Prevalence of Echinococcus granulosus among different intermediate host in Erbil province

Research Project

Submitted to the department of Medical Analysis, Faculty of Applied Science, Tishk International University in partial fulfillment of the requirements for the degree of BSc. in

Medical Analysis

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Dedication

We dedicate this project to everyone who has supported us throughout this academic journey.

Acknowledgments

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Our heartfelt thanks go to our families for their unwavering support and encouragement. To our parents, whose belief in our abilities has been our greatest motivation.

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Contents

Abstract

Echinococcus granulosus, are very common parasite in Kurdistan region/Iraq and causes different intermediate hosts included human. Many cases as intermediate host causes *E.granuloses* but according to our proposal we looking to find out of *E.granulosus* in animals(different intermediate host). *E.granulosus* in intermediate host make cyst called hydatid cyst. Adult worms live in the intestines of dogs, which are the definitive host. In current research which are done in Erbil city among small and big animals with the different organs in animal especially (Liver and lung). The percentage of infection in liver small animal by hydatid cyst during October 2023 it was (2.90%) while in lung it was (0.92%).in same month among big animal the percentage of liver infection it was (4.9%) while in same group in lung it was (3.48%). In November 2023 small animals liver it was (2.7%) while in same group in lung it was(0.7%).in same month among big animal the percentage of liver infection it was(4.6%) while in same group in lung it was(3.1%).In December 2023 small animals liver it was (2.7%) while in same group in lung it was(0.8%).in same month among big animal the percentage of liver infection it was(5.1%) while in same group in lung it was(3.7%).In January 2024 small animals liver it was (2.6%) while in same group in lung it was(0.7%) in same month among big animal the percentage of liver infection it was(4.6%) while in same group in lung it was(2.9%). In February 2024 small animals liver it was (2.8%) while in same group in lung it was (0.8%) in same month among big animal the percentage of liver infection it was (3.7%) while in same group in lung it was (2.8%). In March 2024 small animals liver it was (3.1%) while in same group in lung it was (1.1%). in same month among big animal the percentage of liver infection it was (4.3%) while in same group in lung it was (2.5).

Keywords: prevalence *Echinococcus granulosus*, Intermediate host, Erbil province.

Introduction

1.1. General introduction

One of the tapeworms that causes hydatid cyst disease, or echinococcosis, is *Echinococcus granulosus*. Carnivores, such as dogs, foxes, lions and hyenas, are the main host of the parasite. The granuloma and parasite (adult stages) reside in their intestines, while the larvae of the parasite (hydatid cyst) live in the intestines of herbivores (sheep, goats, camels, cows, buffalo, horses, donkeys, pigs, rabbits and humans) who act as intermediate hosts [1]. *E. granulosus* develops into three distinct stages: eggs, larvae, and adult worms. Larvae and adult worms are small in size, measuring no more than 7 mm in length as shown in Figure 1. They reside adjacent to the mucosal layer of the small intestine of the definitive host until they reach adult sexual maturity, which takes approximately 4-5 weeks [2,3]. The adult worm has a spherical head with a diameter of 0.3 mm, a short neck, and three different types of attached segments. The head also has four lateral suckers and a sucker surrounded by two rows of spikes with between 50 and 28 spines. The mature middle part, which includes the ovaries and testes, is located in the middle of the genital opening, while the part after the head is immature and contains immature reproductive organs [4,5]. The third part, which is referred to as the pregnant part, contains a branched uterus with 12-15 branches containing 500-1000 eggs [5]. The parasite *Echinococcus granulosus*, spread from the carne plant, is one of the tapeworms that causes hydatid cyst disease, also known as echinococcosis [6]. *Echinococcus granulosus*, also called hydatidiform worm, is a tapeworm parasite that can live and feed in the human intestine. *Echinococcus granulosus* has both males and females. If the parasite is only male or female, it is less dangerous than when both males and females are together.

1.2. Aims of the Study

The goal of this study is to investigate the prevalence and distribution of *Echinococcus granulosus* infections in various intermediate hosts within Erbil city, Kurdistan, Iraq. Specifically, the study aims to:

1.2.1.Determine the Infection Rates:

Quantify the monthly infection rates of *Echinococcus granulosus* in the liver and lungs of small and large animals over a six-month period provide detailed statistical data on the prevalence of hydatid cysts in these organs, highlighting seasonal variations and potential risk factors associated with the infection.

1.2.2.Enhance Understanding of the Parasitic Lifecycle:

Explore the lifecycle of *E. granulosus*, including the roles of definitive and intermediate hosts in the transmission and propagation of the parasite analyze the structural characteristics of hydatid cysts, contributing to a deeper understanding of the parasite's biology and its impact on host organisms.

1.2.3.Assess Diagnostic Techniques:

Evaluate the effectiveness of various diagnostic methods, such as imaging, serology, and molecular tests, in identifying and confirming *E. granulosus* infections. Highlight the importance of accurate diagnostics in managing and controlling the spread of echinococcosis.

1.2.4.Provide Public Health Insights:

Generate data that can inform public health policies and control measures aimed at reducing the prevalence of *Echinococcus granulosus* infections in both animals and humans emphasize the need for community education, improved veterinary practices, and enhanced sanitation to mitigate the risk of hydatid disease by achieving these goals, the study aims to contribute valuable knowledge to the field of parasitology, support the development of effective control strategies, and ultimately protect the health of both animals and humans in the region.

Literature Review

2.1. Sign and symptom:

Infection of humans with *E. granulosus* results in the emergence of one or more of these hydatid cysts are found mostly in the liver and lungs, and less frequently in the liver bones, kidneys, spleen, muscles, and central nervous system.

The asymptomatic incubation period can last for many years until the disease appears, hydatid cysts grow to the point that they produce clinical signs, but only roughly half of patients who receive medical treatment for an infection do so within a few days, years after their initial infection with the parasite abdominal pain, nausea, and vomiting are common when hydatid occurs liver. If the lung is affected, clinical signs include chronic cough, chest pain, and shortness of breath. Other signs depend on the location of hydatid cysts and pressure exerted on surrounding tissue. Non-specific signs include loss of appetite, weight loss and weakness.[7]

2.2. **Life cycle:**

We have adult stages of *Echinococcus granulosus* in humans, sheep, cattle, goats, and pigs as intermediate hosts. *Echinococcus granulosus* eggs are highly resistant to extreme environmental influences and can survive for several months or even a year, depending on conditions, in the mucosal layer of the host's small intestine [8]. Thus, because the eggs attach to the dog's hair around the anus, they remain a source of infection for intermediate hosts who drink contaminated water and food, including humans who may become infected through contact with infected dogs, especially in young children [9, 10]. After the eggs enter the stomach of the intermediate host, digestive juices break down the chitinous shell, releasing the embryo(s) of the sixth hook: Cancer cells enter the intestine, and metastasize to the liver, lungs, and other organs, such as the brain. and muscles, where they develop into hydatid cysts, which eventually rupture after five months [11]. The parasite enters the small intestine of the definitive host after feeding on the infected organs of the intermediate host. There, they grow into adult worms within 4-7 weeks, each releasing thousands of eggs daily, starting the cycle all over again [8] Figure 1.

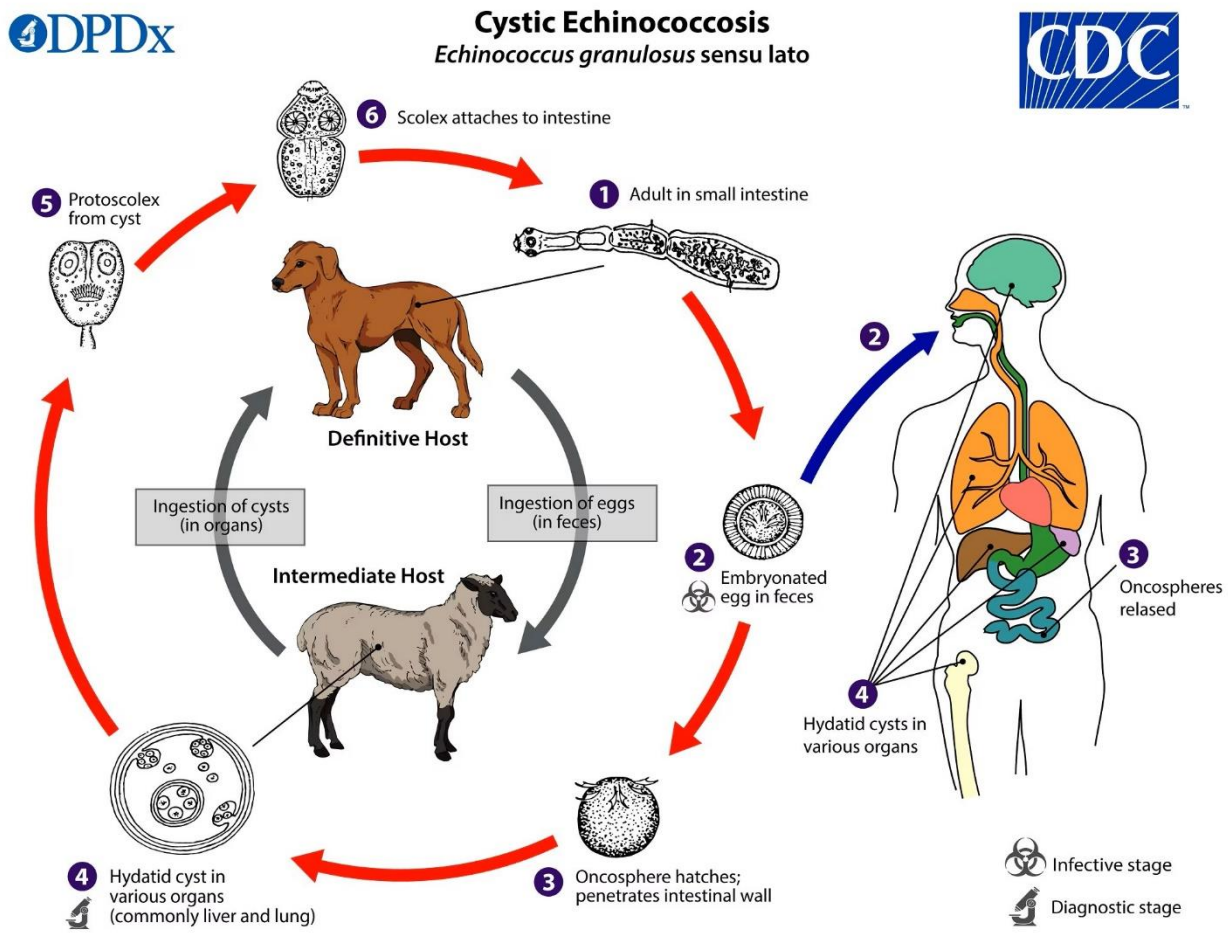

Figure 1: lifecycle of *Echinococcus granulosis*.

2.3. Structure of hydatid cyst (larval stage):

Hydatid cysts in *E. granulosus*, as shown in **Figure 2**, are usually round or slightly flattened unless restricted by adjacent organs. The volume of these cysts can range from approximately 15 to 1 cm3, depending on the age of the individual [13]. the hydatid cyst layer consist of three layers:

2.3.1. The outer (pericyst) layer

The hydatid cyst is carried by an outer layer known as the adventitia or external cyst, which is carried out by host cells (non-autonomous fibrous protective tissue) in response to infection. There is a close relationship between host tissue and parasites, which is essential for cyst growth and survival. The water bag will fail or explode if it is external divinity. The diameters of the phyllomedusines extend over the local organ in which the water is present, but within a few millimeters [14].

2.3.2. Laminated (medial) layer

Under the electron microscope, it is a solid, acellular white chitinous layer composed of dense granules and microfibrils rich in amino carbohydrates [15]. In addition to reducing the effect of drugs used to treat the disease, it helps protect the parasite from the host's immune response and provide appropriate conditions for its growth.

2.3.3. Germinal (inner) layer

This is the inner layer of the hydatid cyst, which contains the nucleus of the stratum phyla and is linked to the lamellar layer by the fingerprints formed by the germinal layer [12, 16]. It protects the cyst components and controls the osmotic pressure of the cyst wall [17]. Buds form from the germinal layer and grow toward the cyst cavity, after which the buds become hollow and successive.

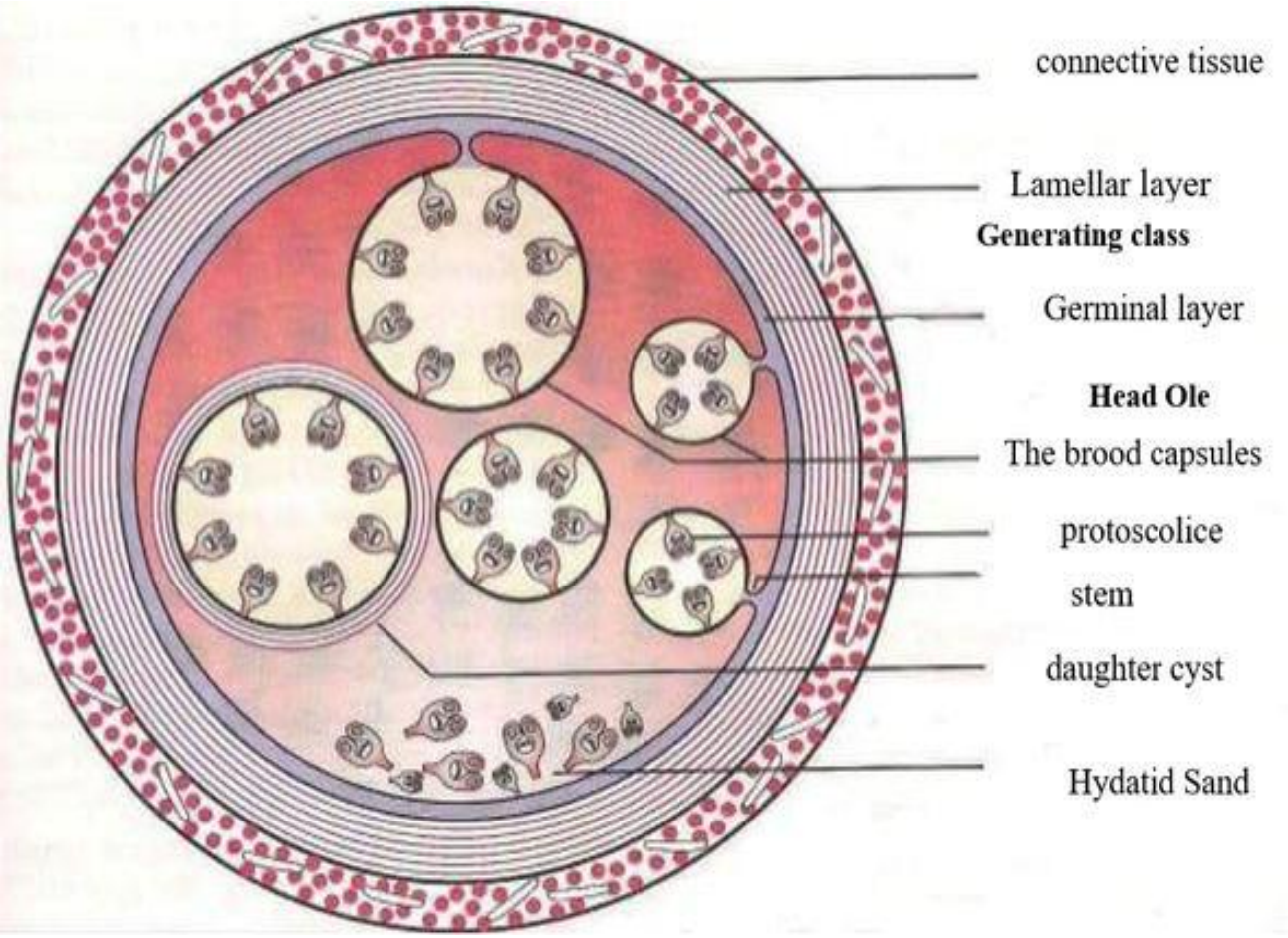

Figure 2: shape of larva *Echinococcus granulosis*.

2.4. Habitat

Habitat of *Echinococcus granulosus* adult worm found in the wall of intestinal mucosa of dogs and other canines while, Larval found in the viscera of herbivores and man.

Figure 3: Egg of *Echinococcus granulosis* in final host (dog feces).

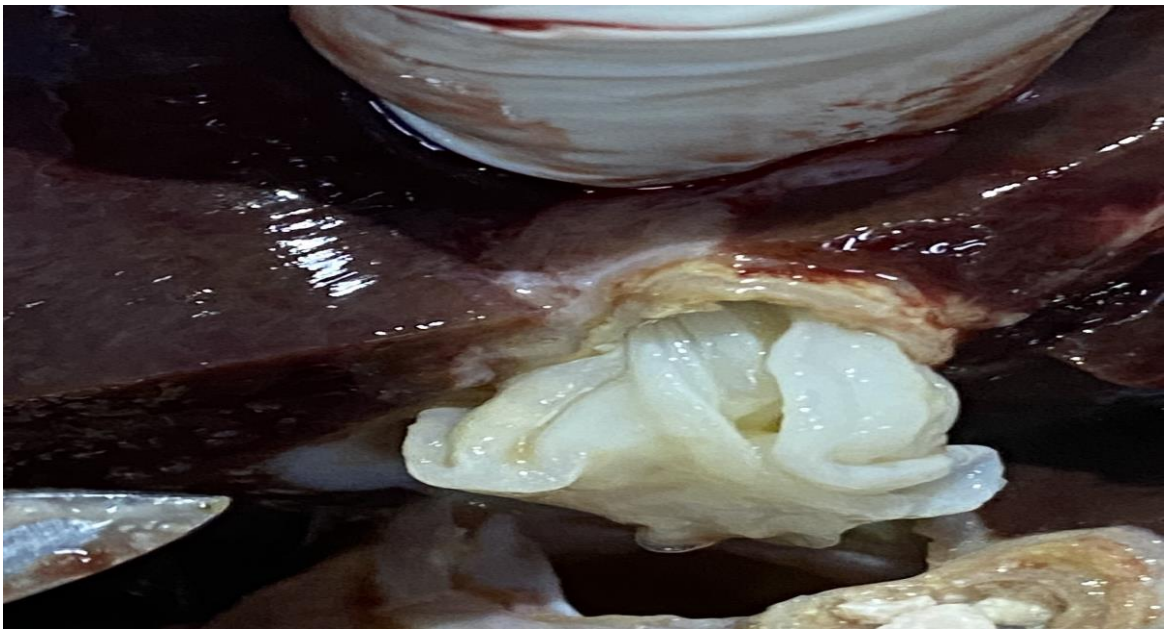

Figure 4: *Echinococcus granulosus* in liver.

2.5. Hydatid disease can mimic a wide range of conditions, depending on the location of the cyst.

The differential diagnosis of hydrolytic liver disease includes:

Liver abscess, liver cysts, Budd-Chiari syndrome, biliary colic, biliary cirrhosis, tuberculosis, and primary liver cancer are among the conditions that can be confused with hydric liver disease. A careful history and physical examination, along with necessary tests (such as imaging and serology), are crucial in diagnosing and ruling out conditions that can mimic hydric liver disease. [18].

2.6. Diagnostic Methods for *Echinococcus granulosus*:

The most important contributors to population-based acanthosis. Aside from careful study of animal anatomy, there is no perfect model. Therefore, methods of direct detection of parasites in the lab are based on the basophil antigen and the basophil detection device. The app for anatomy is in the average family. Serology and diagnostic imaging can be commonly used in humans. The absence of perfect criteria can be found using multiple equilibrium liquidity or certainty testing (or liquidity) in strategic diagnosis. Assuming that the study is well designed, and any testing is incorporated into the analysis, this will produce insightful data at the population and individual level. Here we will learn about population analyzes related to acanthosis.

2.7. Type of Diagnosis

2.8. Stool examination:

Stool examination can be used to detect tapeworm eggs, although it is less common for *Echinococcus granulosus* than for other types of tapeworm infections. Stool screening for *Echinococcus granulosus* involves using microscopic techniques to identify parasite eggs in stool samples. Typically, a stool sample is collected, processed, and examined under a microscope for the presence of the characteristic eggs, which are oval and have a thick, radially striped outer membrane. Special staining techniques may also be used to enhance visualization. It is important to follow proper laboratory protocols and safety measures when handling potentially infectious specimens. If you suspect infection, it is essential to consult a healthcare professional for appropriate diagnosis and treatment.

2.8.1. Ct scans:

Typical CT findings of cystic echinococcosis are sequential reflections in cystic thickening, calcification of the cyst wall, or a daughter cyst or collapsed internal cyst. Computed tomography of the abdomen shows the presence of countless medical cysts in the diaphragm and abdominal cavity. In laparotomy, cysts are found in the abdominal holes, whether in the detection of bloody and elegant cysts of cirrhosis, or in bladder feces, as they are scattered within the abdominal holes.

2.8.2. MRI:

The aim of our retrospective study is to provide a summary of different MRI patterns and indices that can be useful in identifying hydrophilic soft tissue hydatid disease. Seven patients with subcutaneous and soft tissue were examined with MRI images.

2.8.3. Ultrasound:

Among the imaging techniques available, transmission ultrasound (US) has unique properties that can be used for the management of cystic acanthosis. It is organ harmless, can image almost all organs and systems, record as many as are required, is portable, does not require patient preparation, is expensive and directs diagnosis and follow-up without radiation to irradiate or harm the patient.

2.9. Serology test:

This information is provided to confirm the effectiveness of the body (antibodies) for echinococcosis (also known as hydatid disease) at the Public Health Ontario (PHO) laboratory. The causative agent of cystic echinococcosis (CE) includes the E. granulosus complex (including E. granulosus sensu stricto, E. equinus, E. ortleppi, and E. canadensis).

2.10.Molecular test

Molecular testing for the presence of *Echinococcus granulosus* is performed on a stool sample and can be performed: By taking a collection container from Diagnostic Athinon. Alternatively, you can get a simple stool collection container from a pharmacy. The sample must be delivered to the laboratory. Echinococcosis, also referred to as hydatid disease or hydatid disease, is a parasitic infection common among patients who come into contact with sheep or cattle and affects more than one million people worldwide. The types of echinococcosis are tapeworms (Cestodes), and the two most important types that infect humans are *Echinococcus granulosus* .

3.1 Materials and method

We know many techniques we are using for diagnosis hydatid cyst of *Echinococcus granulosus* including CT scan, X-ray and MRI we are as medical laboratory for diagnosis we are using stool examination, serology test and molecular test during our research depending of veterinary team we already diagnosed by naked eye when we are find out a hydatid cyst which is see by naked eye which attach in liver and lung in different intermediate host in Erbil slaughter.

Results

From the data that we get it for six months in Erbil slaughter, while we started getting information in month 10-11-12/2023 and 1-2-3/2024 almost 50423 animals that get slaughtered in Erbil city in Kurdistan Iraq. Of those animals almost 2350 get infected in liver and lung and the percentage is (4.34%) *Echinococcus granulosus* during six months in table 1 according month 10/2023 show big animals like(cow, buffalo) and small animals(sheep, goat) the result shown The percentage of infection in liver small animal by hydatid cyst during October 2023 it was (246) (2.90%) while in lung it was (78) (0.92%).in same month among big animal the percentage of liver infection it was (69) (4.9%) while in same group in lung it was (49) (3.48%) In November 2023 small animals liver it was (225) (2.7%) while in same group in lung it was (58) (0.7%).in same month among big animal the percentage of liver infection it was (67) (4.6%) while in same group in lung it was(45)(3.1%).In December 2023 small animals liver it was (219) (2.7%) while in same group in lung it was (64) (0.8%).in same month among big animal the percentage of liver infection it was (77) (5.1%) while in same group in lung it was (55) (3.7%).In January 2024 small animals liver it was (210) (2.6%) while in same group in lung it was (60) (0.7%) in same month among big animal the percentage of liver infection it was (69) (4.6%) while in same group in lung it was (44) (2.9%). In February 2024 small animals liver it was (198) (2.8%) while in same group in lung it was (63) (0.8%) in same month among big animal the percentage of liver infection it was (55) (3.7%) while in same group in lung it was (42) (2.8%). In March 2024 small animals liver it was (186) (3.1%) while in same group in lung it was (70) (1.1%). in same month among big animal the percentage of liver infection it was (64) (4.3%) while in same group in lung it was (37) (2.5%).The relation statistically significant for liver (0.00189) but non-significant for lung (2.38).

Infection by *Echinococcus Granulosus* in different organ of intermediate according of sexs

Month & Year	Type of animal	Number of slaughter	Infected in liver & percentage	Infected in lung & percentage
M/10-Y/2023	Small animal	8472	246 (2.90%)	78 (0.92%)
M/10-Y/2023	Big animal	1407	69 (4.9%)	49 (3.48%)
M/11-Y/2023	Small animal	8055	225 (2.7%)	58 (0.7%)
M/11-Y/2023	Big animal	1449	67 (4.6%)	45 (3.1%)
M/12-Y/2023	Small animal	7915	219 (2.7%)	64 (0.8%)
M/12-Y/2023	Big animal	1481	77 (5.1%)	55 (3.7%)
M/1-Y/2024	Small animal	7850	210 (2.6%)	60 (0.7%)
M/1-Y/2024	Big animal	1496	69 (4.6%)	44 (2.9%)
M/2-Y/2024	Small animal	7056	198 (2.8%)	63 (0.8%)
M/2-Y/2024	Big animal	1463	55 (3.7%)	42 (2.8%)
M/3-Y/2024	Small animal	5906	186 (3.1%)	70 (1.1%)
M/3-Y/2024	Big animal	1473	64 (4.3%)	37 (2.5%)

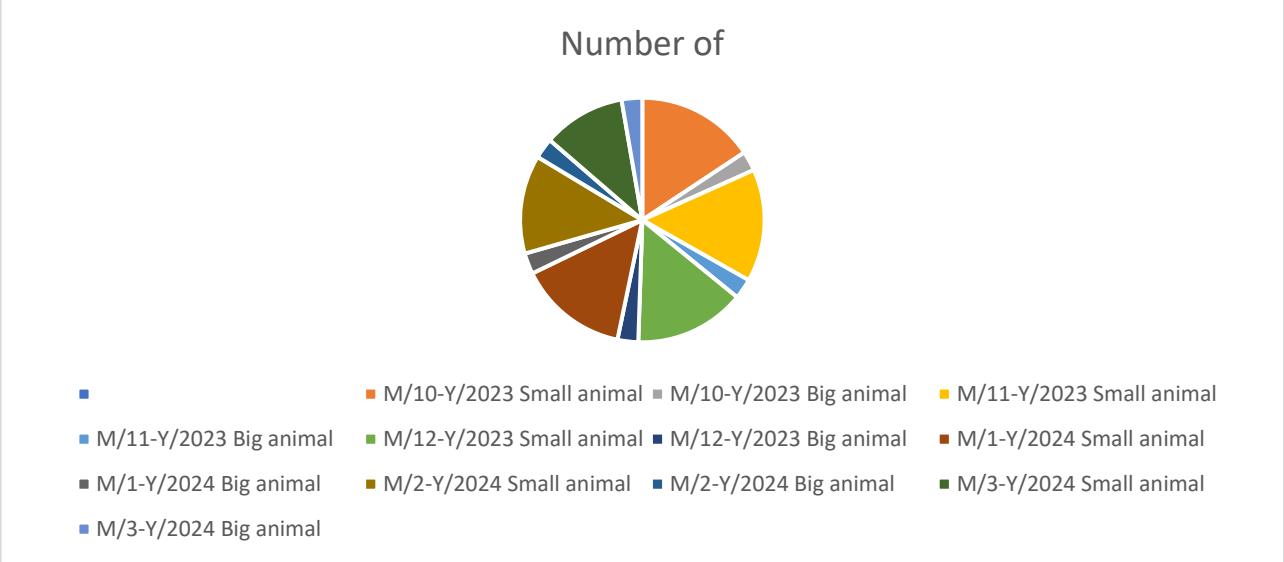

Figure:5 The relation is significant or non-significant according to p value (less or more than 0.05. relation statistically significant liver (0.00189) but non-significant for lung (2.38)

Table 1: Rate of infection of hydatid cyst from liver and lung of small and big animal during October 2023 is:

Month & Year	Type of animal	Number of slaughter	Liver	Lung
M/10-Y/2023	Small animal	8472	246 (2.90%)	78 (0.92%)
M/10-Y/2023	Big animal	1407	69 (4.9%)	49 (3.48%)

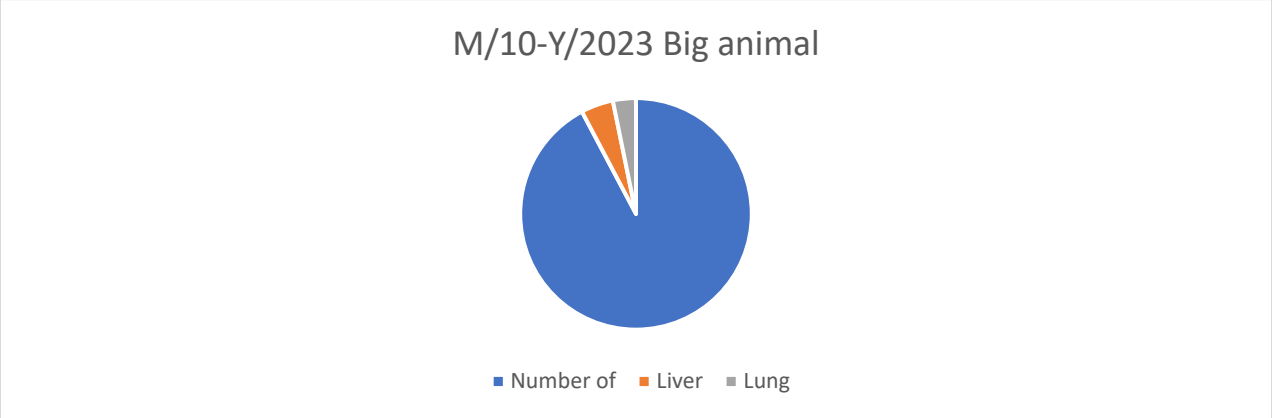

Figure 6: The relation statistically significant liver (0.00189) but non-significant for lung.

Table 2: Rate of infection of hydatid cyst from liver and lung of small and big animal during November 2023 is:

Month & Year	Type of animal	Number of slaughter	Liver	Lung
M/11-Y/2023	Small animal	8055	225 (2.7%)	58 (0.7%)
M/11-Y/2023	Big animal	1449	67 (4.6%)	45 (3.1%)

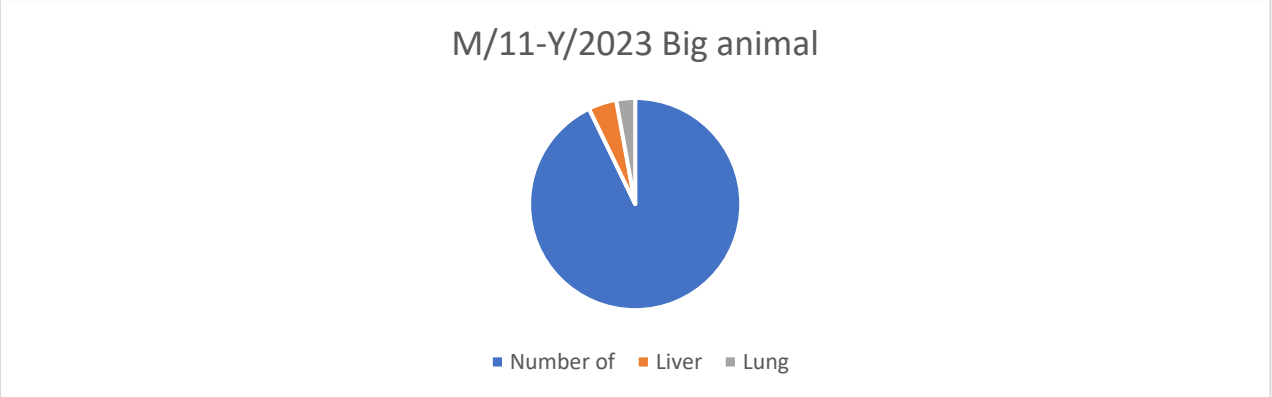

Figure 7: The relation statistically significant liver (0.00189) but non-significant for lung.

Table 3: Rate of infection of hydatid cyst from liver and lung of small and big animal during December 2023 is:

Month & Year	Type of animal	Number of slaughter	Liver	Lung
M/12-Y/2023	Small animal	7915	219 (2.7%)	64 (0.8%)
M/12-Y/2023	Big animal	1481	77 (5.1%)	55 (3.7%)

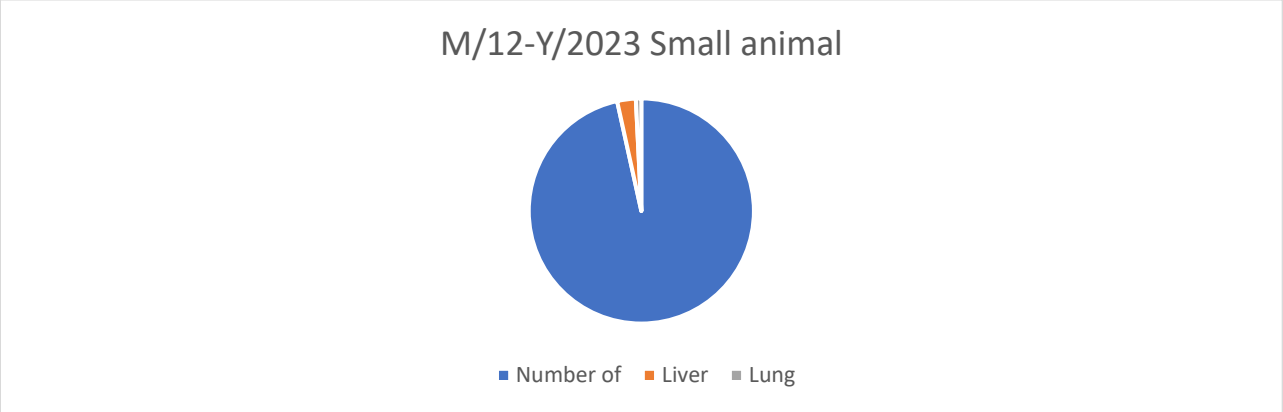

Figure 8: The relation statistically significant liver (0.00189) but non-significant for lung.

Table 4: Rate of infection of hydatid cyst from liver and lung of small and big animal during January 2024 is:

Month & Year	Type of animal	Number of slaughter	Liver	Lung
M/1-Y/2024	Small animal	7850	210 (2.6%)	60 (0.7%)
M/1-Y/2024	Big animal	1496	69 (4.6%)	44 (2.9%)

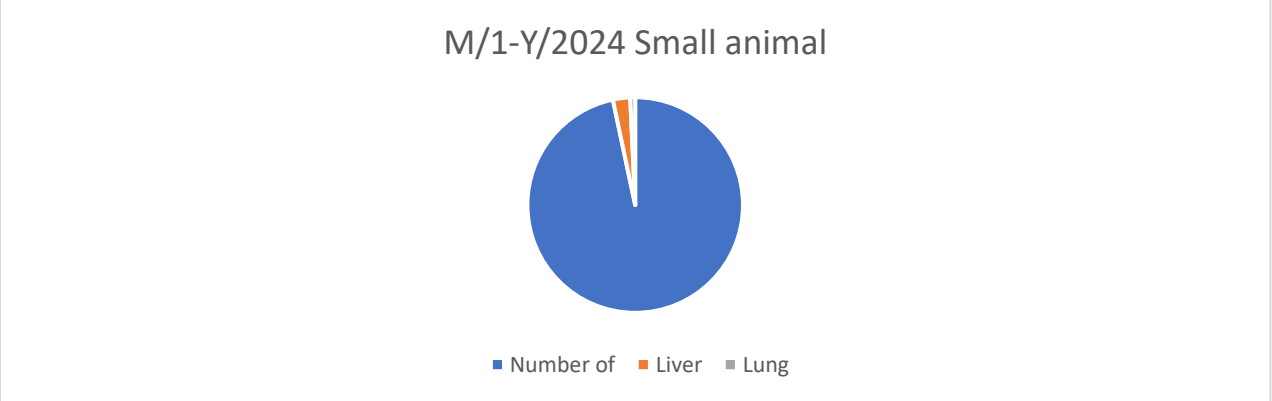

Figure 9: The relation statistically significant liver (0.00189) but non-significant for lung.

Table 5: Rate of infection of hydatid cyst from liver and lung of small and big animal during February 2024 is:

Month & Year	Type of animal	Number of slaughter	Liver	Lung
M/2-Y/2024	Small animal	7056	198 (2.8%)	63 (0.8%)
M/2-Y/2024	Big animal	1463	55 (3.7%)	42 (2.8%)

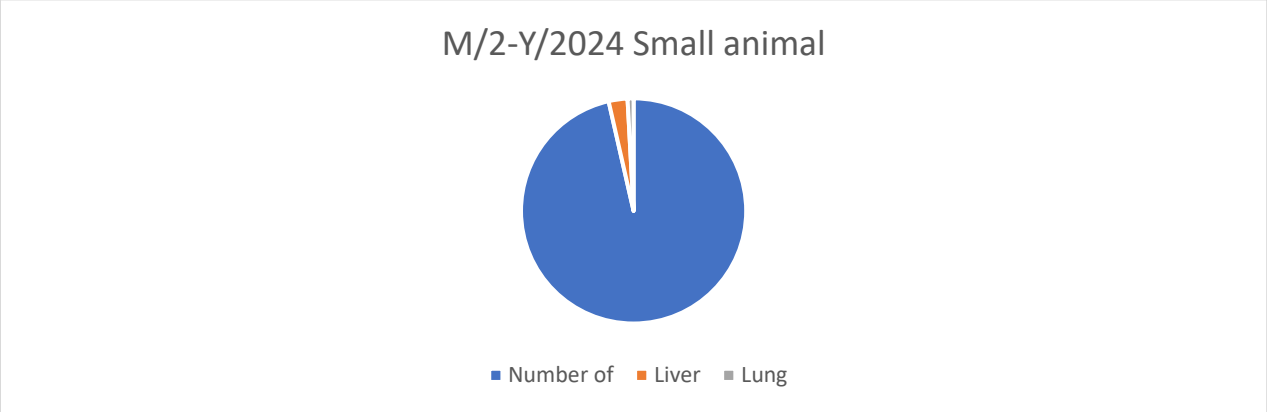

Figure 10: The relation statistically significant liver (0.00189) but non-significant for lung.

Table 6: Rate of infection of hydatid cyst from liver and lung of small and big animal during March 2024 is:

Month & Year	Type of animal	Number of slaughter	Liver	Lung
M/3-Y/2024	Small animal	5906	186 (3.1%)	70 (1.1%)
M/3-Y/2024	Big animal	1473	64 (4.3%)	37 (2.5%)

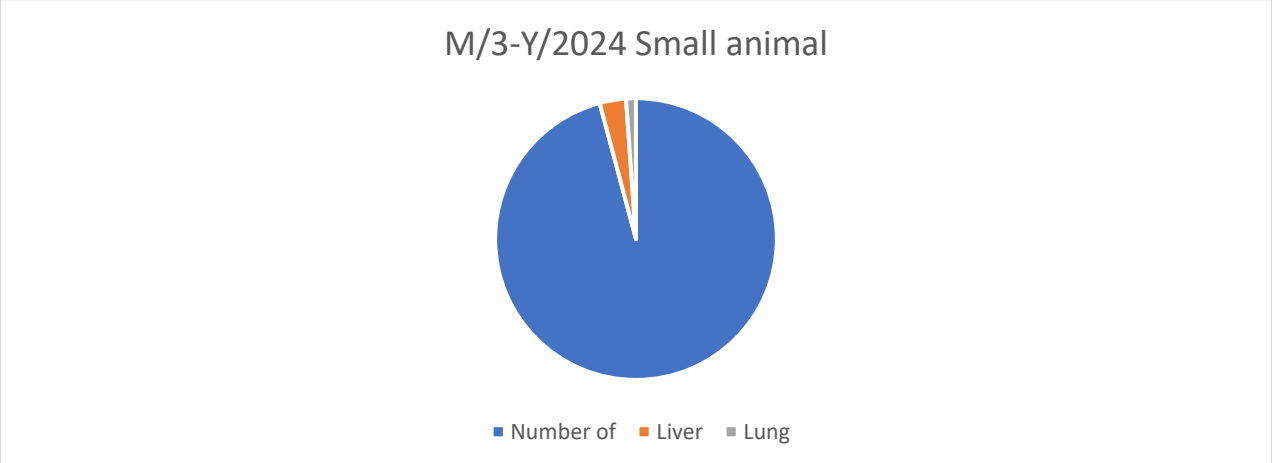

Figure 11: The relation statistically significant liver (0.00189) but non-significant for lung.

Discussion

This study on *Echinococcus granulosus* infection rates in intermediate hosts in Erbil city provides important insights into the epidemiology of this parasitic disease. The data collected from October 2023 to March 2024 reveal notable findings regarding the prevalence and seasonal distribution of hydatid cysts in both small and large animals, contributing to a broader understanding of the public health implications of echinococcosis.

Infection Rates and Seasonal Variations

The documented infection rates show a clear presence of *E. granulosus* in the animal population. Small animals exhibited liver infection rates between 2.6% and 3.1%, and lung infection rates between 0.7% and 1.1%. In contrast, large animals had higher liver infection rates ranging from 3.7% to 5.1% and lung infection rates from 2.5% to 3.7%. These rates suggest a significant burden of the parasite, particularly in larger animals. The monthly variations in infection rates may indicate environmental or management factors influencing the transmission cycle of the parasite.

Lifecycle and Transmission

The lifecycle of *E. granulosus* involves definitive hosts, typically dogs, and various intermediate herbivore hosts. The presence of hydatid cysts in crucial organs like the liver and lungs of intermediate hosts highlights the parasite's adaptability and resilience. The cycle's complexity, involving multiple hosts and environmental stages, poses challenges for control measures. This study underscores the need for integrated management strategies targeting both definitive and intermediate hosts to break the transmission cycle.

Diagnostic Techniques

The study evaluates several diagnostic methods, including imaging (CT, MRI, ultrasound), serology, and molecular tests (PCR-RFLP, multiplex PCR). The use of these techniques is essential for accurate detection and management of echinococcosis. Imaging techniques are crucial for identifying cysts in affected organs, while serological and molecular methods provide confirmation and help in understanding the genetic diversity of the parasite. The combination of these methods ensures higher diagnostic accuracy and better epidemiological tracking.

Public Health Implications

The findings highlight significant public health concerns. The infection of livestock not only impacts animal health and agricultural productivity but also poses a zoonotic risk to humans, who can become accidental intermediate hosts. Hydatid disease in humans can lead to severe health issues, including organ damage and life-threatening complications. Public health initiatives should focus on educating the community about the risks associated with *E. granulosus*, promoting regular veterinary checks, and improving hygiene practices to reduce infection rates.

Control Measures and Recommendations

Effective control measures require a multifaceted approach. Strategies should include regular deworming of dogs, improved meat inspection practices, and public education campaigns. Additionally, better waste management practices to reduce the exposure of dogs to infected offal can help break the transmission cycle. Veterinary services should be strengthened to monitor and manage infections in livestock, and public health services should focus on early detection and treatment of human cases.

Conclusions

This research project provides a comprehensive analysis of the prevalence and impact of *Echinococcus granulosus* in various intermediate hosts in the Erbil region of Kurdistan, Iraq. The findings reveal significant infection rates in both small and large animals, highlighting the public health importance of this parasite.

The study meticulously documented infection rates in the liver and lungs of animals over a six-month period, revealing a persistent presence of hydatid cysts in both types of hosts. Small animals showed liver infection rates ranging from 2.6% to 3.1% and lung infection rates from 0.7% to 1.1%, while large animals had liver infection rates between 3.7% and 5.1% and lung infection rates from 2.5% to 3.7%. These infection rates underscore the widespread nature of the parasite and its ability to infect multiple organ systems within intermediate hosts.

The lifecycle of *E. granulosus*, which involves definitive hosts such as dogs and various intermediate herbivore hosts, is complex and highlights the challenges in controlling its spread. The parasite's ability to form hydatid cysts in critical organs like the liver and lungs poses significant health risks to both animals and humans, who can inadvertently become intermediate hosts.

The study also emphasizes the importance of accurate diagnostic methods, including imaging, serology, and molecular tests, to detect and manage echinococcosis effectively. The use of multiple diagnostic approaches ensures a higher accuracy in identifying infections, which is crucial for implementing appropriate control measures.

In conclusion, the research underscores the need for continued surveillance and control programs to mitigate the impact of *Echinococcus granulosus* in the region. Public health initiatives should focus on educating communities about the risks of hydatid disease, promoting regular veterinary checks for definitive hosts, and

improving sanitation to reduce the transmission of this parasite. By addressing these areas, it is possible to reduce the prevalence of hydatid disease and protect both animal and human health in Kurdistan and beyond.

Recommendations

We recommended that:

1. Mystery of health they write down guideline how the general people deal with the meat for those animals like cow, sheep, and goat because in Kurdistan we have many cases that show infected by *Echinococcus granulosus*.
2. We as a medical analyzer try to use other techniques beside naked eye to see the hydatid cyst in live and lung, we will try to find out egg of worm inside feces of dog is the final host.
3. Try to use molecular technique to diagnosis which strain of Echinococcus is very common in Erbil city.

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