	824	659200	8993.2523	794800 [10843.1992]
	Lungs	226	678	135600	1849.9469	
Total		4200	14297	7599800 DA	103681.6126 \$	7599800 DA [103681.6126 \$]

DISCUSSION

Hydatidosis is one of the most important zoonotic helminth, represents a serious livestock and human health concern, in the Mediterranean region and in the world [3, 18, 48]. The prevalence is high in humans and animals in the Mediterranean region, especially in North Africa, including Algeria, Egypt, Libya, Morocco and Tunisia [19,27] and also in sub-Saharan Africa, notably Ethiopia and Sudan [41]. This type of disease, also called cyst echinococcosis that is not obvious to farmers has considerable impact on the economy in different countries [13,20,23]. In this context, the objective of this work was to study the prevalence of hydatidosis infection in ruminants slaughtered in the Sidi-Bel-Abbes slaughterhouse. Infections with hydatid cysts in intermediate hosts (goats, sheep, and cattle) are asymptomatic [29]. The pathogenicity of hydatidosis depends on the organ on which it is located and the extent and severity of the infection [25]. Sheep dogs are the main predisposing factor

in the transmission of the disease, as they are exposed to uncooked offal considered unfit for human consumption [37].

In North Africa, the cycle between sheep and dog has been described as the major cycle involved in human contamination [10]. The hydatid cyst is also known to affect many parts of Asia, as well as Middle East countries, including Iran, Iraq, Pakistan and Saudi Arabia [42, 51]. Animals and humans acquired the infection by ingesting eggs eliminated by the dogs acting as the definitive host [49]. In Algeria, the hydatid cyst continues to be a major public health problem, despite attempts to control slaughter practices [11]. Indeed, post-mortem inspection is the most reliable technique for the detection of hydatid cysts and therefore the slaughterhouse is the best place to study hydatidosis in livestock [17]. The prevalence of this disease is high in Arabic countries [7,40], results from Morocco reported that the prevalence of hydatid cyst is 22.98% in cattle and 10.58% in sheep [9] and it is substantially higher in sheep (27.6%) in Jordan (Karak) [31]. However, a low prevalence has been reported from Mauritania (5.5% in cattle and 6.5% in sheep) [44]. In Iran prevalence values were 38.3% for cattle and 74.4% for sheep [20].

In the present study, 7409 animals slaughtered between 2001 and 2010 and the lungs were more frequently infected than the livers, 32.51% and 24.45% respectively (significant difference is showed between the two organs prevalence; $p>0.05$). This is in agreement with the results reported by [26] in Sicily, [9] in Morocco, [28] in Egypt, [1, 32] in Ethiopia, [45] in India and [20, 36] in Iran. On the other hand, the prevalence of hydatid cysts in the liver was higher than that of lung in the results of [31] in Jordan, [43] in Iraq, [6, 30,52] in Saudi Arabia.

The lungs and liver were mainly infected with the hydatid cyst, probably because of the presence of the large capillary sites encountered by the blood-borne oncospheres. After egg hatching in the small intestine and leaving the digestive tract, they prefer the portal vein pathway and the hepatic and pulmonary filtering system [5,24,36]. Furthermore, for the lungs, this may be due to the relatively soft consistency, which allows easy growth of the cysts [39].

The high costs of annual losses of animal production due to the hydatid cyst between 142 and 2190 million US dollars have been estimated around the world [14, 16, 22, 38]. At the abattoir the veterinarian performs a macroscopic examination of carcasses and organs. The condemnation of organs such as the liver and lungs due to the hydatid cyst represents a high financial loss, following studies in different countries in Jordan [31,50], Tunisia [35], Turkey [46,53], Spain [14] and Ethiopia [1].

In the present study, over the ten years included a total loss is estimated at over 7599800.00 DA equivalents to 103681.6126 USD. The reported economic losses are 358.58 USD in 2001 (sheep and goats) in Jordan [50] and 459663.2 USD from 1998 to 2008 in Ahwaz Iran (cattle, sheep and goats) [4].

However, it is so difficult to compare the exact economic losses due to this disease, according to [12], the extent of the losses caused by the condemnation of livers and lungs may vary according to the legislative rules of each country, depending on the compulsory condemnation and destruction (total or partial) of the infected organs and the number of animals slaughtered under veterinary supervision. For this reason it is so difficult to compare the exact economic losses due to this disease, due to changes in market prices from one country to another and the prevalence of the disease which is not stable over the years. However, due to the high affinity of the parasite to infect the lungs and due to its lower price, the lungs were condemned more than the livers [47].

In conclusion, current results have shown that hydatidosis causes considerable economic losses in Sidi-Bel-Abbes due to the lungs and liver condemnation of ruminants. Inspection at the slaughterhouse level should function as an important monitoring agent for the control of hydatid cysts through the safe disposal of infected offal, as this disease is inapparent for livestock owners and veterinarians. Algeria doesn't escape from this scourge which is considered as a real problem of public health because man is also affected by this disease through eating habits. Therefore, public health education in terms of the zoonotic importance of hydatidosis and the control of stray dogs are of paramount importance. Additional studies should be carried out for the future monitoring of this important parasitic disease in the north-western part of Algeria.

REFERENCES

1. Abiyot, J. and F. Abunna, 2011. Prevalence of hydatidosis in small ruminants and its economic significance in Modjo Modern Export Abattoir, Ethiopia. *Journal of Public Health and Epidemiology.*, 3(10):454-461.
2. Adel, F., J. M. Ramia, L. Gijón, R. de la Plaza-Llamas, V. Arteaga-Peralta, and C. Ramiro-Perez, 2017. Extrahepatic and extrapulmonary hydatidosis. *Cirugía y Cirujanos.*
3. Adwan, G., K. Adwan, S. Bdir, and S. Abuseir, 2013. Molecular characterization of *Echinococcus granulosus* isolated from sheep in Palestine. *Experimental parasitology.*, 134(2):195-199.
4. Ahmadi, N. and M. Meshkekar, 2011. An abattoir-based study on the prevalence and economic losses due to cystic echinococcosis in slaughtered herbivores in Ahwaz, south-western Iran. *Journal of helminthology.*, 85(01):33-39.

5. Al-Khalidi, N., 1998. Cystic echinococcosis (hydatidosis) in sheep, goats, cattle and camels in Shahat Abattoir, Al-Jabal, Libya. In the Proc. Proceedings of the Third Annual Meeting for Animal Production Under Arid Conditions, United Arab Emirates University, pp: 143-149.
6. Almalki, E., S. Al-Quarishy, and A.-A. S. Abdel-Baki, 2017. Assessment of prevalence of hydatidosis in slaughtered Sawakny sheep in Riyadh city, Saudi Arabia. *Saudi Journal of Biological Sciences*.
7. Andersen, F. L., H. Ouhelli, and M. Kachani, 1997. Compendium on cystic echinococcosis in Africa and in Middle Eastern countries with special reference to Morocco. Provo' Brigham Young University.
8. Aoun, K. and A. Bouratbine, 2007. Epidemiological data concerning hydatidosis in Tunisia. *Médecine et Maladies Infectieuses*, 37:S40-S42.
9. Azlaf, R. and A. Dakkak, 2006. Epidemiological study of the cystic echinococcosis in Morocco. *Veterinary parasitology*, 137(1):83-93.
10. Bahia, G., 1997. Echinococcus. In the Proceedings of the Seminars in Respiratory Infections, pp: 171–187.
11. Bardonnnet, K., M. Benchikh-Elfegoun, J. Bart, S. Harraga, N. Hannache, S. Haddad, H. Dumon, D. Vuitton, and R. Piarroux, 2003. Cystic echinococcosis in Algeria: cattle act as reservoirs of a sheep strain and may contribute to human contamination. *Veterinary parasitology*, 116(1):35-44.
12. Battelli, G., 2009. Echinococcosis: costs, losses and social consequences of a neglected zoonosis. *Veterinary research communications*, 33(1):47-52.
13. Benito, A., D. Carmena, L. Joseph, J. Martinez, and J. A. Guisantes, 2006. Dog echinococcosis in northern Spain: comparison of coproantigen and serum antibody assays with coprological exam. *Veterinary parasitology*, 142(1):102-111.
14. Benner, C., H. Carabin, L. P. Sánchez-Serrano, C. M. Budke, and D. Carmena, 2010. Analysis of the economic impact of cystic echinococcosis in Spain. *Bulletin of the World Health Organization*, 88(1):49-57B.
15. Bourée, P. and F. Bisaro, 2007. Hydatidose: aspects épidémiologique et diagnostique. *Antibiotiques*, 9(4):237-245.
16. Budke, C.M., P. Deplazes and P.R. Torgerson, 2006. Global socioeconomic impact of cystic echinococcosis. *Emerging Infectious Diseases*, 12 (2): 296-303.
17. Cardona, G. A. and D. Carmena, 2013. A review of the global prevalence, molecular epidemiology and economics of cystic echinococcosis in production animals. *Veterinary parasitology*, 192(1):10-32.
18. Casulli, A., M. T. Manfredi, G. La Rosa, A. R. Di Cerbo, C. Genchi, and E. Pozio, 2008. Echinococcus ortleppi and E. granulosus G1, G2 and G3 genotypes in Italian bovines. *Veterinary parasitology*, 155(1):168-172.
19. Dakkak, A., 2010. Echinococcosis/hydatidosis: a severe threat in Mediterranean countries. *Veterinary parasitology*, 174(1):2-11.
20. Daryani, A., R. Alaei, R. Arab, M. Sharif, M. Dehghan, and H. Ziaei, 2007. The prevalence, intensity and viability of hydatid cysts in slaughtered animals in the Ardabil province of Northwest Iran. *Journal of helminthology*, 81(01):13-17.
21. Eckert, J. and P. Deplazes, 2004. Biological, epidemiological, and clinical aspects of echinococcosis, a zoonosis of increasing concern. *Clinical microbiology reviews*, 17(1):107-135.
22. Fasihi, H.M., C.M. Budke, and S. Rostami, 2012. The monetary burden of cysticechinococcosis in Iran. *PLoS Negl. Trop. Dis.*, 6 (11) : e1915.
23. Garippa, G., A. Varcasia, and A. Scala, 2004. Cystic echinococcosis in Italy from the 1950s to present. *Parassitologia*, 46(4):387-391.
24. George M. Urquhart, 1996. *Veterinary Parasitology*. Blackwell Science Ltd London, pp. 120–129.
25. Getaw, A., D. Beyene, D. Ayana, B. Megersa, and F. Abunna, 2010. Hydatidosis: prevalence and its economic importance in ruminants slaughtered at Adama municipal abattoir, Central Oromia, Ethiopia. *Acta tropica*, 113(3):221-225.
26. Giannetto, S., G. Poglayen, E. Brianti, C. Sorgi, G. Gaglio, S. Canu, and A. N. Virga, 2004. An epidemiological updating on cystic echinococcosis in cattle and sheep in Sicily, Italy. *Parassitologia*, 46(4):423-424.
27. Grosso, G., S. Gruttadauria, A. Biondi, S. Marventano, and A. Mistretta, 2012. Worldwide epidemiology of liver hydatidosis including the Mediterranean area. *World J. Gastroenterol.*, 18: 1425–1437.
28. Haridy, F., B. Ibrahim, A. Elshazly, S. Awad, D. Sultan, G. El-Sherbini, and T. Morsy, 2006. Hydatidosis granulosus in Egyptian slaughtered animals in the years 2000-2005. *Journal of the Egyptian Society of Parasitology*, 36(3):1087-1100.
29. Hayajneh, F. M. F., A. M. H. Althomali, and A. T. Nasr, 2014. Prevalence and characterization of hydatidosis in animals slaughtered at Al Taif abattoir, Kingdom of Saudi Arabia. *Open Journal of Animal Sciences*, 4(1): 38–41.

30. Ibrahim, M. M., 2010. Study of cystic echinococcosis in slaughtered animals in Al Baha region, Saudi Arabia: interaction between some biotic and abiotic factors. *Acta tropica*, 113(1):26-33.
31. Kamhawi, S., N. Hijawi, A. Abu-Gazaleh, and M. Abbass, 1995. Prevalence of hydatid cysts in livestock from five regions of Jordan. *Annals of Tropical Medicine & Parasitology*, 89(6):621-629.
32. Kebede, N., A. Mitiku, and G. Tilahun, 2009a. Hydatidosis of slaughtered animals in Bahir Dar abattoir, northwestern Ethiopia. *Tropical Animal Health and Production*, 41(1):43-50.
33. Kebede, W., A. Hagos, Z. Girma, and F. Lobago, 2009b. Echinococcosis/hydatidosis: its prevalence, economic and public health significance in Tigray region, North Ethiopia. *Tropical Animal Health and Production*, 41(6):865-871.
34. Macpherson, C. N and T. W. Wachira, 1997. Cystic echinococcosis in Africa south of the Sahara. *Compendium on cystic Echinococcosis in Africa and in Middle Eastern Countries with special reference to Morocco*. Brigham Young University, Print Services, Provo, UT 84602, USA, pp. 245–277.
35. Majorowski, M. M., H. Carabin, M. Kilani, and A. Bensalah, 2005. Echinococcosis in Tunisia: a cost analysis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 99(4):268-278.
36. Mansoorlakooraj, H., D. Saadati, R. Javadi, S. Heydari, E. Torki, H. Gholami, and R. M. N. Fard, 2011. A survey on hydatidosis in livestock in Northern Iran based on data collected from slaughterhouses from 2004 to 2008. *Veterinary parasitology*, 182(2):364-367.
37. Mezgebu, M., 2003. Survey on hydatidosis and lung infestation in and around Addis Abeba, D.V.M. Thesis, Addis Ababa University., Debre Zeit, Ethiopia.
38. Moro, P. L., C. M. Budke, P. M. Schantz, J. Vasquez, S. J. Santivanez, and J. Villavicencio, 2011. Economic impact of cystic echinococcosis in peru. *PLoS Negl Trop Dis*, 5(5):e1179.
39. Rausch, R.L., 1975. Taeniidae. In: *Diseases transmitted from animals to man* (eds W.F. Hubbert and P.R. Schurrenberger) pp: 678-707. Springfield.
40. Romig, T., 2003. Epidemiology of echinococcosis. *Langenbeck's Archives of Surgery*, 388(4):209-217.
41. Romig, T., R. Omer, E. Zeyhle, M. Hüttner, A. Dinkel, L. Siefert, I. Elmahdi, J. Magambo, M. Ocaido, and C. Menezes, 2011. Echinococcosis in sub-Saharan Africa: emerging complexity. *Veterinary parasitology*, 181(1):43-47.
42. Sadjjadi, S. M., 2006. Present situation of echinococcosis in the Middle East and Arabic North Africa. *Parasitology international*, 55:S197-S202.
43. Saeed, I., C. Kapel, L. Saida, L. Willingham, and P. Nansen, 2000. Epidemiology of *Echinococcus granulosus* in Arbil province, northern Iraq, 1990–1998. *Journal of helminthology*, 74(01):83-88.
44. Salem, C. O. A., F. Schneegans, J. Chollet, and M. et Jemli, 2011. Epidemiological studies on echinococcosis and characterization of human and livestock hydatid cysts in mauritania. *Iranian journal of parasitology*, 6(1):49.
45. Sangaran, A. and L. John, 2009. Prevalence of Hydatidosis in sheep and goats in and around Chennai. *Tamilnadu J. Vet. Animal Sci.*, 5(5):208-210.
46. Sariözkan, S. and C. Yalçın, 2009. Estimating the production losses due to cystic echinococcosis in ruminants in Turkey. *Veterinary parasitology*, 163(4):330-334.
47. Tavakoli, H., M. Bayat, and A. Kousha, 2008. Hydatidosis infection study in human and livestock populations during 2002-2007. *Am-Eurasian J Agri Environ Sci.*, 4:473-477.
48. Thompson, R., 2008. The taxonomy, phylogeny and transmission of *Echinococcus*. *Experimental parasitology*, 119(4):439-446.
49. Thompson, R.C.A., 1995. Biology and systematics of *Echinococcus*. In: *Echinococcus and Hydatid Disease* (eds R.C.A. Thompson and A.J. Lymbery) pp. 1–50. CAB International, Wallingford.
50. Torgerson, P., P. Dowling, and M. Abo-Shehadeh, 2001. Estimating the economic effects of cystic echinococcosis. Part 3: Jordan, a developing country with lower-middle income. *Annals of Tropical Medicine & Parasitology*, 95(6):595-603.
51. Torgerson, P. R., B. Oguljahan, A. E. Muminov, R. R. Karaeva, O. T. Kuttubaev, M. Aminjanov, and B. Shaikenov, 2006. Present situation of cystic echinococcosis in Central Asia. *Parasitology international*, 55:S207-S212.
52. Toulah, F. H., A. A. El-Shafei, and M. N. Alsolami, 2012. Prevalence of hydatidosis among slaughtered animals in Jeddah, Kingdom of Saudi Arabia. *Journal of the Egyptian Society of Parasitology*, 42(3):563-572.
53. Umur, S. and O. R. Kaaden, 2003. Prevalence and economic importance of cystic echinococcosis in slaughtered ruminants in Burdur, Turkey1. *Journal of Veterinary Medicine, Series B*, 50(5):247-252.
54. Who/Oie, 2002. Manual on echinococcosis in Humans and Animals: a Public Health Problem of Global Concern. World Organization for Animal Health France, pp: 87-92.