*Current Journal of Applied Science and Technology*

***Volume 42, Issue 25, Page 19-26, 2023; Article no.CJAST.104974***
***ISSN: 2457-1024***
*(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)*

# Epidemiology and Public Health Significance of Hydatidosis: A Review

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Author CM designed the article, wrote the first draft of the manuscript, designed the figures. Author VJA managed the literature searches and proof reading. Author CAFB did the editing of the manuscript. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/CJAST/2023/v42i254182

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/104974

***Review Article***

***Received: 07/06/2023***
***Accepted: 12/08/2023***
***Published: 17/08/2023***

## ABSTRACT

*Echinococcus granulosus* is an important dog tape worm whose larval stage causes hydatidosis in animals and man. The objective of this review on hydatidosis is to get a comprehensive knowledge about the disease and it had included the data of past 10 years collected from various scientific articles. Food animals such as sheep, goat, cattle etc. act as its intermediate host. It is a major parasitic zoonosis having high economic loss and public health significance and high worldwide prevalence rate. There are different strains of *E. granulosus* from G1 to G10 which is distributed worldwide infecting various animals and humans. The tapeworm in dogs causes fewer ill effects but in food animals it affects liver, lungs and spleen which lead to condemnation of meat thereby affecting economic value of meat. In humans it causes severe disease mainly cystic echinococcosis and alveolar echinococcosis in addition to two forms of neotropical echinococcosis namely

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polycystic echinococcosis and unicystic echinococcosis. Diagnosis and treatment of hydatidosis in animals is practically difficult and uneconomical but more promising in human medicine due to advanced techniques. The role of stray dogs in the maintenance of the life cycle of parasite is important hence health education and public awareness are very essential in the control of echinococcosis.

*Keywords: Echinococcus granulosus; hydatid cyst; dogs; humans; public health.*

## 1. INTRODUCTION

"Hydatidosis is a parasitic disease caused by larval stage of helminthic tapeworms called *Echinococcus* spp. It is a zoonotic cosmopolitan parasitic disease with a significant economic loss directly by causing organ or carcass condemnation and indirectly by affecting human and animal health which increase in the cost for diagnosis, treatment and control of the disease" [1]. Annually there are estimated more than 18,000 new cases worldwide of echinococcosis with 91% of those occurring in China [2] and more than 1 million people are affected with echinococcosis at any given time [3]. In 1855, Rudolf Virchow, the German pathologist, [4] recognized that alveolar echinococcosis was at the time known as colloid carcinoma of the liver, which was known for its tumor-like lesions in the liver, were actually caused by an *Echinococcus* species. Though hydatidosis is a very common disease prevalent in countries like India, very little work has been done to learn about it. Hence this review is designed having the following objectives namely, the prevalence of hydatidosis in India as well as in the world and its importance to animals and humans.

## 2. PARASITE AND THE DISEASE

The most important species of Echinococcus is *Echinococcus granulosus* which belongs to Phylum: Platyhelminthes, Class: Eucestoda, Order: Taeniidea, Family: Taeniidae, Genus: Echinococcus, Species: *E. granulosus* [5] and found in the intestines of dogs and other canids. The metacestode or the larval stage of the tape worm is called hydatid cyst and found in the intermediate host (ungulates) such as sheep, cattle, goat, buffaloes, moose, camels etc. The cyst may be fertile or sterile. Accidental ingestion of *E. granulosus* eggs by man results in hydatidosis. The mature adult tapeworm measures about 3-9 mm long and consists of only 3 proglottids, a scolex with four suckers and an armed rostellum with 28-50 number of hooks [6]. There are basically four forms of echinococcosis as given in the Fig. 1.

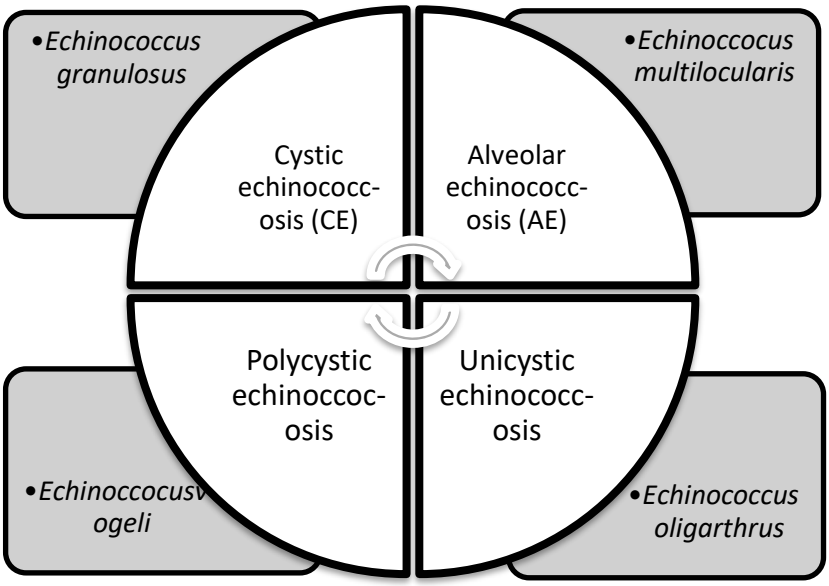


**Fig. 1. Forms of echinococcosis**

CE and AE vary in their clinical manifestations, course of disease, and prognosis, to the extent that clinicians should look at these two parasitic infections as distinctly different entities. CE causes displacement and pressure atrophy, while AE expands by infiltrative growth [7].

### 2.1 *E. granulosus*- Strains and Distribution

There are various strains of *E. granulosus* found infecting humans and animals. The distinct genetic types (Table 1) of *E. granulosus* include two sheep strains (G1 and G2), two bovid strains (G3 and G5), a horse strain (G4), a camelid strain (G6), a pig strain (G7), and a cervid strain (G8). A ninth genotype (G9) has been described in swine in Poland and a tenth strain (G10) in reindeer in Eurasia [8]. The most frequent strain associated with human CE appears to be the common sheep strain (G1).

## 3. PREVALENCE OF HYDATIDOSIS

There are various factors affecting prevalence/ incidence of hydatidosis which are responsible for occurrence as well as emergence of the disease. It includes the dogs harbouring, *E. granulosus* worms, access of dogs to infected offals, inadequate facilities for slaughter, improper disposal of infected viscera, practice of slaughtering livestock in households etc. These practices may result in feeding the dogs with slaughter wastes which are particularly important to maintain the parasite viability and so as results in emergence or reemergence.

### 3.1 Worldwide

"WHO has designated AE as 1 of the 20 neglected tropical diseases and *E. multilocularis* as the food-borne parasite with the third largest global impact of 24 ranked parasites" [11,12]. "Echinococcosis is a cosmopolitan zoonosis. Both CE and AE are serious diseases, the latter especially so, with a high fatality rate and poor prognosis if managed inappropriately" [13]. "Many variables can affect hydatidosis such as regions, sex, age and seasons" [14]. "Temperate zones including several parts of the Mediterranean regions, central and Southern parts of Russia, some parts of America, Australia, North and East Africa, China, and central Asia recorded the highest prevalence of hydatidosis in human and animal hosts" [15].

"Hydatidosis is currently considered an endemic zoonotic disease in the Mediterranean region" [10]. Hydatidosis is endemic in all North African countries including Algeria Morocco, Tunisia, Libya, and Egypt [16] and also in sub-Saharan Africa including Mauritania, Tanzania, Sudan, Kenya, and Ethiopia [17]. The analysis of 134 isolates by Kamenetzky [18] "from Argentina showed that hydatid cysts were produced by G1 (sheep strain) and G2 (Tasmanian sheep strain) genotypes in sheep; by G1, G2 and G5 (cattle strain) genotypes in cattle, only by G6 (camel strain) genotypes in goats and by G1 and G7 (pig strain) genotypes in pigs". "Molecular analyses and sequencing revealed the prevalence of *Echinococcus* spp. as 14.13% (63/446) in faecal samples of stray dogs in Turkey and the common strains includes G1/G3, G4, G5 and G6/G7" [19].

**Table 1. Worldwide occurrence of various strains of *E. granulosus***

| Sl.No. | Continent/ Regions | Country/States | Strain of *E. granulosus* |
|---|---|---|---|
| 1. | North America | - | G8, G1, G10 [9] |
| 2. | South America | Peru, Chile, Argentina and Brazil | G1 |
| 3. | Australia | - | G1 [9,10] |
| | | Tasmania | G2 [9] |
| 4. | Western and Central Asia | Iran | G1 and G6 [9,10] |
| | | Turkey | G1 [10] |
| 5. | China | - | G1 and G6 [10] |
| 6. | Africa | (Poorly researched) | G1 and G6 [9,10] |
| 7. | Europe and the Mediterranean | Poland, Slovakia and Ukraine | G6-G10 [9] |
| | | Spain | G1, G7 &G4 [9] |

### 3.2 India

Incidence of hydatidosis in buffaloes was found to be 30.61% in Andhra of Pradesh [20] and 10% in animals slaughtered at Chennai, Tamil Nadu [21]. Naik [22] observed a higher infection rate in females than the male animals from necropsied sheep and goats during a period of one year. The prevalence rate of hydatidosis in Jammu was 19.8% by Godara [23] where "a total of 14.1% goats had cysts in both the livers and lungs while 2.3 and 3.4% goats had cysts in the livers or lungs, respectively. It was also found that 9.1 % goats had fertile cysts. The adult goats (>4 years) had a significantly higher prevalence rate as compared to the young goats (<2 years) and sex had no significant effect on the prevalence of hydatidosis in goats".

"Hydatid cysts were found in 12.2% (n = 28) of sheep and 10.7% (n = 21) of goats in Kangra Valley of the north-western Himalayas. Pulmonary echinococcosis was more prevalent in slaughtered sheep and goats (sheep 56.36%; goats 62.90%) than hepatic echinococcosis (sheep 43.64%; goats 37.10%)" [24]. A seven (2010-2017) year study by Vaidya [25] revealed that the prevalence of hydatidosis in cattle (3.00%) was highest followed by buffalo (2.05%), pig (1.28%), sheep (0.09%) and goat (0.01%), by PM examination.

## 4. VETERINARY PERSPECTIVES

Abo-Aziza [14] studied, variable factors of hydatidosis infection in sheep, cattle, buffaloes and camels slaughtered at Cairo and Giza abattoirs and found that prevalence of hydatidosis varies according to species, and it was significantly higher in camel (23.2%) followed by buffaloes (21.8%), then cattle (18.5%) and sheep (9.8%). The infection of hydatidosis in cattle was found to be 19.7% and 13.5% in sheep slaughtered at Addis Ababa abattoir in Ethiopia [26]. Concerning age variability, it was observed that the prevalence of hydatidosis was higher in adult sheep, cattle and camel [26]. "Hydatid cyst(s) was found in 1,290 (0.124 %) out of 1,037,872 slaughtered cattle, 320 (0.030%) out of 1,051,648 slaughtered small ruminants, and 1610 (0.077%) out of all the 20,89,520 slaughtered animals (cattle, shoats) in Turkey" [27]. "The overall prevalence of CE in all examined animals was 2.77% from 123 butcher's shops in Rawalpindi and Islamabad, Pakistan" [28].

## 5. HUMAN FRONTIERS

Human echinococcosis is a zoonotic disease (a disease that is transmitted to humans from animals). Humans are infected through ingestion of parasite eggs in contaminated food, water or soil, or after direct contact with animal hosts. The two most important forms, which are of medical and public health relevance in humans, are CE and AE. Among the major species, *Echinococcus multilocularis* is the most virulent species of the genus *Echinococcus*. It causes a highly lethal helminthic disease in humans. The disease may present as hepatic mass mimicking a malignant neoplasm [29]. A total of 155 patients with hydatid disease were identified by Mathur [30] in 6 years from 2010 to 2015 and found that there were 96 male (61.93%) and 59 female (38.06%) patients. The enzyme-linked immunosorbent assay found that 72 (5.03%) of 1,429 samples from various districts of the Kashmir region (North India) tested positive for *E. granulosus*-specific Ig G antibody [31].

## 6. PUBLIC HEALTH IMPORTANCE

"Hydatidosis is a neglected public health problem in developing countries" [32]. Animal handlers, veterinarians, dog owners are all at a higher risk of infection since the eggs are shed in the environment and contaminate fruits [33], vegetables or water and also by direct contact with the fur of an animal containing eggs which will be transferred on hands to the mouth [32,34]. The analyzes of dog faecal samples by sedimentation method showed the prevalence of echinococcosis as 4.34% (19/438) [25]. In a study by Rong [35], it was found that the dog was the most effective risk factor since 65% of the sheep have close contact with domestic dogs and stray dogs, also 47% of the domestic dogs may be in direct contact with stray dogs. Aziz and co workers, [36] found that 97 (24.25%) out of 400 faecal samples of stray dogs positive for taeniid parasites in Iraq [36]. Hence, to curtail the transmission of the disease and to avoid the occurrence of hydatidosis, prevent sheep, goat and other animals which are slaughtered in street (out of the proper place).

## 7. DIAGNOSIS

Echinococcosis in dogs can be diagnosed based on faecal examination. Detection of cysts in intermediate host is highly uneconomical and very often it is diagnosed during post mortem examination or meat inspection. "Radiography is

used for the detection of hydatid cysts in man. However, calcification is necessary for detecting cysts in other sites for deep-seated lesions in various organs. Radiographic visualization, computed tomography, ultrasonography and magnetic resonance imaging are useful for diagnosis. It is because these methods are available easily and very useful for defining site, dimensions, number and vitality of cysts, as well as the extent and condition of the avascular fluid-filled cysts" [37].

## 8. TREATMENT

Until 1980, surgery was the only option for treating hydatid cysts in humans. However, treatment using benzimidazole compounds was late discovered to be efficacious for protoscolices [38]. More recently, treatment includes cyst puncture, injection of chemicals and re-aspiration, aspiration and percutaneous thermal ablation etc. have been introduced for management of CE. Though, use of anthelmintics is more important form of treatment for lesions of liver, but for cysts in lungs, it is not recommended [39,40,41]. "Albendazole therapy was found effective in 61.5% of inoperable lung hydatid patients and in surgically treated patients when given concomitantly pre- and post-operatively" [42].

## 9. MANAGEMENT AND CONTROL

"The epidemiology and control of hydatidosis is often considered to be a veterinary matter since the disease can be regulated by controlling parasites in animals" [43]. However, collaboration between veterinarians and public health workers is essential for the successful control of hydatidosis.

Control of hydatidosis (Fig. 2) can properly achieved by the support of dog-owners and this is possible through increasing health education, improving sanitation, and raising awareness of community regarding the disease [44]. Health education is a paramount controlling measure. A holistic control approach that targets humans, livestock, dogs and the environment (one health approach) will play a commendable role in disease epidemiology. This approach should also involve strategic use of anthelmintics in animals, standardized veterinary meat inspection in abattoirs, control of stray dogs to reduce environmental contamination and proper environmental sanitation.

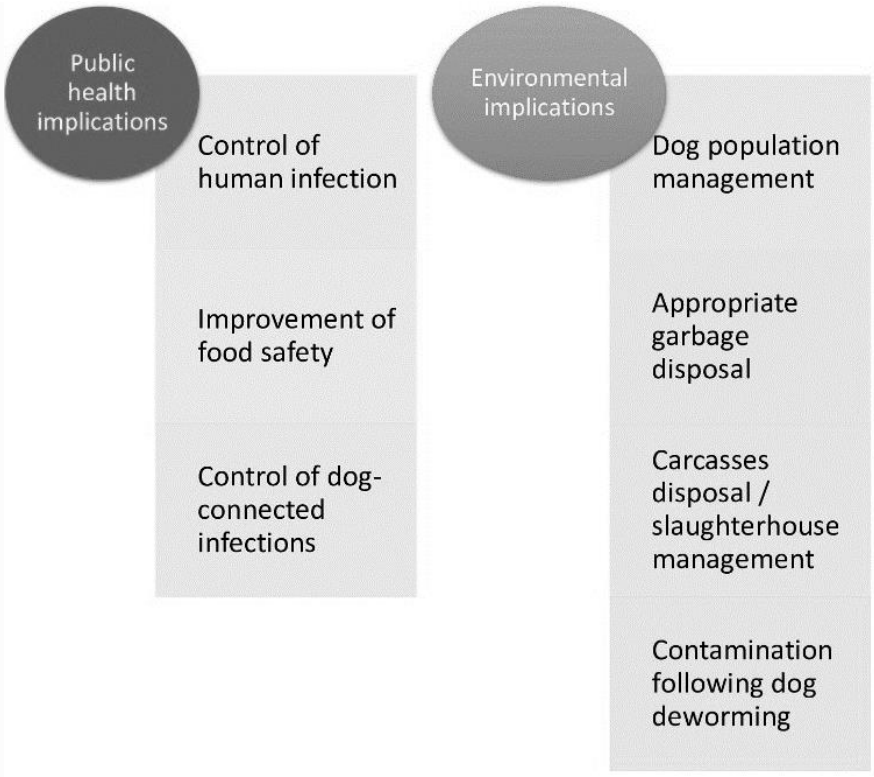


**Fig. 2. Preventive measures for control of hydatidosis**

## 10. CONCLUSION

A rapid and sensitive method to diagnose parasitosis condition in dogs is crucial as the relationship between dogs, humans and sheep is very close. Mass screening of humans in highly endemic regions will also encourage early detection and treatment. Echinococcosis is often expensive and complicated to treat and may require extensive surgery and/or prolonged drug therapy. In the case of cystic echinococcosis preventive measures also include, deworming dogs which are the definitive hosts, slaughterhouse hygiene, and public education. Hence, public awareness about the transmission and control of the disease and its public health significance needs to be disseminated in order to obtain better results. Collaboration between veterinarians and public health workers in the prevention and control of the disease is also mandatory.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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