INTESTINAL PARASITES IN DOGS AND HUMANS, ENVIRONMENTAL EGG CONTAMINATION AND RISK OF HUMAN INFECTION WITH ZOONOTIC HELMINTH PARASITES FROM DOG IN HOSANNA TOWN

MVPH THESIS

By

Yimer Mulugeta

JUNE, 2013

JIMMA, ETHIOPIA

JIMMA UNIVERSITY
COLLEGE OF AGRICULTURE AND VETERINARY MEDICINE,
SCHOOL OF VETERINARY MEDICINE

Intestinal Parasites in Dogs and Humans, Environmental Egg Contamination and Risk of Human Infection with Zoonotic Helminth Parasites from Dog in Hosanna Town

A thesis submitted to the School of Veterinary Medicine, Jimma University, in a partial fulfillment of the requirements for the Masters of Veterinary Public Health (MVPH)

By

Yimer Mulugeta

June, 2013

Jimma, Ethiopia

Jimma University

School of Graduate Studies

As thesis research advisors, we hereby certify that we have read and evaluated this thesis prepared, under our guidance, by **Yimer Mulugeta** entitled **Intestinal Parasites in Dogs and Humans, Environmental Egg Contamination and Risk of Human Infection with Zoonotic Helminth Parasites from Dog in Hosanna Town**

We recommend it to be submitted as fulfilling thesis requirement.

Major Advisor:

Name	Signature	Date
Moti Yohannes (DVM, MVPH, Associate Prof.)	_____________	__________

Co-Advisor:

Hailu Degefu (DVM, M.Sc, Associate Prof.)	_____________	___________

As member of the *Board of Examiners* of the M.Sc. *Thesis Open Defense Examination,* we certify that we have read, evaluate the thesis prepared by **Yimer Mulugeta** and examined the candidate. We recommended that the thesis could be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Veterinary Public Health.

Chairperson	Signature	Date
____________________________	___________________	________________
Internal Examiner	Signature	Date
____________________________	___________________	________________
External Examiner	Signature	Date
____________________________	___________________	________________

TABLE OF CONTENTS **Pages**

ACKNOWLEDGMENTS ..... **i**

STATEMENT OF THE AUTHOR ..... **ii**

DEDICATION ..... **iii**

BIOGRAPHY ..... **iv**

LIST OF TABLES ..... **v**

LIST OF FIGURES ..... **vi**

ABBREVIATIONS ..... **vii**

ABSTRACT ..... **viii**

1. INTRODUCTION **1**

2. LITERATURE REVIEW **3**

2.1. Pet Zoonoses **3**

2.1.1. Zoonotic Gastrointestinal Helminths in Pets 8

2.1.2. Prevalence of Zoonotic GI Helminth Parasites from Pets' in Ethiopia 12

2.1.3. Potential Risk Factors Associated with GI Helminthes Zoonoses from Pets 15

2.2. Control Practices for Zoonoses from Pets **16**

2.2.1. Prophylactic Anthelmintic Treatment 17

2.2.2. Educating and Counseling Pet Owners in Preventing Zoonotic Diseases 20

2.2.3. Pet Owner and Community Education 21

3. MATERIALS AND METHODS **22**

3.1. Description of the Study Area **22**

3.2. Study Population **23**

3.3. Study Design **23**

3.4. Sample Size Determination and Sampling Methods **24**

3.4.2. Sampling Methods 25

3.5. Study Methodology **26**

3.5.1. Parasitological Procedures 26

3.5.2. Retrospective Survey 27

3.5.3. Questionnaire Survey 27

3. 6. Data Analysis **28**

4. RESULTS **29**

4.1. Gastrointestinal Helminth Parasites in Dogs **29**

4.1.1. Overall Prevalence of Helminth Infection and Species of Parasites Identified in Dogs. 29

4.1.2. Assessment of the Effect of the Different Risk Factors Considered for the Helminth Parasitism in Dogs. 32

4.2. Gastrointestinal Helminth Parasites in Human **35**

4.2.1. Overall Prevalence of Helminth Infection and Species of Parasites Identified in Human. 35

4.2.2. Assessment of the Effect of the Different Risk Factors Considered for the Helminth Parasitism in Human. 38

4.3. Detection of Eggs of Helminth Parasites form Soil Samples **40**

5. DISCUSSIONS **42**

6. CONCLUSION AND RECOMMENDATIONS **50**

7. REFERENCES **52**

8. ANNEXES **62**

Annex I: Materials and Procedures of Parasitological Techniques **62**

Annex II: Questionnaire Format for Pet Owners in Hosanna Town and/or Interview Questions **68**

ACKNOWLEDGMENTS

Above all, I would like to praise and glorify Jesus for the patience he gave me to travel this journey of my educational career and without his/whose divine supervision, I couldn't have been a man of today.

I would like to express my deepest gratitude to my advisors Dr. Moti Yohannes and Dr. Hailu Degefu for their valuable and continuous advice, correction and guidance on how to make a scientific paper during my study period.

Special thanks go to the Jimma University College of Agriculture and veterinary Medicine, School of Veterinary Medicine, Department of Veterinary Public Health for creating/opening the chance and for my postgraduate study and their supporting in research work.

I would like to express also my grateful to the staff of Hosanna Health Science Collage for their collaboration, cooperation and creating a good working environment.

I like to thank all households that own dogs in Hosanna town for, their time and all valuable cooperation during my study time.

I would like to express thanks to Gombora woreda of Hadiya Zone for their contribution in giving chance and budget for my postgraduate study.

I want to thank the JUCAVM computer center worker and librarian for their patience during writing this thesis.

Finally, my thanks have to reach to all my family and friends for their moral support.

STATEMENT OF THE AUTHOR

First, I declare that this thesis is my work and that all sources of materials used for this thesis have duly acknowledged. It has been submitted in partial fulfillment of the requirements for M.Sc degree in Veterinary Public Health at Jimma University. I truly declare that this thesis is not submitted to any other institution anywhere for the award of any academic certificate. Quotations from this thesis are allowable with accurate acknowledgement of source.

Name: Yimer Mulugeta Signature: ____________ Date:____________

Place: Jimma University,

Jimma, Ethiopia

Date of submission: June, 2013

DEDICATION

I dedicate this manuscript to my father Mulugeta Agga. He passed away without seeing my achievements.

BIOGRAPHY

The author was born from his father Mulugeta Agga and his mother Adenech Eyako near Hosanna town, Hadiya zone of the southern region in 1988. He attended elementary education in Shallele primary school from 1993 – 2000 and his secondary preparatory education at Wachamo secondary and preparatory school from 2000 to 2004.

In November 2005, he joined Mekelle University, Faculty of Veterinary Science and graduated with Degree of Doctor of Veterinary Medicine in 2009. After graduation, he joined the bureau of Agriculture at Gombora woreda Agricultural office in Hadiya Zone and served as a veterinary service coordinator and professions from August 2009 to September 2011. In September 2011, he joined Jimma University to pursue his Master of Veterinary Public Health

LIST OF TABLES ....Pages

Table 1: Zoonoses potentially transmitted by household pets 5

Table 2: Summary of some outbreaks and case series of pet zoonoses from U.S.A and Canada. 6

Table 3: A summary on prevalence of zoonotic GI helminth Spp. infecting pets in Ethiopia 14

Table 4: Drugs for the treatment of GI helminth infections in dogs and cats. 19

Table 5: Species of Helminth parasites identified in household dogs of Hosanna town (n= 261) and their prevalence. 30

Table 6: Prevalence in dogs with different risk factors (KAPs of dog owners) regarding potential zoonotic intestinal helminthes parasites in Hosanna, south Ethiopia. 34

Table 7: Species of Helminth parasites identified in dogs owners of Hosanna town (n= 261) and their prevalence. 35

Table 8: Result of logistic regression analysis for factors potentially associated with zoonotic intestinal helminth parasites among dog owners in Hosanna town. 39

Table 9: Important geo-helminth parasites egg diagnosed in soil sample of seven selected sites or plots and their prevalence. 40

Table 10: Over all summery of intestinal helminthes species identified in dogs, human and soil with their prevalence in Hosanna town. 41

LIST OF FIGURES ....Pages

Figure 1: Ways of transmission of zoonotic parasites from dogs. 5

Figure 2: Some risky human behavior and pet ownership are associated with pet zoonoses........ 7

Figure 3: Clinical effects of toxocariasis and hookworms in man. 9

Figure 4: Childrens have property of playing with dirt, sand and contaminated soil and risk of being infeccted. 20

Figure 5: Geographical location of the study area, Source: (Tile, 2012).................................... 22

Figure 6: The number (with SD error) and percentage of dogs infected with one, two and three helminth species among the 187-helminth infection positive animals. 30

Figure 7: The overall prevalence of gastrointestinal helminth infection in dogs living in different kebeles of Hosanna town 31

Figure 8: The minimum and maximum helminth parasitic egg loads in different species in infected dogs. 32

Figure 9: The overall prevalence of gastrointestinal helminth infection in human living in different kebelles of Hosanna town 36

Figure 10: Proportion of helminthes per year of diagnostic record, center of diagnostic lab and sex of cases 37

Figure 11: Different intestinal helminth species that were collected from different diagnostic laboratory 37

ABBREVIATIONS

BC	Before Christ
CI	Confidence Interval
CLM	Cutaneous Larva Migrans
ESCCAP	Europeans Scientific Counsel Companion Animal Parasites
EPG	Eggs per Gram of stool
FAO	Food and Agricultural Organization
g	Gram
GI	Gastro-intestine
HIV	Human immunodeficiency virus
HLCV	Human lymphocytic chorimeningitis virus
KAP	Knowledge, Attitude and Practices
masl	Meter above sea level
ml	Milliliter
OLM	Ocular Larva Migrans
OR	Odds Ratio
PM	Post Mortem
Spp	Species
SPSS	Statistical Package for Social Science
U.S.A	United States of America
VLM	Visceral Larva Migrans
WHO	World Health Organization
ZGIHI	Zoonotic gastro intestinal helminths infection

ABSTRACT

Pets are companion animals that play an important role in societies throughout the world including Ethiopia and dogs are the first domesticated species. However, potential hazards are associated with pet ownership and thus, the objectives of the study were to determine the prevalence of gastrointestinal helminths infection in dogs and their owners in Hosanna, with special attention to potential zoonotic parasites and also to assess knowledge, attitude and practice of dog owners on dog parasites and health related management aspect of dogs. Cross sectional and retrospective study designs were employed with systematic random sampling methods to select households owning dogs in Hosanna town. Results based on coproscopy examination revealed that overall prevalence of helminth infection in dogs were 71.6% (n=187) out of 261 dogs sampled and species of parasites identified were: *Ancylostoma caninum* (49**%)** followed by *Toxocara canis* (34**%)**, *Toxocara leonine* (7.2**%)**, *Taenia* species (4.2**%)**, *Strongyloides stercoralis* (2.6**%)** and *Trichuris vulpis* (1.9**%)** with a statistically significant variation (χ^2: 365, df: 5, p: 0.000) between species. The highest prevalence was recorded in Arada kebele (85.7%) followed by Meli-amba (85.3%). Intestinal helminth parasites in human showed overall prevalence of 17.62% (95% CI: 13.20-22.79) and species of parasites identified were *Hookworm* species (6.5%) followed by *Ascaris* (4.6%), *H. nana* (2.7%), *S. stercoralis*(1.5%), *Taenia* species (1.5%) and *H. diminatus* (0.8%). The highest prevalence was recorded in Bobicho kebele (27.58%) followed by Heto (26.60%). In the analysis of the five year Human hospital and different clinics patient records *Ascaris, E. vermicularis, H. nana, Hookworm* species, *S. stercoralis*, *Taenia* species and *Trichuria* species were found with an overall abundances of 24.6%, 1.4%, 1.4%, 19.4%, 7.6%, 7% and 6.4% respectively. Out of the seven purposively collected soil samples, upon laboratory analysis helminth eggs were recovered in five of the soil samples and the eggs of the following species of helminth parasites identified in decreasing were: *Trichuris* species, *T. canis*, *Ancylostoma* species, *A. lumbricoides*, *S. stercoralis* and *Taenia* species. The major risk factors for the spread and zoonotic transmissions of parasites were lack of treatment for dog (prevalence: 81.2%, P value: 0.000 and OR (95%CI):16(7.1-35)), poor awareness on transmissible helminth intestinal parasites of dog (prevalence: 76.5% P value: 0.002 and OR(95%CI):2.5(1.36-4.4)) and composting practice of dog faece (prevalence in human: 35.3%, P value: 0.013 and OR(95%CI): 2.83(1.01-8.3)). In general the prevalence and parasitic egg loads were high in dog and all of species are zoonotically important/ recognized. So, deworming of dog and community awareness were suggested as a way forward. Furthermore, research in the area of pet zoonoses, communication and collaboration among human and animal professionals for coordinated surveillance system were forwarded as recommendation.

Key words*: Dogs, Helminth, Hosanna, Human, Prevalence, and Zoonoses*

1. INTRODUCTION

A pet is a companion animal that people take care of and that gives them company, like a dog or a cat. The word pet is also defined as any animals kept by humans for companionship or pleasure rather than for utility. The main distinction between pets and domesticated livestock is the degree of contact between owner and animal. Pets can be classified according to the type of premises or habitat they usually occupy as household pets, vivarium pets and aquarium pets. Dogs are known to have been kept as first pets and first domesticated species since prehistoric times and cats since the 16 century BC. Other common pets include birds, rabbits, rodents, raccoons, reptiles, amphibians, and even insects. More than 50% of all households in the English-speaking world keep one or more animals as pets. Dogs and cats are the most common (Kuma and Smith, 2000; Smith and Whitfield, 2012).

Pets play an important role in societies throughout the world. They are important companions in many households, contributing to the physical, social and emotional development of children and the well-being of their owners, especially the elderly (Patricia and Bruno, 2005). The major roles include for entertainment, as racing and fighting, for hunting, as guards, draught animals, for food, or for commercial purposes, for transportation, and for research. However, pets specifically dogs and cats also act as reservoirs of a large number of pathogens of parasitic zoonoses, such as toxoplasmosis (Elmore *et al.,* 2010), giardiasis (Ballweber *et al*., 2010), toxocariasis (Won *et al*., 2008) and ancylostomiasis (Landmann and Prociv, 2003). Their roles in transmitting human infections have been recognized worldwide (Traub *et al.,* 2002; Weese *et al.,* 2011).

In many African countries including Ethiopia, appropriate policies regarding pet ownership has never been exercised and awareness of owners regarding their effects on individual and community health remained poor. According to some studies, the prevalence of parasites with public health importance in household pets was found usually high (Ugbomoiko *et al*., 2008; Degefu *et al.,* 2011); resulting in risk of zoonotic transmission from household pets to humans that may occur directly or indirectly via environmental factors. In that sense, different studies have demonstrated that the soil contamination of gardens and public grounds by infectious parasitic forms constitutes a significant zoonotic risk (Habluetzel *et al*., 2003). The risk is further increased by non-favourable ecological, human behavioural factors and low awareness of pet owners about the diseases they may acquire from their own pets (Malgor *et al.*, 1996; Ugbomoiko *et al*., 2008; Endrias *et al*., 2010).

Most pet owners do not know that their pets may carry worms capable of infecting people. Therefore, practicing veterinarians can provide an important public service by recommending regular fecal examinations, providing well-timed anthelmintic treatments, counseling clients on potential public health hazards, and advising them on any precautionary measures that may be taken. Veterinarians are in an ideal position to provide pet owners with this service because of their access to the pet-owning public, their knowledge and training, and their role in the human-animal bond (Schantz, 2002).

In Ethiopia, veterinary researches mainly focus on large animals with no or little attention to pets like dogs and cats. Few studies that have been done so far are at the expense of research interests of limited veterinarians such as Legesse (2001) in Nekemt; Yacob *et al. (2007)*, in Debreziet; Endrias *et al*. (2010), in Ambo and Jones *et al*. (2011) in Wondogenet areas; which are small administrative units in a given town, of Ethiopia. In this regard, so far there is no available data on the occurrence of zoonotic helminth parasite from dog in Hosanna area. Therefore, the objectives of this research project were:

- ✓ To determine the prevalence of gastro intestinal helminth infection in dogs and their owners in Hosanna, with special attention to potential zoonotic parasites.
- ✓ To assess the contamination of the environment (children play ground) with zoonotic dog helminth eggs.
- ✓ To assess the knowledge, attitude and the practice of dog owners on zoonotic dog parasites in the study area.

2. LITERATURE REVIEW

2.1. Pet Zoonoses

Pet zoonoses are an emerging public health issue, especially as pet ownership increases and pet definitions expand to include new and exotic animals. There are many companionship and psychological benefits to human contact with pets; however, pets are known reservoirs of zoonotic diseases. Many pet owners are often unaware of the risks their pets may pose and as a result, engage in husbandry and hygiene practices that increase the likelihood of acquiring diseases (Smith and Whitfield, 2012*)*.

Historically, zoonoses only referred to animal disease; however, the current use refers to disease and infections transmitted between animals and man. The term commonly used to refer to the more specific and scientific terms of zooanthroponoses and anthropozoonoses (WHO, 1959). Zoonoses from pets are classified in to bacterial, viral, parasitic and fungal based on its etiology and listed under **table** 1 (Kuma and Smith, 2000).

The group of enteric pathogens of concern in pets consists almost exclusively of *Salmonella, Campylobacter* and *Yersinia*. A variety of dermatophytes, many strictly anthropophilic, cause ringworm in man. *Microsporum canis* and zoophilic strains of *Trichophyton mentagrophytes* are the only frequently encountered dermatophytes of significant concern which are obtained from pets (Lynch, 1987).

From Japan, Asano *et al.* (2003) reported flea bites (62.3%), dermatophytosis (26.9%), cat-scratch disease (16.0%), tick bites (9.0%) and pasturellosis (6.1%) in staff members' of companion-animal hospital acquiring zoonotic diseases from pets while working in companion-animal hospitals. Their report also indicated a small number of veterinary technicians that had been infected with Q fever, toxoplasmosis, parrot fever, salmonellosis, tetanus, campylobacteriosis or scabies (Asano *et al.,* 2003).

Rabies, salmonella and toxoplasmosis are among the most commonly known zoonoses that can be transmitted between pets and pet owners. Rabies largely under control in the US due to successful dog vaccination programs, salmonella risks can be significantly reduced through proper sanitation, and toxoplasmosis, which is primarily a concern for pregnant women and immune-compromised individuals, is not an issue if those at risk avoid contact with cat faeces (http://www.pijac.org/about/committees/zoonoses; Riley and Chomel, 2005; Knobel *et al*., 2008)

Avian Chlamydiosis /Psittacosis are Zoonotic intracellular bacterial disease of pet birds/man and caused by *Chlamydophila psittaci.* This agent can survive outside the host for days to weeks. It is an occupational hazard to workers in bird industry and sporadic cases associated with pet bird ownership. Flu like symptom in man, being an acute, generalized infectious disease with variable clinical presentation that may include fever, headache, myalgia, chills and upper or lower respiratory tract disease. The principal reservoir is pet bird. Birds that appear healthy can be carriers, particularly when subjected to the stresses of crowding and shipping. Humans are infected when they inhale the agent in desiccated (dried) droppings, secretions and mouth-to-beak contact **figure 2** (http://www.nasphv.org/Documents/Psittacosis.pdf; Lynch, 1987; Smith *et al.,* 2010)

From Canada, Smith and Whitfield (2012) reported that pets have been the source of numerous human infections, such as salmonellosis, tularensis, murine typhus, monkeypox, cutaneous larvae migrans, and Human Lymphocytic Chorimeningitis Virus (HLCV) infections. Currently, an estimated 75% of emerging infectious diseases are zoonotic. Summary of out breaks are listed below under **table** 2 from different counters, including the gap, source and recommendations, some of them are trans-boundary.

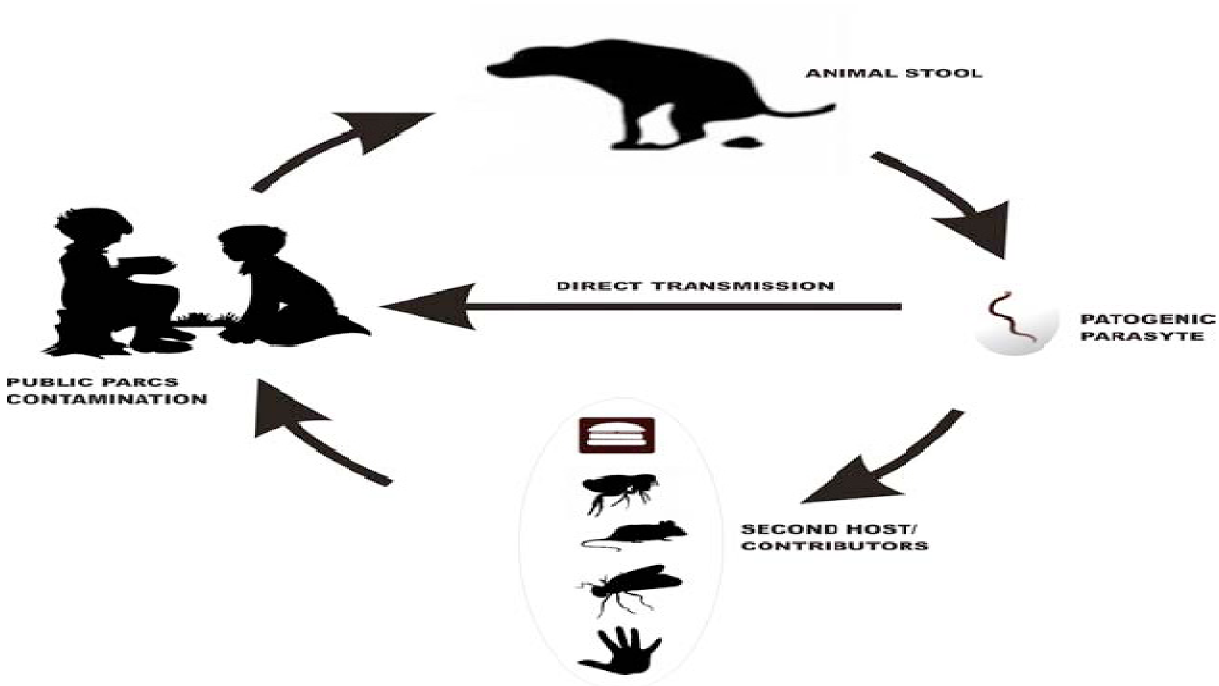


Figure 1: Ways of transmission of zoonotic parasites from dogs.

Source: (Haxhiraj *et al*., 2012)

Table 1: Zoonoses potentially transmitted by household pets

Pets	Viral	Bacterial	Parasitic	Mycotic
Dog	Rabies	Salmonellosis	Cryptosporidosis	Dermatophytosis
Cat	HLCV	Campylobacter	Toxocariasis	
Chicken	Influenza	Yersiniosis	Giardiasis	
Rat		Mycoplasmosis	Cutaneous leishmaniasis	
		Rat bite fever	Sarcoptic mange	
		Tularemia	Cutaneous larva migrants	
		Pasteurellosis	Toxoplasmosis	
		Brucellosis	Hydatidosis	
		Plague	Diaphilldiasis	

Source: (Kuma and Smith, 2000; Riley and Chomel, 2005).

Table 2: Summary of some outbreaks and case series of pet zoonoses from U.S.A and Canada.

Publication Dates	Outbreak /Case Series typ	Number of People Ill	Source	Gaps	Findings or Recommendations
2007	Monkey pox Outbreak Wisconsin	19 confirmed cases: 5 probable; 3 suspect cases	dogs transported with ill Gambian giant rats imported from Ghana	Issues identified included inadequate quarantine measures; infection control; personal protective equipment; environmental sanitation.	Standard veterinary infection control guidelines -very important. Education of pet storeowners and pet suppliers in infection control practices.
2005	Tularaemia	1 case: 3 year old	Pet hamster bite	Pet hamsters not previously identified as a source of tularaemia	Healthcare and public health practitioners should be aware that pet hamsters might be a source of tularaemia.
2008	Murine Typhus	33 cases	Fleas on animals	Lack of awareness of the disease and methods of prevention	Increased awareness of the public re-treatment of animals exposed to other wild animals with exposure to fleas.
2006	Cutaneous Larva Migrans	22 cases	Cats or dogs Hookworm	Improper cleaning of sandbox; poor hygiene - cat sand box	Lack of awareness of sanitation measures for sand boxes, to prevent the transmission of the disease
2007 2008	*Salmonella*Schwarzengrund	79 cases: median age 3 yrs;	Dry dog foods	Dry dog food not removed from homes even though recall was issued;	Handwashing after handling pet foods; Handling by children <5 years should be prohibited;
2010	*Salmonella* Typhimurium	85 cases	African dwarf frog purchased from pet shops	Only 31% of cases knew that *Salmonella* can be acquired from amphibians; while 53% were aware of link with reptiles,	African dwarf frog purchased from pet shops.
2009	*Salmonella*Paratyphi var Java	107 cases: median age 7yrs old; 33 hospitalized	Retail pet shops, flea markets, gift shops, street vendors, internet	Lack of awareness of link between Salmonella and contact with reptiles; Some children inserted the turtles into their mouths;	Small turtles continue to be sold and pose a health risk, especially to children; "many people remain unaware of the link between Salmonella infection and reptile contact"

Source: (Smith and Whitfield 2012).

Figure 2: Some risky human behavior and pet ownership are associated with pet zoonoses.

Source : (http://www.extsoilcrop.colostate.edu/Soils/powerpoint/cla/ZoonoticDiseases.pdf)

2.1.1. Zoonotic Gastrointestinal Helminths in Pets

Our close relationship with and the numerous uses to which we put companion animals and their ever-present distribution has resulted in dogs and cats unsuspecting participation in sharing over 60 parasite species. Changing human behavior through education to encourage the proper cooking of food which may have cultural and social significance will remain as challenging as controlling stray and feral pet populations, improving hygiene levels and the provision of safe drinking water and the proper use of sanctuary facilities. For instance several helminth parasites of dogs and cats may be transmitted to humans, namely the roundworm (*Toxocara* species), hookworms (*Ancylostoma* spices) in dog and cat*,* dog tapeworm *Echinococcus granulosus*, dog whipworm *Trichuris vulpis* and flea tapeworm *Dipylidium caninum* (infection of humans occurs only via swallowing the intermediate host, a flea. Other zoonotic parasites from pets include *strongyliodes stercoralis* and *taenia* species (Schantz, 2002; Macpherson, 2005; Endrias *et al*., 2010 and Degfu *et al*., 2011).

Hookworm

Hookworm eggs are excreted from infected canine or feline intestine in faeces and develop into free living larvae in soil. Infective larvae survive in moist, dark, cool microenvironments. They penetrate bare skin and transmission is associated with occupational and recreational contact (example walking barefoot) with contaminated, shaded, sandy soils, frequented by dogs and cats, in warm moist climates (Kuma and Smith, 2000).Young pets like puppies and kittens acquire hookworm infections (*A. caninum, A. braziliense* and *A. tubaeforme*) through ingestion of or skin penetration by infective larvae or from infective larvae passed in their dam’s milk (*A. caninum*) (Burke and Roberson, 1985).

In humans, percutaneous penetration of *A. caninum* and *A. braziliense* infective larvae leads to Cutaneous Larva Migrans Syndrome **figure** 2 and its larval migrations are characterized by the appearance of progressive, intensely pruritic, linear eruptive lesions, which are usually more extensive with *A. braziliense* infections. *A. caninum* larvae may also penetrate into deeper tissues and induce symptoms of visceral larva migrans or migrate to the intestine and induce an eosinophilic enteritis (Landmann and Prociv, 2003; Caumes, 2006).

Ascarids

The rout of transmission and infection of *Ascarids* are because of the occurrence of both transplacental and transmammary transmission of *T. canis*, puppies are usually born with or acquire ascarid infections early in life (Burke and Roberson, 1985). Larval stages of *Toxocara canis* and *Toxocara cati*, are common intestinal roundworms of dogs and cats respectively and frequently infect humans worldwide. *Toxocara* eggs are passed unembryonated in the feces of these animals, become infectious under ideal conditions of temperature and humidity after two to six weeks and can remain infective in the soil for many years favoring accidental transmission to people (Schantz, 1989 and Overgaauw, 1997).

The signs and symptoms of Toxocariasis seen in humans are determined by the tissues or organs damaged during larval migration. Organs commonly affected are the eye, brain, liver, and lung, where infections can cause permanent visual, neurologic, or other tissue damage. The common dog ascarid, *T. canis*, has long been recognized as a cause of larva migrans syndromes in children. The cat ascarid, *T. cati*, can also cause disease in humans; although for reasons partly related to the defecation habits of cats, it does so less frequently (Kazacos, 2000). Toxocariasis can result in a variety of syndromes with different clinical manifestations. Two commonly described syndromes, visceral larva migrans and ocular larva migrans, can include abdominal pain, hepatomegaly, persistent eosinophilia, visual impairment, and retinal scarring (Schantz, 1989 and Overgaauw, 1997a).

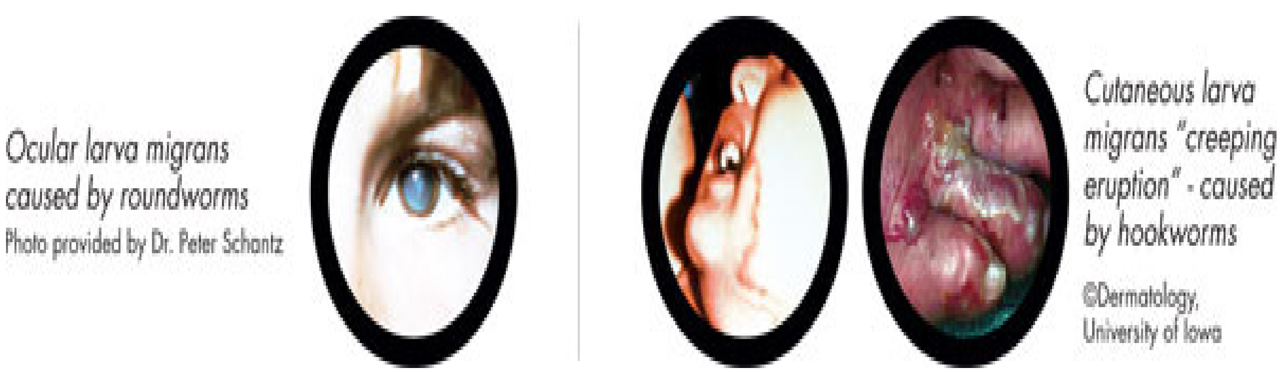


Figure 3: Clinical effects of toxocariasis and hookworms in man.

Source: (Schantz, 1989)

Echinococcosis

Echinococcosis/hydatidosis is a zoonotic parasitic disease caused by the dog tapeworm *Echinococcus* and its larval stage, the hydatid cyst. This parasite is found worldwide and causes serious public health problems in certain parts of the world (Schantz, 2002). In addition, there are economic losses from the condemnation of affected organs. Echinococcosis is a cyclozoonosis that requires two vertebrate hosts to uphold the life cycle. Humans can accidentally become intermediate hosts by ingesting the eggs of the tapeworm. While most cysts develop in the liver and lungs, other organs and tissue may become affected (Soulsby, 1982). The adult echinococcus is considered to be rather harmless to the definitive host (dog), except when it occurs in large numbers, which may cause severe enteritis. Post-mortem examination is the most reliable method of diagnosis (Gasser *et al.,* 1990).

In humans the hydatid cyst is normally well tolerated until its development results in pressure on adjacent tissue or organs. The cyst may also burst into the peritoneal or thoracic cavity, which can cause anaphylactic shock or give rise to many new cysts (FAO, 1982).

Strongyloides

S. stercoralis is a nematode that is sometimes referred to as the human threadworm. While humans are the principal hosts, dogs and nonhuman primates can also be infected and act as reservoirs for human infection. Found worldwide and favors warmer tropical and subtropical climates. Worms can be free-living in the soil or live in a host. There are numerous reports of S. stercoralis in the faeces of dogs, most from tropical and subtropical regions, with reported prevalence's of larvae in faeces ranging from 0% to 58% (Itoh *et al.,* 2009; Paulos *et al*., 2012). Infections are more common in young animals, particularly puppies in pet stores and breeding kennels, because of close mixing of young puppies and greater environmental contamination. It can be a cause of chronic disease in kennels. It is possible that *S. stercoralis* is under diagnosed because of infrequent and low - level shedding of larvae and the infrequent use of techniques that would detect larvae (Itoh *et al.,* 2009; and Weese *et al.,* 2011).

Human infections usually result from the penetration of infective larvae through the skin, after contact with soil contaminated with human and dog faeces. Direct contact with feces containing infectious larvae and fecal – oral infection can also occur. Hyperinfection syndrome occurs as a result of "accelerated autoinfection" from filariform larvae. This is a rare but potentially devastating syndrome that can occur in immunocompromised individuals, particularly people with HIV/AIDS, Tuberculosis and young's (Macpherson *et al*., 2000b; and Weese *et al.,* 2011).

Trichuris

The most important feature regarding infection with ***Trichuris*** is the longevity of the eggs in the environment; up to five years, survival has been recorded in a humid and warm climate. Once Trichuris eggs have been passed, under optimal conditions they will only reach infectivity in three to four weeks, hence removal of all faeces frequently will avoid environmental contamination and re-infection (Dunsmore and Shaw, 1990).

Trichuris vulpis species have been discovered in the intestinal tracts of humans, sometimes producing severe signs of intestinal disease and diarrhea. Now, it could be expected that humans infested with these 'animal-specific' whipworms of dog would be on immune suppressed people (HIV-ADIS patents and elders), people on farms, and children of animal owners (Macpherson *et al*., 2000b).

Dipylidium

The definitive hosts of Dipylidium include dogs, cats and wild carnivores; humans are Occasional hosts. Flea (*Ctenocephalides canis* (dog flea) and *Ctenocephalides felis* (cat flea).) and biting lice (*Trichodectes canis*), and the dog and cat become infected through the ingestion of these intermediate hosts. Adult tapeworms cause little harm in dogs and cats (Bowman *et al*., 2003) and prevention of infection is by keeping pets free of fleas (Molina *et al*., 2003).

2.1.2. Prevalence of Zoonotic GI Helminth Parasites from Pets' in Ethiopia

Systematic animal diseases surveillance, monitoring and control have not been addressed well in almost all developing countries including Ethiopia as part of an effort to reduce the heavy socio-economic cost of the major diseases endemic to or threatening the region (Malgor *et al.*, 1996). Fragments of research done in the area of zoonotic GI helminthes from pets in various parts of Ethiopia are summarized here under.

In and around Debre Zeit, Yacob *et al.* (2007) conducted examination of 100 fecal samples and 20 dogs necropsy to determine the frequency of GI nematode infections of dogs. The coproscopical examination revealed 32% infection with *Ancylostoma caninum* followed by *Toxocara canis* (21%), *Spirocerca lupi* (7%) and *Trichuris vulpis* (3%), while postmortem examination showed 70, 45, 23.5 and 5% infection, respectively.

In Ambo, Endrias *et al*. (2010) reported GI helminth infection prevalence of 86.54% and 52.86% using postmortem and coprological examination in dogs, respectively. The coproscopical examination revealed 35.7% infection with *Ancylostoma caninum* followed by *Dipylidium caninum* (25.57%), *Toxocara canis* (17.14%), *Strogyloides stercoralis* (14.29%) and *Echinococcus granulosus* (8.57%). On the other hand, 86.54% of the necropsied dogs were found positive for one or more species of adult parasites and the specific species found were *Dipylidium caninum* (71.15%), *Ancylostoma caninum* (50%), *Strongyloides stercoralis*(40.38%), *Toxocara canis* (17.3%), *Echinococcus granulosus* (17.3%), *Trichuris vulpis* (3.8%) and *Spirocerca lupi* (1.9%).

In Jimma town, Degfu *et al*. (2011) examined 334 dogs to determine the occurrence and prevalence of zoonotic gastrointestinal helminth parasites in household dogs. Among the dogs examined, helminth parasite infection was detected in 215 (64.4%) dogs, and the species of helminth parasites found with their relative frequencies were: *Ancylostoma caninum* (58.8%), *Toxocara canis* (25.8%), *Dipylidium caninum* (25.8%), *Taenia* spp. (18.3%), *Toxocara leonina* (16.8%) and *Trichuris vulpis* (0.6%).

Jones *et al*. (2011) examined 269 fecal samples and 13 necropsy of dog and also used questionnaire survey on 50 households to estimate the prevalence of dog gastrointestinal parasites and risk perception of zoonotic infection by dog owners in Wondo Genet, Southern Ethiopia. Their results indicated that no trematodes were found in the intestine of these dogs. The following cestodes were identified: *Echinococcus granulosus* (61.5 %), *Taenia pisiformis* (74.7%), *Taenia hydatigena* (69.2%), *Taenia ovis* (30.8%), *Dipylidium caninum* (46.8%) and *Mesocestoides* (84.6%). Other intestinal worms in dogs were *Toxocara canis* (53.9%), *Tirchuris vulpis* (70.3%) and *Ancylostoma caninum* (73.9%).

In Hawassa town, Paulos *et al.* (2012) examined 455 fecal sample of dog with the aims of determining the prevalence of intestinal helminths of dogs and evaluating owner's awareness about zoonotic dog parasites. The result revealed that *Strongyloides stercoralis* (58%), *Ancylostoma caninum* (49.9%), *Dipylidium caninum* (39%), *Toxocara canis* (25.1%), *Echinococcus granulosus* (8.4%) and *Tirchuris vulpis* (3.3%), and only 13.2% were free of above helminths.

In Illubabore zone, Legesse (2001) examined 221 civet cats from 29 civet cats farms to determine the management, production and health problems of civet cat in captive. Their result indicated 83(68.6%), 68(57.1%) and88 (72.7%) civet cats positive for nematode, cestodes and protozoa, respectively. *Ancylostoma caninum* (40.5%) were the most frequent among helminthes detected in their study.

Summary of reports of helminthes infection of pets from different parts of Ethiopia are indicated in Table 3.

Table 3: A summary on prevalence of zoonotic GI helminth Spp. infecting pets in Ethiopia

Study area and animal	**Sample size**	**Prevalence (%)**								**Reference**
		Ac	**Tc**	**TL**	**Eg**	**Dc**	**Ts**	**Tv**	**Ss**	
Debre Zeit Dog	100 Faecal	32	21					3		Yacob *et al., 2007*
	20 *PM*	70	45					5		
Ambo town Dog	70 Faecal	35.7	17.14		8.57	25.6			14.3	Endrias *et al*., 2010
	52 *PM*	50	17.3		17.3	71.2		3.8	40.4	
Jimma town; Dog	334 Faecal	58.8	*25.8*	*16.8*		25.8	18.3	0.6		Degefu *et al*., 2011
Wondo-Genet Dog	269 Faecal	73.9	53.9			46.8	74.8	70.3		Jones *et al*., 2011
	13 *PM*	53.8	61.5		61.5	76.9	9.2	53.8	46.1	
Hawassa Dog	455 Faecal	49.9	25.1		8.4	39		3.3	58	Paulos *et al*., 2012
Illubabore Cat	221 Faecal	40.5								Legesse, 2001

Ac=*Ancylostoma caninum*, Tc = *Toxocara canis*, Dc= *Dipylidium caninum*, TL= *Toxocara leonina,* Tv = *Trichuris vulpis,* Eg = *Echinococcus granulosus,* Ss = *Strongyloides stercoralis,* PM= postmortem inspection and Ts= *Taenia species.*

2.1.3. Potential Risk Factors Associated with GI Helminthes Zoonoses from Pets

The risk of infection in humans can be difficult to predict, based solely on the pets' clinical presentation. It is common for a household pet to carry a zoonotic disease and be asymptomatic or demonstrate non-specific symptoms *(*Smith and Whitfield, 2012)*.* These are due to most of the parasites affect the pets sub clinically and pets may harbor a wide range of parasites with zoonotic potential; thus, causing a health risk to humans. In areas of high population density such as urban and peri-urban, pets keeping practices may also be a risk to the transmission of zoonoses, some of which could be of parasitic origin (Khante *et al*., 2009). The major risk factors affecting epidemiology of helminthosis can be classified broadly as parasite factors, host factors and environmental factors (Thrusfield, 2005).

The host risk factors associated with GI helminthes zoonoses dissemination are those pets include Puppies, kittens, pregnant and nursing pets are at highest risk for these infections, and therefore responsible for most of the environmental contamination and human disease(Duwel and Strasser, 1978). Population at risk of this zoonotic helminth includes immune-compromised elderly people, young peoples, diabetics, people with HIV-infection, pregnant women and people with specific occupational health risk such as farmers, kennel workers and hunters. (http://www.esccapuk.org.uk/professionals.php?run=zoonoses). Children/ babies are more likely to become infected in part because they are more apt to play in contaminated areas or put dirty objects in their mouths (**Figure** 3). Almost 73% of pediatricians in the US reported cases of children with parasitic infection (Kazacos, 2000).

Witold *et al.* (2012) determined risk factors for the spread of parasitic zoonoses among dog owners and their families in rural areas, Poland. That poor sanitary habits and/or among them unsanitary living conditions, making light of pets' diseases, unsatisfactory veterinary care, lack of proper care for dogs and allowing them to interact with wild animals and stray animals, their faeces and contaminated soil as well as too close dog-human contacts, may increase the risk of transmission. Results of Jones *et al*. (2011) in Ethiopia indicated that very few households (22%) were aware that canine parasites could be transmitted to humans but none of them could provide correct information on the mode of transmission. None of the dog owners had treated their dogs using anthelmintics. Almost all owners had fed their dogs' raw carcass of a dead animal and condemned offals. Stray dogs revealed 90.7% of them were infected with at least one intestinal helminth parasite.

Pfukenyi *et al.* (2010) reported that in Zimbabwe the proportion of pet owners who knew helminths as zoonoses in dogs (21.3%) and cats (1.1%) was low compared to rabies (95.7%) with ancylostomosis (4.3%) and toxocariosis (2.1%) being the specific parasitic zoonoses known to occur in dogs and toxoplasmosis (2.1%) in cats. More than 50% of the pet owners indicated that veterinarians never discussed the potential hazards of zoonoses or discussed it only when asked and 33% indicated that veterinarians initiated discussion of the subject whenever zoonoses were diagnosed in pets. Over 90% of the pet owners indicated that veterinarians should discuss zoonoses with them.

Toxocara seroprevalence differed by sex, age, poverty level, geographic location, pet ownership, household crowding and education. Persons > 20 years of age who reported being involved in a soil occupation, such as farming and agriculture, had a seroprevalence of 25.5% compared with 13.5% for those persons not involved in these types of occupations (Won *et al*., 2008).

2.2. Control Practices for Zoonoses from Pets

Generally, to control either pet zoonoses, which are current and main source of many emerging and reemerging zoonotic disease outbreak or any zoonotic diseases, three key points have been suggested by Metre D. V. from Colorado state university. These three step processes include: firstly prevention with vaccination, parasite control and basic biosecurity, secondly appropriate sanitation / hygiene practices that includes cleaning and disinfecting animal areas as needed, hand washing and eating or drinking not in animal facilities, and finally early diagnosis and treatment of both people and animals. (http://www.extsoilcrop.colostate.edu/Soils/powerpoint/Cla/ZoonoticDiseases.pdf; Riley and Chomel, 2005; Knobel *et al.,* 2008)

2.2.1. Prophylactic Anthelmintic Treatment

Anthelmintic treatments are most effective when they are initiated early and targeted at pets especial to highest risk groups. While it has long been recognized that transplacental and transmammary infection of ascarids and hookworms could be prevented through prophylactic treatment of pregnant dogs, no drugs are currently approved for this use. However, the effectiveness of this approach with different drugs approved for parasite control in dogs has been well documented. Daily treatment of pregnant dogs with fenbendazole from the 40th day of gestation through the 14^{th} day of lactation has been shown to inhibit *T. canis* larvae in tissues, thereby preventing or greatly reducing the incidence of infection in puppies (Duwel and Strasser, 1978). Alternatively, studies have shown that treatment with ivermectin on day 0, 30, and 60 of gestation and 10 days post whelping reduced the adult *T. canis* worm burden in pups by 100% and prevented the shedding of eggs. In yet another study, treatment with selamectin at 10 and 40 days both before and after parturition was effective in reducing *T. canis* fecal egg counts in both pups and their dams and adult worms in the pups (Payne *et al*., 2000; Payne and Ridley, 1999). If the mother did not receive prophylactic treatment, puppies and kittens must be treated early and repeatedly in order to prevent patent infections. In areas where both ascarids and hookworms are common, begin treating both puppies and their mothers with an age-appropriate anthelmintic at 2, 4, 6, and 8 weeks of age. Some experts recommend extending this treatment to 12 weeks and then treating monthly until the pet is 6 months old (Stoye, 1992).

Because most puppies and kittens are not routinely brought to a veterinarian before 6-8 weeks of age, they will already have patent infections and be actively contaminating the environment. For this reason, it is important to reach out to clients who have pregnant or newly born animals at home and provide these animals with early prophylactic treatment for intestinal parasites. Early identification of these high-risk animals will provide the veterinarian with the opportunity to educate the owners on the public health risks, provide them with an appropriate anthelmintic, and advise them on how and when to administer it to their pets at home. This approach to treatment is justified by the frequency with which puppies and kittens acquire intestinal parasites from their mothers and the difficulties that exist in early diagnosis. There are a variety of anthelmintic drugs available that are safe and effective against ascarids, hookworms, and other intestinal helminthes of dogs and cats **Table** 4 (Schantz, 2002).

Mature animals can also be monitored through biannual or yearly diagnostic stool examinations and treated with anthelmintics directed at specific intestinal nematodes. Treatment with anthelmintics is needed, even for animals with negative stool tests, besides adopting a control of the number of animals in public places in order to decrease the likelihood of environmental contamination, since this parasite represents a potential hazard to human and animal health (Weese *et al.,* 2011).

Table 4: Drugs for the treatment of GI helminth infections in dogs and cats.

Name of Drugs or (Antihelmentics)	Administration Route / Frequency/ Dose	Range of Efficacy	Pet Spp.	Minimum age/weight
Diethylcarbamazine citrate	Oral 6.6 mg/kg daily	DI	Dog	8 weeks and above
	55–110 mg/kg once; repeat in 10–20 days	A		
Diethylcarbamazine or Oxibendazole	Oral/daily 6.6 mg/kg (Diethylcarbamazine) 5.0 mg/kg (Oxibendazole)	A, H, W, DI	Dog	8 weeks and above
Fenbendazole	Oral/daily for 3 days 50 mg/kg	A, H, W, T	Dog	None
Ivermectin or Pyrante Pamoate	Oral/monthly 6 micrograms/kg (Ivermectin) 5 mg/kg (Pyrante Pamoate)	A, H, DI	Dog	6 weeks and above
Moxidectin	SC/twice yearly 0.17 mg/kg	H, DI	Dog	6 months
Piperazine	Oral/discretionary See label for dose	A	Dog/Cat	6 weeks and above
Pyrantel pamoate or Praziquantel or Febantel.	Oral/discretionary 5 mg/kg (Pyrantel pamoate) 20 mg/kg (Praziquantel) 25 mg/kg (Febantel)	A, H, T, A, H, E	Cat	1 month and above
Selamectin	Topical/monthly 6 mg/kg	DI	Dog	6 weeks and above
		A, H, DI	Cat	

Source: (http://www.cdc.gov/ncidod/diseases/roundworm/roundworm.htm and Foreyt, 2001).

A = *ascarids (Toxocara* and *Toxascaris spp.);* H = *hookworm (Ancylostoma* and *Uncinaria spp.);* W = *whipworm (Trichuris vulpis);* T = *Taeniid tapeworms (Taenia pisiformis, Taenia taeniaeformis, Taenia spp.);* D= Flea tapeworm (*Dipylidium caninum;* E = *(Echinococcus granulosus, Echinococcus multilocularis);* DI = *Dirofilaria immitis.*

2.2.2. Educating and Counseling Pet Owners in Preventing Zoonotic Diseases

Figure 4: Childrens have property of playing with dirt, sand and contaminated soil and risk of being infeccted.

Source : (http://www.cdc.gov/ncidod/diseases/roundworm/roundworm.htm)

Important preventive measures for pet owners include: Detailed understanding of ascarids and hookworms that infect dogs and cats, early signs of illness, and information about when pets are at greatest risk for infection (in utero and when nursing), practicing good personal hygiene, particularly washing hands after handling pets and before eating food, controlling pet parasite infections through repeated treatments and/or regular diagnostic testing, preventing infection by reducing, where possible, the risk of the pet acquiring infection or prophylactic treatment of pregnant and nursing pets and their offspring can protect their pets from becoming infected, thus preventing them from shedding eggs into and contaminating the environment, cleaning up pet faeces regularly to reduce environmental contamination with infective parasite stages. Don't dispose of the faeces or cat litter in recyclable waste or compost, minimizing exposure of children in particular to potentially contaminated environments and teaching them for good personal hygiene. Keep their nails short, grooming dogs regularly to minimize the risk of coat contamination with worm eggs and finally keeping children away from areas that may be contaminated with pet feces and detailed understanding on how ascarids and hookworms cause disease in humans, especially in children whose play habits and attraction to pets put them at increased risk (http://www.cdc.gov/ncidod/diseases/roundworm/roundworm.htm; Macpherson *et al*., 2000b; ESCCAP., 2010; and Jones *et al*., 2011).

2.2.3. Pet Owner and Community Education

Protocols for the control of parasitic infection should be communicated to veterinary and para-veterinary staff and consistently applied. Awareness of parasitic zoonoses, including clinical manifestations in people and particularly children, should be created as a minimum in the medical profession through information brochures. Cooperation between the medical and veterinary profession should be encouraged wherever possible and its benefits underlined in case of zoonoses. Pet owners should be informed about the potential health risks of parasitic infection, not only to their pets but also to family members and all people living within the action radius of their pets. Brochures in veterinary practices, pet shops, posters or specific websites are useful tools to facilitate this. Regular deworming or joining "pet health-check programmes" should be made clear to the general public by veterinary surgeons, veterinary nurses and other animal health professionals (e.g. by wearing clear coloured fobs associated with a calendar year). Responsible dog and cat ownership can remove public health concerns (ESCCAP, 2010)

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in Hosanna town, capital of Hadiya zone, Southern Nations Nationalities and People Regional State (SNNPRS), Ethiopia. Hosanna is located at 7.58(7° 34’ 60 N Latitude and 37.88 (37° 52’ 60E) Longitude, 232 Km away from Addis Ababa, in the south direction. The area has an altitude of 2100–2340 masl and exhibit a bimodal rainfall system (long and short rainy seasons). The long rainy season extends from June to September, whereas the short rainy season ranges from March to April. The annual rainfall is 950–1200mm while the maximum and minimum annual temperature is 25°C and 13°C respectively. The major soil type is clay loam. The town have an abattoir that is not fenced well, thus dogs get access. With an estimated human population of 100,000 inhabitants and the total animal population comprise cattle (8703), sheep’s (2650), goats (1327), chicken (10132), dogs (1889), cats (1932), donkey (1577), horse (35) and mule (9) (Tile, 2012 and HTAO, 2013).

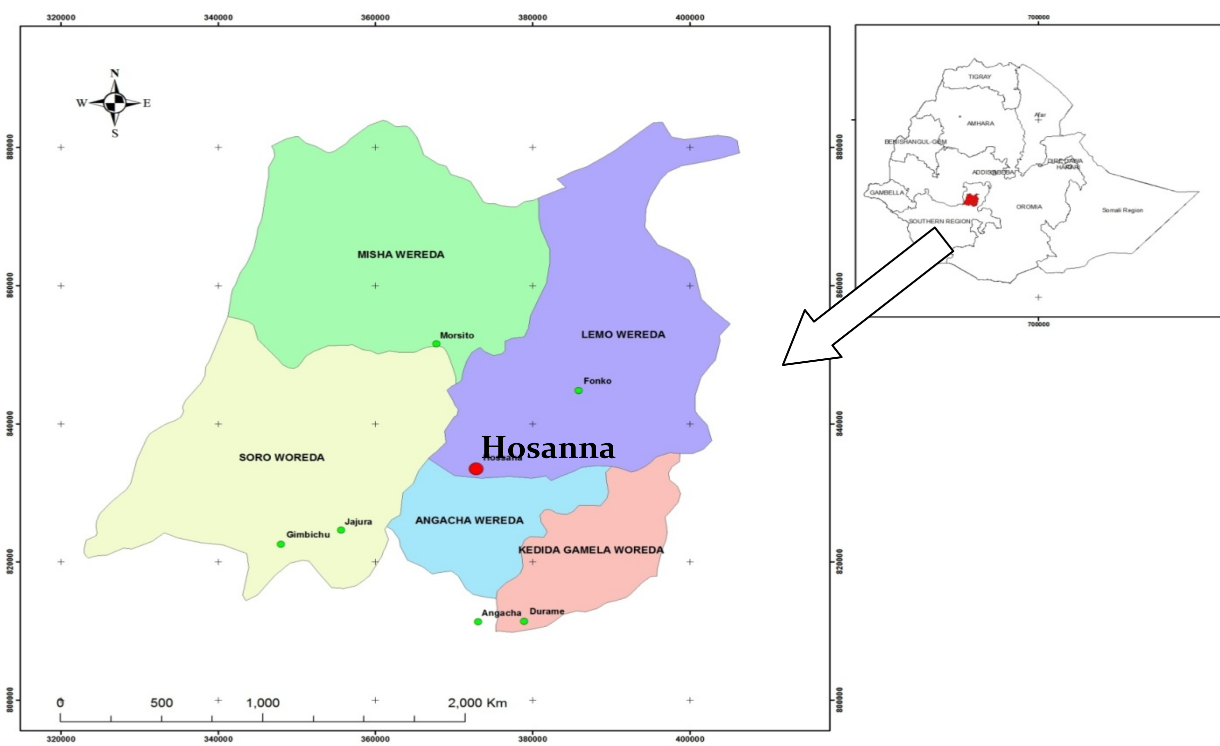


Figure 5: Geographical location of the study area, **Source: (**Tile, 2012**).**

3.2. Study Population

The sampling units were all local and exotic breeds of household dogs of both sex and all age groups (young and adult) from Hosanna town (**annex I**).

The study populations used to study helminth parasite in human were all young children below 15 years old age living in the resident having dog, due to their high close contacting property with dogs and contaminated soil and also their low immune resistance of both sexes (Macpherson *et al*., 2000b; Cisneros and Rendon, 2007).

The study populations for the questionnaire survey were dog owners of different localities within Hosanna town, having different age, sex and educational background.

Soil samples were purposively collected from the different children plays ground, abattoir for beef animal slaughter and market areas (due to adjacent to abattoir and children also play over there) in Hosanna town, was selected as relatively high dog and people population coexist.

The number of people who visited the different human health clinics found at Hosanna town was used as a study population for retrospective study on gastrointestinal infection among the population.

3.3. Study Design

Cross-sectional studies were carried out to determine the prevalence of gastro intestinal helminths parasites in human and dogs using parasitological technique. Retrospective studies or data gathering were carried out from the official clinical casebooks previously recorded data from human health centers.

A questionnaire (**Annex II**) survey was also applied to assess the risk factors associated with helminth infection in human and dog. Both open-ended and closed type questionnaires were applied to interview individual household head or in groups. The questionnaires were pre-tested in the field before administrating to the study population.

3.4. Sample Size Determination and Sampling Methods

3.4.1. Sample Size Determination

Dog

Sample size for faecal examination from dogs was determined by using sample size determination formula of Thursfield (2005), as indicated below:

$N = (1.96)^2 \times PQ/ D^2 \approx 129 \approx 129 * 2 \approx 258$.

Where N is the required sample size, P = is expected prevalence= (90.7%) by Jose *et al*. (2011) from Wondo Gent, Southern Ethiopia through coprological study, Q is 1-P, D is the level of precision (5%) and 1.96 is to indicate 95% confidence level. Actually, the sample size is doubled to obtain 258 for the purpose of increasing the precision of the study. By adding 5% for non-response, a total of 270 subjects were included. However, 10 (3.7%) subjects were excluded because of incomplete data a total of 261 subjects were enrolled in the study.

Human

Sample size for human stool examination was determined by using previous similar study expected prevalence (82.4%) by Alemu *et al.* (2011) in Zarima town, Northwest Ethiopia. By using the same sample size determination formula like the dog above, were given us 223 individuals. Similarly, by adding 20% for non-response, a total of 267 individuals were included. However, 6(2.24%) subjects were excluded because of incomplete data or inabilities to provide stool sample a total of 261 individuals were enrolled in the study.

Using the same formula like the dog and fitting expected prevalence of 50% (no previous done study), which were given us 384 individuals for questioner interview of head of household who own dogs and if head not present other family member were selected.

Soil sample

Soil samples were collected purposively from an area of children plays ground or any area with high dog and people contact. Then by considering these, in Hosanna town seven areas were commonly known, that includes a single abattoir not fenced well and easily accessed by a number of dogs, a market area (for animals sale or purchase in a week once and the rest days occupied by dogs, due to being adjacent to abattoir to feed on offal's of animal slaughtered and also it is area for children plays), three separate common children play grounds in different position with respect to dogs existence and finally from gofermeda area due to small /minor market and plane marshal public area and continuously visited by dogs.

3.4.2. Sampling Methods

For the purpose of this particular cross sectional study, households which owned dogs in the Hosanna town were first identified as a sampling frame then a systematic random sampling was employed to select a household. According to information from Hosanna town agricultural office, a total of 1889 dog population are owned by 1536 households. To identify households for collection of questioner data and stool sample from human and dog, randomly every fourth household was selected to get sample size calculated. In each selected household a single faecal sample from dog and household family member were collected for laboratory examination. In addition, questioner prepared for the study were administered to all household heads or others family members in the absence of the house head.

Soil samples were collected purposively from the different children playground, abattoir and market areas in Hosanna town. In addition previously recorded laboratory results of faecal samples data from all governmental and private human clinics were used.

3.5. Study Methodology

3.5.1. Parasitological Procedures

Collection and examination of dog and dog owner's faecal/stool samples

Fresh fecal samples were collected from 261 house hold dogs and owners by systematic random sampling methods as described above in sampling methods. The fecal samples were collected at a specimen collection tubes in the morning time, and before collection the tube were labeled to identify one another and 10% formalin were added to preserve until processing (Jose *et al*., 2011). Then faecal samples were submitted or transported from households to Hosanna collage of health science, medical laboratory for preparation and evaluation. The faecal samples were assessed visually to check presence of proglitids to categorize the sampled animal as *Taenia* species positive or negative then after samples were stored until conducting parasitological techniques. The sedimentation and floatation technique (**annex I**) as described by Soulsby (1982) and Urquhart *et al*. (1987) were used to detect the presence of stomach and intestinal parastic eggs (cestodes and nematodes) in the samples. For the parasitic load of helminth parasites eggs of each faecal sample were examined by the standard McMaster technique (**annex I**). After preparation immediately each faecal sample/slides was examined microscopically for parasite egg identification by using 10×10 magnification of light microscope. All helminth eggs were identified based on their morphological characteristic described by (Thienpoint *et al.,* 1998 and Taylor *et al.,* 2007).

Collection and Examination of Soil Samples

Soil samples were collected purposively from an area of relatively high populations of dogs and childrens coexist. Down to a depth of not more than 3 cm by 10 cm surface, with each sample weighing an average of 200 g as described by Dado *et al.* (2011) from an area of suspected at risk like abattoir area, market area, children play grounds. To represent that place/plot/area the samples were collected from corners and centers of total area (5 sites) with various distances between sampled sites as per the wideness of the area (annex **I**). Then collected soil samples were dried at room temperature and filtered through a set of two sieves with pore widths of 4 and 1 mm (Angulo-Madero *et al.,* 1987). Afterwards, a 5-10 g sample was analyzed using coprological methods (**Annex I**). Finally, the ova/larvae of helminth parasites were identified with reference to atlas of parasitology or their structures described by (Thienpoint *et al.,* 1998 and Taylor *et al.,* 2007).

3.5.2. Retrospective Survey

Laboratory diagnostic records of humans data from 2008 – 2012 were collected from different human health clinics/hospitals found in Hosanna town, comprising Nigest Eleni Mohammad Government Hospitals and two Private Medical clinics (Hiwot and Myo-Mybrathers). Record of helminth investigation and demographic details of the patients including age, sex, address, and date of test were obtained. All laboratory results with confirmed helminthes species were taken with some exclusion criteria like incomplete or not clear records, cases presented from out of study area, and some recently established clinics.

3.5.3. Questionnaire Survey

Structured questionnaires were designed to assess the knowledge, attitude and the practice of dog owners on zoonoses from dogs in Hosanna town. The designed questionnaire were helped to gather information on the dogs' demographic characteristics (age, gender, and breed), dog ownership, the occupation of the dog's owner, purpose of keeping dog, feeding of dogs, treatment for dogs, the extent of awareness on dog parasites, history of deworming, control measures taken and other related factors (**Annex II**). In this, individual interviews of the household heads or some other family member in the absence of the household heads were used.

Ethical consideration

The purpose of this study was explained to the intended study human population and verbal consent were obtained from them before stool sample collection.

3. 6. Data Analysis

Collected data entered into Excell sheets and analysis was done by statistical package for social science (SPSS version 16.0). Descriptive statistics and logistic regression were used to analyze the risk factors and its association with helminths parasitism. Associations between parasitism and categorical factors were compared using chi-square tests for independence. The point prevalence for both human and dog parasites were calculated for all data as the number of infected individuals divided by the number of individuals sampled × 100. Categorical data were analyzed first with the Chi-square ($\chi 2$) test for independence as a screening process. This test was followed by stepwise multivariate logistic regression, to account for confounding variables and interactions. For analysis of continuous data (faecal egg count), t-test for independent samples was used to compare means of two groups whereas ANOVA was used to compare means of three or more groups. A P value < 0.05 was required for significance. Odds ratios (OR) were determined from the coefficients in the logistic regression.

4. RESULTS

Socio-demographic Characteristics

A total of 384 households both female 185 (48%) and males 199 (52%) with age of 14 to 83 years old and average age of 25 years old in the Hosanna town were interviewed. Out of 384 respondents' only 87(22.6%), respondents' have some awareness on transmissible helminths between human and dog from different responsible parties like: Veterinarian 18 (4.6%), Medical doctors 4(1.04%), other health department 11(2.8%), television media 15(3.9%), radios 3(0.8%), Magazines 7 (1.8%) and family or friends 29 (7.5%). Finally, among 384 owners interviewed, 261 owners were able to provided or collected stool/faecal sample (from owners and dog's) for further investigation and the results with different risk factors are presented under (**Table** 6 & 7).

4.1. Gastrointestinal Helminth Parasites in Dogs

4.1.1. Overall Prevalence of Helminth Infection and Species of Parasites Identified in Dogs.

Based on coproscopy examination, out of the 261dogs' faecal sample examined, the overall prevalence of intestinal helminth parasites eggs was 71.6% (n=187).

During the study period the following species of helminth parasites were identified, with their decreasing order of abundance in the household dogs of Hosanna: *A. caninum* followed by *T. canis*, *T. leonina*, *Taenia* species, *S. stercoralis* and *T. vulpis* with a statistically significant variation (χ^2 = 365, df = 5, p = 0.000) *and* all of them known to have zoonotic important (**Table 5**).

Table 5: Species of Helminth parasites identified in household dogs of Hosanna town (n= 261) and their prevalence.

Species of Parasite identified	**No Positives**	**Prevalence (%)**	**95%CI**	**χ^2, p-value**
Ancylostoma species	124	49	41.3-53.7	
Toxocara canis	89	34	28.3-40.2	
Strongyloides stercoralis	7	2.6	1.1-5.4	365.5,(0.000)
Toxocara leonina	19	7.2	4.4-11.1	
Trichuris vulpis	5	1.9	0.6-4.4	
Taenia species	11	4.2	2.1-7.4	
Overall	187	71.65	65.75-77.03	

Among the 187 dogs positive for helminth infection, 66.3%, 30.6% and 3.1% of them were infected with one, two and three helminth species respectively (**Figure 6**). All of the five animals infected with three species of helmenth were found to harbor: *T. canis, A. caninum* and *T. vulpis*. Among the 58 dogs found to be infected with two species: forty-five, nine and three of them were infected with *T. canis* and *A. caninum*, *Strongloides* species and *T. canis*, and *T. leonina* and *T. canis* at the same time, respectively.

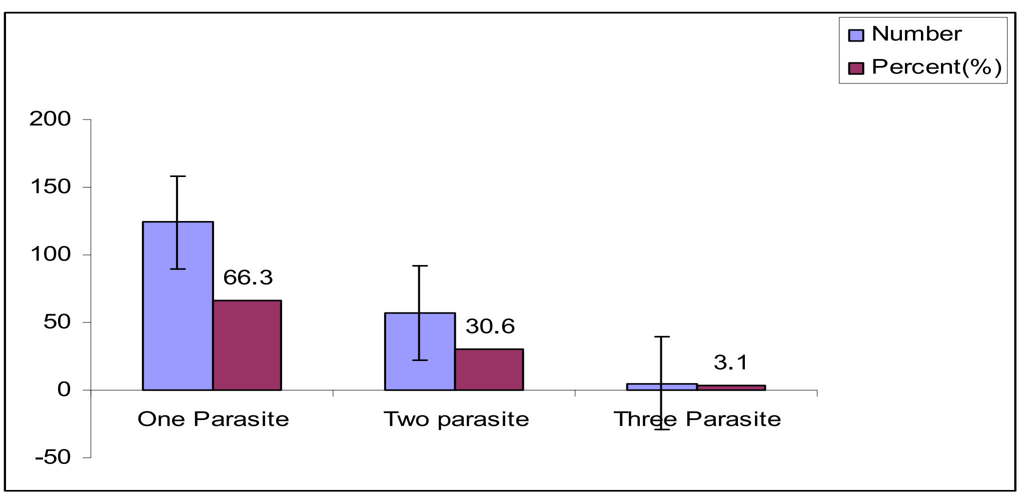


Figure 6: The number (with SD error) and percentage of dogs infected with one, two and three helminth species among the 187-helminth infection positive animals.

Gastrointestinal helminth parasitic prevalence in different kebeles of Hosanna

The overall prevalence of gastrointestinal helminth parasite in the different kebeles of Hossana town is depicted in (**Figure 7**). Relatively a high prevalence was recorded from faecal samples collected from Arada and Meni-Amba kebeles', however no statistical variation was observed among the eight kebeles ($\chi^2 = 11.41$, df = 7, P = 0.11).

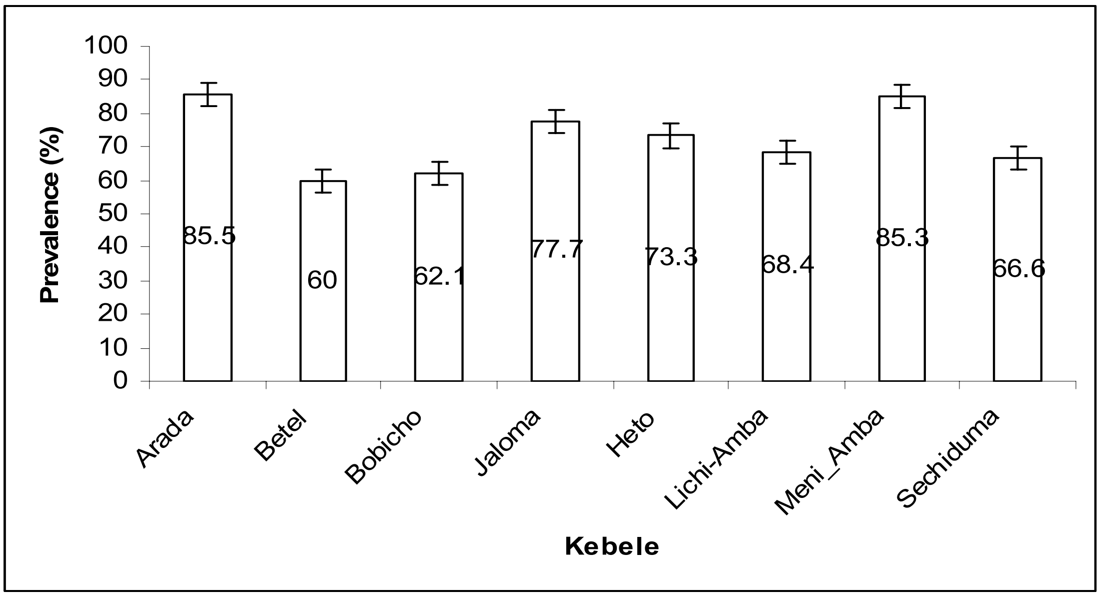


Figure 7: The overall prevalence of gastrointestinal helminth infection in dogs living in different kebeles of Hosanna town

EPG result or density

The overall density or mean EPG counts (EPG ± Std. Err) for *A. caninum*, *T. canis, S. stercoralis* and *T. leonina* were 734 ± 497.9, 1452.8 ± 1087.5, 700 ± 325 and 842.8 ± 271.6. Upon one-way analysis of variance (ANOVA) a statistical significant variation was observed among the mean faecal egg count each parasite species identified in this study (F= 12.87, P = 0.000)

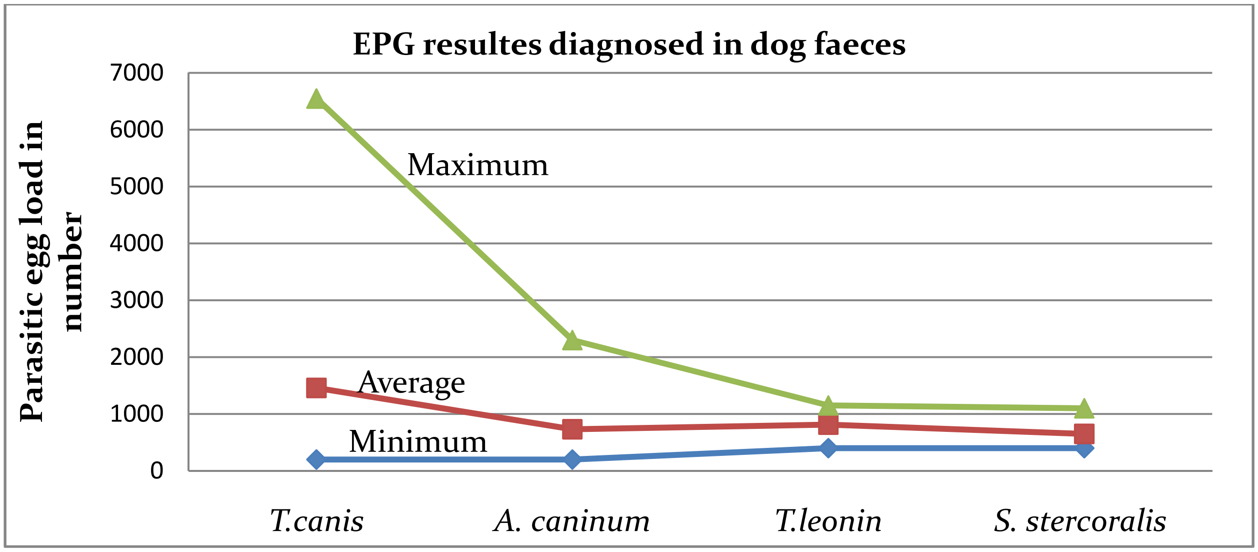


Figure 8: The minimum and maximum helminth parasitic egg loads in different species in infected dogs.

4.1.2. Assessment of the Effect of the Different Risk Factors Considered for the Helminth Parasitism in dogs.

Simple bivariate and multivariate analysis was used to determine which risk factors were associated with the risk for infection with intestinal helminth parasites in dogs. The results are presented as chi-square with their p-value and odd ratios with 95% confidence interval.

Age of dogs and prevalence of gastrointestinal helminth parasites

In this study, the dogs were classified in to three age groups, less than one, between one and three and greater than three years. As it is presented in **Table** (6) the prevalence was found to be high (80%) in very young dogs (< 1 year) with no statistical significance variation. Its OR (1.94) estimate that gastrointestinal parasitism was approximately 2 times as likely to occur among dogs less than one year than among those between one and three and greater than three years.

The analysis of the result showed that dog faecal samples' taken from Catholic households showed a high frequency (90%) of helminth parasitism when compared to parasitism in dogs kept at Orthodox and Protestants (**Table 6**)

Practice of deworming of dogs and gastro intestinal helminth parasitism

Table (6) describes that dogs which are kept in households who don't practices deworming of their pets were 16 time more infected than households who were deworming their dogs (OR= 16, 95% CI = 7.1 - 35, P = 0.000)

Shelter type used for dogs and parasitism

In this study infection with intestinal helminth parasites was observed to be more common (OR = 3.3, 95% CI = 1.5-7.5) among dogs which share house with the owners than the dogs which are kept in open air, kennel and with livestock and significance variations were observed (p value = 0.022) (**Table 6**).

The result of simple bivariate analysis showed a high risk of helminth infection in dogs which kept by owners who have got no awareness of disease transmission from dog to human than dogs resided in households who have awareness (OR = 2.5, 95% CI = 1.36-4.40, P= 0.002)

No significant association were identified between dog's gastro intestinal helminth parasite infection and the dogs movement (stay at home or spent its day outside home) and weather the dog play with children or not (**Table 6**)

Table 6: Prevalence in dogs with different risk factors (KAPs of dog owners) regarding potential zoonotic intestinal helminthes parasites in Hosanna, south Ethiopia.

Variables or risk factors	Categorical parameters	Total sampled N (%)	Prevalence N (%)	OR(95%CI)	X^2 (p-value)
Age of dog	<1Yr	82 (31.4%)	66 (80.4%)	1.94(0.9-3.8)	4.620(0.099)
	2-3Yr	82(31.4%)	55(67%)	0.96(.5-1.8)	
	>3Yr	97(37.2%)	66(68%)	Refer	
Kebelles'	Arada	28(10.7%)	24(85.7%)	3(0.8-10.6)	11.42(0.112)
	Betel	39(14.9%)	23(58.9%)	0.8(0.2-1.8)	
	Bobicho	29(11.1%)	18(62.1%)	0.82(0.3-2.3)	
	Jalo-naramo	27(10.3%)	21(77.7%)	1.7(0.5-5.-4)	
	Heto	30(11.5%)	22(73.3%)	1.4(0.5-3.9)	
	Lichi-amba	38(14.6%)	26(68.4%)	1.1(0.4-2.8)	
	Meli-amba	34(13.0%)	29(85.2%)	2.9(0.9-9.4)	
	Sechiduna	36(13.8%)	24(66.6%)	Refer	
Religion	Catholic	20(7.7%)	18(90%)	4.3(0.95-19)	4.89(0.087)
	Orthodox	76(29.1%)	57(75%)	1.4(.77-2.66)	
	Protestant	165(63.2%)	112(67.8%)	Refer	
No of dogs owned per Hh	one dog	183(70.1%)	127(69.3%)	Refer	1.524(0.217)
	≥2	78(29.9%)	60(77%)	1.5(0.8-2.7)	
Housing practice of dog	Kennel	107(41.0%)	70(65.4%)	Refer	9.659(0.022)
	Open air	55(21.1%)	37(67.2%)	1.08(0.5-2.1)	
	Mixed with livestock	33(12.6%)	23(69.6%)	1.22(0.5-2.8)	
	Share with family	66(25.3%)	57(86.3%)	3.3(1.5-7.5)	
Treatment for dog	No	219(83.9%)	178(81.2%)	16(7.1-35)	62.14(0.000)
	Yes	42(16.1%)	9(21.4%)	Refer	
Dog spent mainly	Freely movement	110(42.1%)	82(74.5%)	2(0.9-4)	3.236(0.198)
	No free movement	114(43.7%)	83(72.8%)	1.8(0.8-3.9)	
	1/2 in &out side	37(14.2%)	22(59.5%)	Refer	
Awareness on ZIHP	No	196(75.1%)	150(76.5%)	2.5(1.36-4.4)	9.238(0.002)
	Yes	65(24.9%)	37(56.9%)	Refer	
Valid		**261(100%)**	**187(71.5%)**		

4.2. Gastrointestinal Helminth Parasites in Human

4.2.1. Overall Prevalence of Helminth Infection and Species of Parasites Identified in Human. Analysis of the 261 stool sample of subjects revealed an overall prevalence of 17.62% (95% CI = 13.20-22.79) gastrointestinal helminth parasites based on cross sectional study during from October to May, the most frequently observed helminth parasite species in households of Hosanna town was *Hookworm* species (6.5%) followed by *Ascaris lumbercoids* (4.6%), *Hymenolepis nana* (2.7%), *Strongyloide stercoralis* (1.5%), *Taenia* species (1.5%) and *Hymenolepis diminatus* (0.8%) and listed under (**Table 7**).

Table 7: Species of Helminth parasites identified in dogs owners of Hosanna town (n= 261) and their prevalence.

Species of Parasite identified	No Positives	Prevalence (%)	95%CI	Fisher exact p-value
A. lumbercoids	12	4.6	2.06 - 7.14	
Hook worm spp.	17	6.5	3.51 - 9.49	
Hymenolepis nana	7	2.7	0.73 - 4.67	0.000
Strongyloide stercoralis	4	1.5	0.03 - 2.97	
Taenia spps	4	1.5	0.03 - 2.97	
Hymenolepis diminatus	2	0.8	-	
Over all	46	17.6	13.20-22.79	

Kebele wise distribution of gastrointestinal helminth parasitic prevalence in children

The overall prevalence gastrointestinal helminth parasites in the different Kebele's of Hossana town are described here under (figure 8). Relatively a high prevalence was recorded from feacal samples collected from Bobicho and Heto kebeles', however no statistical variation was observed among the eight kebeles (χ^2 = 9.87, df = 7, P = 0.196).

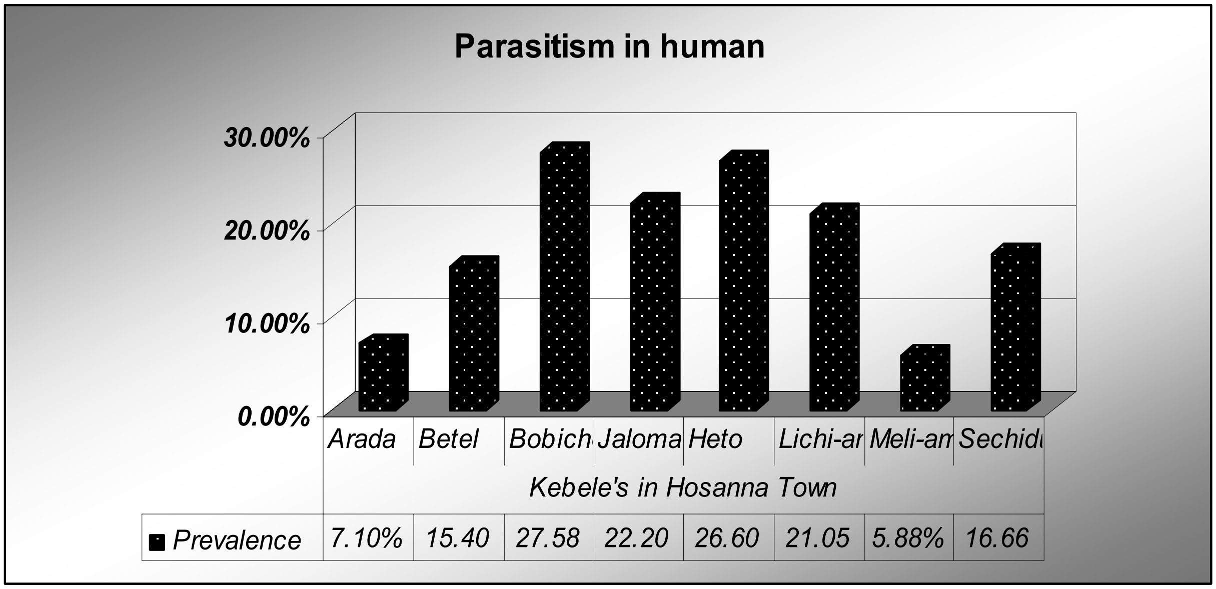


Figure 9: The overall prevalence of gastrointestinal helminth infection in human living in different kebelles of Hosanna town

Based on retrospective survey in medical health centers from both governmental and private clinics revealed that 624 individuals in a 5 years interval were examined for intestinal parasite in different existing diagnostic laboratories comprising 188 cases from Nigest Eleni Mohammad Government Hospitals and 149 and 287 individuals from Hiwot and Myo-Mybrathers Private Medical clinics respectively. From these records, 415 individuals were infected with helminthes parasites comprising 133 cases from Nigest Eleni Mohammad Government Hospitals and 99 and 183 individuals from Hiwot and Myo-Mybrathers Private Medical clinics respectively. The frequency and relative prevalence of intestinal helminthes species were recorded and listed below under (**Figure 10**). The proportion of helminthes in existing medical health center and in different record years including sex of cases were presented under (**Figure 9**)

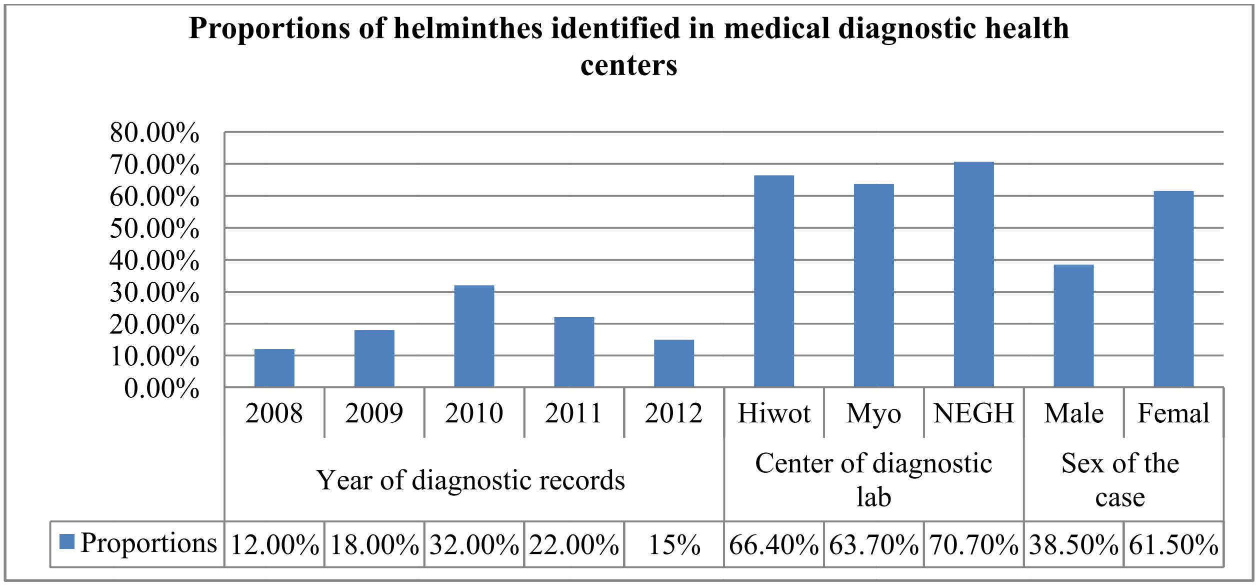
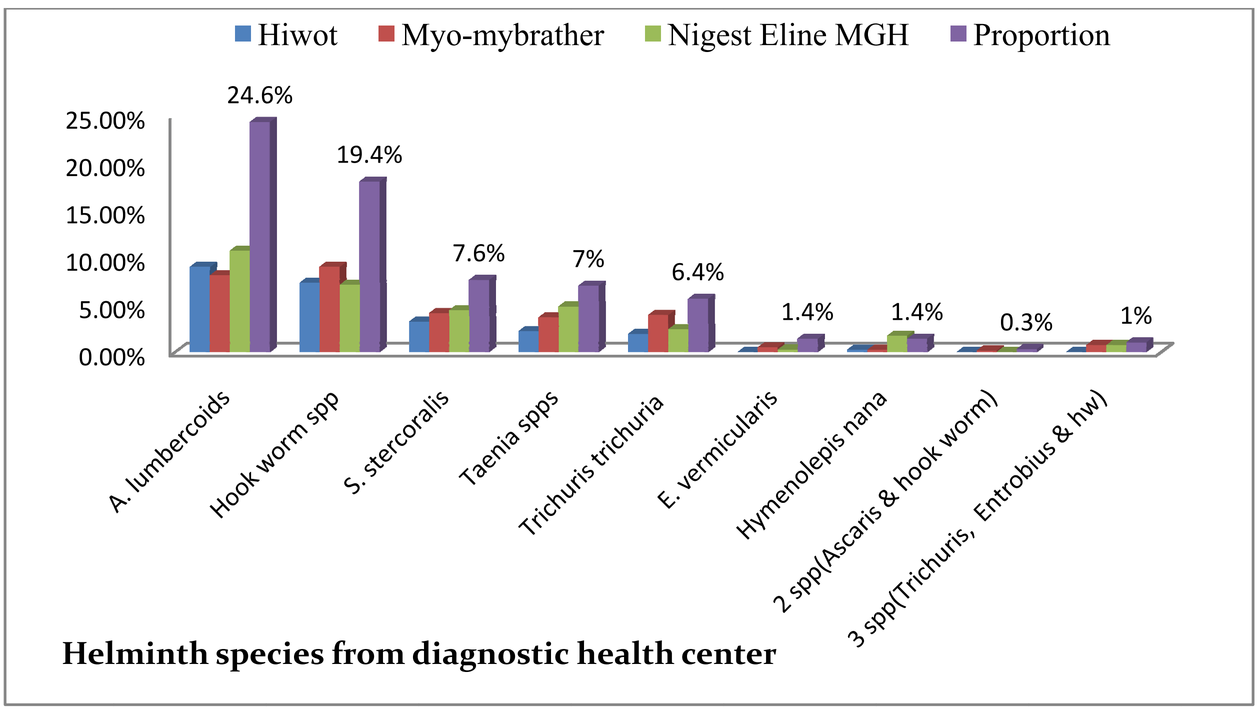


Figure 10: Proportion of helminthes per year of diagnostic record, center of diagnostic lab and sex of cases



χ^2 = 22, p-value = 0.00

Figure 11: Different intestinal helminth species that were collected from different diagnostic laboratory

4.2.2. Assessment of the Effect of the Different Risk Factors Considered for the Helminth Parasitism in Human.

Analysis was used similarly; risks in dog above, determining which risk factors were associated with the risk for infection with intestinal helminth parasites in human. The results are presented as chi-square with their p-value and odd ratios with 95% confidence interval.

Sex of children and helminth parasitism

In this study intestinal parasitism risk of occurrence were among those females was about 1.3 times more likely than among those males as described in (**Table** 8)

Occupation and parasitism

Analysis result in **table** (8) show that the (OR= 4.3, 95%CI=1.7 to 11.1) estimates that intestinal parasitism is four times as likely to occur among farmers(soil occupation) than those among other occupation(daily laborer, private business and employers) with a significance association (p value < 0.005)

Disposal ways of dog faeces with helminth parasitism

Parasitism were associated among those used for composting of dog faeces in the study population was about 2.83 times more likely occur than those of practiced to buried, waste bin and not applicable of dog faeces with a confidence interval of 1.01 to 8.3. This confidence interval suggest that intestinal parasitism among those composting of dogs faces in the study population could be as little as 1.01 times or much as 8.3 times likely to be occur than those other disposal practice of dog faeces with a p value < 0.05 (**Table** 8)

Defeacation area of dog and intestinal parasitism

In this study infection with intestinal helminth parasites was observed to be more common (OR = 2.9, 95% CI = 1.1 - 8.1) among those human population inside of their home or yard defeacation of dogs than among those outside of their home or yard and both in and out defeacation of dog (**Table** 8).

In a summarized form table 8 also presented here under with different risk factors considered for helminth parasitism

Table 8: Result of logistic regression analysis for factors potentially associated with zoonotic intestinal helminth parasites among dog owners in Hosanna town.

Variables or risk factors	Categorical parameters	Total sampled N (%)	Prevalence N (%)	OR(95% CI)	X^2 (p-value)
sex of children	Female	84(32.2%)	17(20.2%)	1.3(0.6-2.5)	.583(0.445)
	Male	177(67.8%)	29(5.1%)	Refer	
Educational Status	Illiterate	16(6.1%)	0	.000(00)	13.03(0.005)
	Primary	93(35.6%)	26(28%)	3.5(1.3-9.1)	
	Secondary	92(35.2%)	14(15.2%)	1.61(.58-4.4)	
	College & above	60(23.0%)	6(10%)	Refer	
Occupation	Farmer	49(18.8%)	17(34.7%)	4.3(1.7-11.1)	15.01(0.005)
	Daily labourers	36(13.8%)	7(19.4%)	1.96(.65-5.9)	
	Private business	69(26.4%)	7(10.1%)	0.91(.31-2.6)	
	Student	34(13.0%)	7(20.6%)	2.1(.69-6.4)	
	Employer	73(28.0%)	8(10.9%)	Refer	
No of people in house hold	≤ 3 people/hh	148(56.7%)	22(14.8%)	Refer	1.79(0.181)
	≥ 4 people/hh	113(43.3%)	24(21.2%)	1.54(.81-2.9)	
Breed of dog	Local	207(79.3%)	33(15.9%)	Refer	1.95(0.163)
	Exotic	54(20.7%)	13(24%)	1.7(0.8-3.4)	
Purpose or use of dog	Guard	205(78.5%)	34(16.56%)	1.1(0.37-2.88)	2.06(0.358)
	Hobby	25(9.6%)	7(28%)	2.02(0.55-7.4)	
	Both	31(11.9%)	5(16.1%)	Refer	
Defecation area	Inside my home/yard	106(40.6%)	24(22.6%)	2.9(1.1-8.1)	3.83(0.148)
	Outside my home/yard	99(37.9%)	16(16.2%)	2.0(0.7-5.9)	
	Both in & out side my home/yard	56(21.5%)	6(10.7%)	Refer	
Disposal ways	Buried	39(14.9%)	4(10.25%)	Refer	10.7(0.013)
	Not applicable	120(46.0%)	16(13.3%)	1.83(.7-4.8)	
	West bin	68(26.1%)	14(20.6)	2.7(1.1-7.2)	
	Composting	34(13.0%)	12(35.3%)	2.83(1.01-8.3)	
Valid		**261 (100%)**	**46(17.6%)**		

4.3. Detection of Eggs of Helminth Parasites form Soil Samples

The sample size determination procedure followed in collecting soil sample to detect helminths eggs from dog had its own limitations. Out of the seven purposively collected soil samples, upon laboratory analysis helminth eggs were found in five of the soil samples. The species and number of eggs found from the collected soil samples revealed the occurrence of environmental contamination and risk of infection to human. **Table** 9 shows the type of eggs recovered and site of soil samples collected and examined, the overall prevalence of intestinal helminth parasites eggs were 71.4% (n=5). The most frequent species were *Trichuris* species (57.1%), *Toxocara* species (57.1%), *Ancylostoma* species (42.8%), *A. lumbricoids* (42.8%), *Strongyloides* species (14.3%) and *Taenia* species (14.3%). Three species were detected from: market area, CPG1 (children play ground Meli-amba), CPG3 (children play ground Areda) and G/M (minor market area around gofermeda) and four species were identified from abattoir area but non-from CPG2 (children play ground Sechiduna) and MA (maremia area) plots.

Table 9: Important geo-helminth parasites egg diagnosed in soil sample of seven selected sites or plots and their prevalence.

Geo-helminths Species	Plots or sites							Total N (%)
	Abattoir	**Market**	**CPG 1**	**CPG 2**	**CPG 3**	**G/M**	**MA**	
Ancylostoma spp	1	1	0	No clear parasitic contents were observed	1	0	No clear parasitic contents were observed	3(42.8%)
A. lumbercoids	0	1	1		0	1		3(42.8%)
Strongyloides spp	0	1	0		0	0		1(14.3%)
Taeni spp	1	0	0		0	0		1(14.3%)
Toxocara spp	1	0	1		1	1		4(57.1%)
Trichuris spp	1	0	1		1	1		4(57.1%)
Total	4	3	3		3	3		17

CPG 1= children play ground Meli-amba, CPG 2 = children play ground Sechiduna, CPG 3 = children play ground Areda, G/M = minor market area around gofermeda, MA = maremia area.

Strongyloides stercoralis infection among dogs and humans

During cross sectional KAPs (Questionnaire) survey of dog owners in the study area seven owners responded that similar responses on: housing practice of dog as it share the same house with their families, as no any history of deworming or treatments for their dogs, as their dogs defaecates in home and yard (bush, grasses, soil, garden and child play grounds), as mostly not disposed their dogs faeces and as used to composting, as their children plays with their dogs without any awareness of dog as a reservoir of zoonotic helminthes infection and zoonotic transmission ways. According to coproscopy analysis the result revealed that all 7(2.6%) owners' dogs were harbor a single 4(1.5%) *strongyloides* and double infection 3(1.15%) with *strongyloides* and *toxocara canis*. In contrast 3(1.15%) human beings were infected with this helminth species from out of 4(1.5%) human *strongyloides* infection identified from 261stool human sample. The summary of Helminth parasites identified from samples of human, dog and soil are presented in Table 10.

Table 10: Overall summery of intestinal helminthes species identified in dogs, human and soil with their prevalence in Hosanna town.

Species of Parasite identified	Prevalence in dog N (%)	Prevalence in human N (%)		Prevalence in soil N (%)
		Cross sectional datas'	Retrospective datas'	
***Ancylostoma* spp**	124(49%) **	17(6.5%)*	120(19.4%)*	3(42.8%)
A. lumbercoids	-	12(4.6%)	154(24.6%)	3(42.8%)
Toxocara spp	89(34%)▲▲ & 19(7.2%)▲	-	-	4(57.1%)
S. stercoralis	7(2.6%)	4(1.5%)	48(7.6%)	1(14.3%)
Trichuris spp	5(1.9%)◊◊	-	40(6.4%)◊	4(57.1%)
Hymenolepis nana	-	2(0.8%)	9(1.4%)	-
H. diminatus	-	7(2.7%)	-	-
Taenia spp	11(4.2%)	4(1.5%)	44(7%)	1(14.3%)
Overall parasitism	**187(71.6%)**	**46(17.6%)**	**415(66.5%)**	**5(71.4%)**

Toxocara canis = ▲▲, *Toxocara leonina* = ▲, *Ancylostoma caninum* =**, *Ancylostoma duodinum* = *, *Trichuris trichuria* = ◊, *Trichuris vulpis* = ◊◊.

5. DISCUSSIONS

Helminths infection is one of the most neglected tropical diseases (NTDs) that means from a group of diseases that are considered not to have received sufficient attention from the donor community and public health planners (WHO, 2011). According to the present study in dogs, dog owners and soil analysis in Hosanna town the results revealed that intestinal helminth species were abundant, and that prevalence and density of infection was very high. The knowledge, attitude and practice of dog owners regarding zoonotic helminthes parasites transmitted by dogs were insufficient.

Although similar findings have been previously documented in dogs throughout the world Senlik *et al*. (2006); Ugochukwu and Ejimadu (1985), the prevalence and the parasitic load have been reported to differ from region to region depending on many reasons. Results of the current study showed that all helminth parasites species of nematode (*T. canis T. leonina, T. vulpis, S. stercoralis* and *A. caninum)* and cestode (eggs of *Taeniids* spp) detected in the faecal samples of studied dogs are recognized as having a potential public health hazard.

The overall helminth parasite prevalence (71.6%) in dog recorded in the present study is higher than previous similar coprological studies of Yacob *et al.* (2007) and Endrias *et al.* (2010) who reported prevalences of 51 and 52.9%, and is less than from previous 90.7% and 86.8% documented by Jones *et al*. (2011) and Paulos *et al*. (2012) in this country respectively. The achieved prevalence is also higher than the 52.4% found by Maria *et al.* (2006) in Argentina, and 53% in Hungary (Fok *et al.,* 2001). Present study result agrees with the 68.4% recorded by Anene *et al.* (1996) in Nigeria and 76% in Philadelphia (Snow *et al.,* 1987). In contrast, similar study done in some developed countries revealed a very low prevalence's of gastrointestinal parasites when compared to the present finding, for example 4.2% in Netherlands by Overgaauw (1997), 20.4% in Belgium by Claerebout *et al. (*2009), 25% in UK by Wolf and Wright (2003). This difference can be associated with a high-level awareness about dog parasites and socioeconomic status of dog owners in developed countries for hygiene and make use of the available veterinary cares for their animals (Schanntz, 1999). In addition to this some factors such as geographic location and diagnostic technique employed, demographic factor and anthelminthic usage are also responsible for the wide variety of endoparasite prevalence (Katagiri and Oliveriasequeria, 2008; Degefu *et al*., 2011).

Infection with only one species of parasite was more common (60.3%) than infection with mixed species. Similar observations have been documented in different places of this country in Debre Zeit 76.5% by Yacob *et al.* (2007) and in Wondo Gent 73.6% by (Jones *et al*., 2011). In contrast infection with mixed helminth species were reported with similar studies conducted in Jimma town 73.6% by Degefu *et al*. (2011), in Ambo town 62.14% by Endrias *et al*. (2010) and in Hawassa 81.2% by (Paulos *et al*., 2012). This difference may be due to the level of awareness about dog parasite, Geographic location, high temperature and relative humidity, housing and other management activities practiced in these areas creates more suitable for the mixed helminth infection of dog.

The predominant species of zoonotic helminth parasite observed in this study was *A. caninum* (49%), which is in agreement with previous documents here in Ethiopia by Degefu *et al*. (2011); and Paulos *et al*. (2012) who reported the prevalence of 58.8% and 49% respectively and other countries such as Brazil (Oliveira-Sequeira *et al*., 2002; Katagiri and Oliveria-Sequeria, 2008), Argentina (Maria *et al*., 2006, South Africa (Minnaar *et al*., 2002), in China (Wang *et al*., 2006) and in Tanzania (Swai *et al*., 2010). In contrast, the current study prevalence report was higher than previous reports with similar study in this country by Yacob *et al.* (2007) prevalence of 32% in Deberzeit and Endrias *et al*. (2010) 35.7% in Ambo area. This is due to different reasons for instance, management factors like the owners allowed their dogs to spent its major time to freely move. Thus, can easily acquired infection 82(74.5%) were positive out of 110(42.1%) dogs that were moved freely and housing practice of dog (out of 261 dogs, 66(25.3%) were share with family and from this 57(86.3%) were positive for this helminth infection and lack of awareness of owners on zoonotic intestinal helminth parasites (out of 75.1% dogs, 76.5% were infected).

The second most prevalent helminth parasite in this study was *T. canis* (34%). Its prevalence was lower than prevalence rate reported in Wondo Gent (53.9%) by (Jones *et al*., 2011) but higher than prevalence rate in Deberzeit, Ambo, Jimma and Hawassa town reported that 21%, 17.14%, 25.8% and 25.1% by Yacob *et al.* (2007); Endrias *et al*. (2010); Degefu *et al*. (2011); Paulos *et al*. (2012) respectively. In addition, the prevalence rate of *Toxocara* infection reported here was higher than the previous reports from other developed country Netherland (Paul *et al*., 2009) and Belgium (Claerebout *et al.*, 2009). This might be due to host factor like exotic breeds are more susceptible than local, agent factors like both trancplacental and trancmammary transmission ability of *T. canis,* puppies are usually born with or acquire ascarid infections early in life (Burke and Roberson, 1985). This occasions further increased by no deworming history (out of 83.9% of not dewormed dog 81.2% were positive for the helminth infection) and also associated with loamy clay type of soil of the present study area or suitable environmental factors created a bit of higher prevalence rate of this agent.

The low prevalence of Taenia eggs and the absence of Spirocerca lupi eggs in fecal samples may be due to the floatation medium (sodium chloride whose specific gravities = 1.2) used in the present study. There are other floatation medias with higher specific gravities (such as saturated solutions of magnesium sulphate or zink sulphate or sodium nitrate) which, when used with the fecal floatation method, yield higher numbers of eggs and therefore prove to be more sensitive (Sloss *et al.,* 1994). The absence of D. caninium may be associated with the absence of flea intermediate host, since dogs are infected with only ingesting this intermediate host.

It is surprising to see that all existing kebelles of Hosanna town: Arada, Betel, Bobicho, Jaloma, Heto, Lichi-amba, Meli-amba and Sechiduna were found to show high prevalence of 85.7%, 60%, 62.1%, 77.7%, 73.3%, 68.4%, 85.3% and 66.6% dog parasitism, respectively . This clearly indicated that there is high prevalence of helminth parasitism in all kebelles of the town. This also shows high risk of human infection of parasitism directly by accidental ingestion or indirectly via from egg contaminated environments either by accidental ingestion of egg/larva or percutaneous penetration of hookworm or Strongyloides. This high prevalence in dog is probably due to making light/ignorant property of dog owners to their dog parasitism, no treatment for dog, no veterinary clinics to perform stool examination, no/poor awareness of dog owners on the zoonotic transmission and spread of helminth parasitic infection from dog to human.

In current study the higher parasitic load were estimated in *T. canis* followed by *T. leonine, A. caninum and S.sterocorali* with their mean EPG of feaces (EPG ± Std. Err) 1452.8 ± 1087.5, 842.8 ± 271.6, 734-± 497.9 and 700 ± 325 respectively. This finding is in line with that of Degefu *et al*. (2011) in Jimma, Ethiopia but higher than the finding of Ugbomoiko *et al*. (2008) in Nigeria. This might be due to lack of any treatment/deworming of dog and control intervention in the study area. This is obvious to environmental egg contamination and risk of re-infection in human and dog itself (Ugbomoiko et al., 2008)

In the present study based on stool examination of dog owner's children, the results showed that overall prevalence of intestinal helminth parasites was 17.6% and these comprised egg of *Hook worm* spps (6.5%), *Ascaris* spp (4.6%), *H. nana* (2.7%), *Strongyloid spp* (1.5%), *Taenia* spps (1.5%) and *H. diminatus* (0.8%). This is from apparently healthy peoples without any clinical history and symptoms of intestinal helminthiasis.

In this study, based on cross sectional stool examination the overall prevalence of intestinal helminth infection (17.6%) and this prevalence was lower when compared with similar previous study in children around Lake Ziway Island with an overall prevalence of 56.7% reported by Tesfa-Michael and Teklemariam, (1983).This result is also lower compared to that reported in South Wello (43.3%) by Assefa *et al., (*1998), in Southern and Central Zones of Tigray (56.4%) by Dejenie and Petros (2009) and (82.4%) by Alemu *et al.* (2011) in Zarima town, Northwest Ethiopia. The lower prevalence obtained in the present study may be due to availability of latrine (to avoid re-infection) and health centers (for frequent stool check up/examination), exclusion were not performed those who had take antihelminthics during specimen collection from study subjects (since, antihelminthic reduces the probability of positive results) and also the technique used in stool examination in the present studies less sensitive than the previous studies.

Over all kebelles wise distribution of helminth parasitism in human from the town: Arada, Betel, Bobicho, Jaloma, Heto, Lichi-amba, Meli-amba and Sechiduna were 7.10%, 15.40%, 27.58%, 22.20%, 26.60%, 21.05%, 5.88% and 16.66% respectively. The prevalence from Bobicho, Heto and Lichi-amba was a bit higher when compared with other kebelles though statically not significant variations among kebelles. This might be due to the their occupation (farmers are four times more infected than those other occupation), they use dog faeces as a composting ways of disposal, they are town border kebelles and relatively no health center access like that of relatively lower prevalent kebelles.

In addition, based on retrospective survey *Hookworm* spps, *Ascarise* spp, *H. nana, Strongyloides spp, Taenia* spps*, Trichuris spp and Entrobiuse vermicularis* were recorded previously in different human clinic in the town of Hosanna. In general, these all species are excreted from intestine of dogs and humans. Dogs can also act as transport hosts for the human roundworm *Ascaris lumbricoides*, whipworm *Trichuris trichiura*, and Coccidia (a protozoon) *Isospora belli* due to its ingesting behavior of infected human faeces and because of the sticky-coated *Ascaris* eggs may adhere to the dog's coat during both coprophagy and defecation(Traub *et al*., 2002). Due to their highly resistant nature, survival of *Ascaris* eggs on the dog's coat for prolonged periods is possible (6 to 12 week incubation period). During this period, the eggs may undergo further development and maturation to infectivity (Weese *et al*., 2011).

A dog tapeworm Hydatidosis /Cystic echinococcosis is a major endemic disease of public health important in various parts of this country (Kebede *et al*., 2009) mainly in Southern Ethiopia. According to some studies the prevalence of this parasite was reported as 61.5% by postmortem examination in Wondo Gent by (Jones *et al*., 2011). Thus, *E. granulosus*, a major zoonotic parasite of livestock and dogs in Ethiopia, these is probably due to the close association between dogs, livestock and humans (Kebede *et al*., 2009). The fact that dogs enjoy unrestrained with humans, scavenge for food in an environment contaminated with faecal material of potential intermediate hosts and feed on offal of slaughtered livestock in abattoirs, makes transmission of zoonotic parasitic diseases predictable in the studied area and from retrospective current study, 5 hydatid cyst were previously diagnosed by medical hospitals in only (2012 and 2013) years using x-ray and ultrasound in liver. Some medical professionals' regarding to retrospective record keeping complained that we are giving individual treatment and we may miss each record keeping, in-fact cases with hydatid cyst in liver is commonly presented in our Hospital.

Based on soil sample investigation of present study, the results revealed that a 71.4% geohelminth parasites eggs content from the study environment and this comprised eggs of *Ascaris* (42.8%), *Ancylostoma* species (42.8%), *Trichuris* species (57.1%), *Toxocara* species (57.1%), *Strongyloides* species (14.3%) and *Taenia* species (14.3%). Due to the fact that the adult stages of these worms reside in the intestine, the presence of the eggs in soil is indicative of faecal pollution. This is proved by the fact that around abattoir, market area and some selected different children play ground, which had the highest prevalence of geohelminths (Weese *et al*., 2011). This is due to in these environments there is no toilet facilities even for human beings and surrounded by bush which create favorable condition to excrete/defecate their stool/faeces. This open defecation, uncontrolled dog movement or management, high close relationship with dogs and lack of awareness on environmental contamination from dog faces results in the eggs being washed and disseminated with rain, wind and insects then the area being highly contaminated with eggs of the parasites and high risk of re infection (Dado *et al.*, 2011).

There are no similar studies to evaluate the degree of soil contamination in Ethiopia when comparing the data published until now. Comparing the result of soil sample analysis with other finding obtained elsewhere seems very difficult due to the small sample size we considered. However the helminth eggs found in the soil samples were known in causing cutaneous larva migrants in human specially children (Caumes, 2006). The degree of helminth parasitic egg contaminated environment in the present study was 71.3%, which is similar to the 66% in London by Snow *et al*. (1987), the 67% found in Murcia Ruiz de Iban˜ez *et al*. (2001), the 77% found in Montreal by Ghadirian *et al.* (1976) and the 82.5% found in Tenerife by Toledo (Seco *et al.,* 1994). The achieved prevalence is also higher than the 40% found by Dubin *et al*. (1975) in Philadelphia and 18% in Spain (Dado *et al.,* 2011). These is due to the expansion of high uncounted number of stray dogs from rural surrounding areas of the country and high ownership of dogs with suitable climatic factors required for the biology of the parasites, inadequate veterinary facilities and no/ very few public awareness to take care of the dogs.

Although the comparison of surveys is difficult due to the differences in sampling, diagnostic techniques used, weather, geographical areas, results of current study indicate that the main risk to public health in detection of eggs of helminth parasites form soil samples is *Toxocara* species (57.1%), the etiological agent of visceral and ocular larva migrans in human. Similar results were found in public area 50% in Italy (Habluetzel *et al.,* 2003). This egg contamination suggests a real risk of human infection, especially to small children who share playgrounds with pets. *Toxocara* eggs need an incubation period of (2- 6 weeks) before its eggs become infective and this also prolongs further risk of zoonotic transmission in environment (Mazgajska, 2001).

In general, the present study demonstrated that the prevalence of the helminth infection 71.6%, 17.6% and 71.4 % were in dogs, human and soil respectively, based on coprological or parasitological techniques. This prevalence's were influenced by different risk factors of KAPs (knowledge, attitude and practices) of dog owners. For instance, treatment for dogs, awareness of dog owners on transmissible ZIH (zoonotic intestinal helminthes) and housing practice for dog were associated to the occurrence of intestinal helminthasis in dog with a statically significant variation value of 62.142(0.000), 9.238(0.002) and 9.659(0.022) respectively. This might be due to lack of access to veterinary services and poor or no awareness of dog owners on zoonotic intestinal helminthes. Then the ova of intestinal helminthes species are passed in the faeces of their host; thus, environmental egg contamination proportions of the present study were 71.4% recorded and it is obvious on public health impact. The main route by which human beings become infected with zoonotic helminth parasites is both via pica/eating soil and by contacting/children play with dogs and soil. Small children are considered particularly at risk due to their lifestyle, especially if they play on contaminated soils. Soil contamination is the best indicator of the risk of zoonotic transmission (Barriga, 1991; Mazgajska 2001). So, by possible care of dog, environmental contamination must be controlled to prevent zoonotic transmission.

Out of 384 respondents' only 87(22.6%), respondents' have some awareness on transmissible helminthes between human and dog from different responsible organs like Veterinarian 18 (4.6%), Medical doctors 4(1.04%), other health department 11(2.8%), television media 15(3.9%), radios 3(0.8%), Magazines 7 (1.8%) and family or friends 29 (7.5%). Though the awareness/information source not accessible, similar awareness (22%) were recorded here in Ethiopia, in Wendo Gent by (Jones *et al*., 2011). In contrast high level of awareness was recorded by Bugg *et al.* (1999) from Perth, Australia. These differences might be associated with veterinary facilities, socio economy, professional manpower and availability of adequate information in different mass Medias in developed nations.

In the present study, it is surprising to see that *Strongyloides stercoralis* were identified or diagnosed in both dogs and dog owners from the same households with similar KAPs of dog owners. During cross sectional KAPs survey of dog owners in the Hosanna town, seven owners responded that similar responses and then according to coproscopy analysis the result revealed that all 7(2.6%) owners' dogs were harbor a single 4(1.5%) *strongyloides* and double infection 3(1.15%) with *strongyloides* and *toxocara canis*. In contrast 3(1.15%) human beings were infected with this helminth species from out of 4(1.5%) human *strongyloides* infection identified from 261stool human sample. This might be due to sleeping with dog by sharing the same house, children played with dogs, poor management practice and level of awareness of dog owners about dog parasites and associated risk, in addition to lack of veterinary attention, could exacerbate risk of transmission of canine parasitic zoonoses to human community (Endrias *et al*., 2010).

6. CONCLUSION AND RECOMMENDATIONS

The present study provides the first systematic assessment and qualitative analysis of parasites, and the prevalent zoonotic gasterointestinal helminthes were estimated in dogs, children's of dog owners and soil of selected environments during study period in Hosanna town, Southern Ethiopia. Both cross sectional and retrospective study revealed the following intestinal helminthes species that includes roundworm (*Toxocara & Ascaris spp*), hookworms (A*ncylostoma species*), hydatid tapeworm (*Echinococcus granulosus)*, whipworm (*Trichuris species)* and threadworm *(Strongyloides stercoralis)*. The knowledge, attitude and practice of dog owners regarding zoonotic helminthes parasites transmitted by dogs were insufficient. Potential risk factors associated with GI helminthes zoonosis from dogs include: parasite factors, host factors and environmental factors were assessed through structured questioner. Control practices in pet zoonoses like preventive anthelmintic treatment, educating and counseling pet owners in preventing zoonotic diseases and community education, these all were addressed. Based on the above conclusions, the following recommendations are forwarded:

- Research information on zoonoses from pets in general and zoonotic helminthes from dogs in particular are scarce at national level. Therefore, disease investigation and research in the area of zoonoses from dogs should get special attention all over the country.

- Communication and collaboration among human and animal professions should be encouraged for effective disease surveillance system, control and prevention of zoonotic helminthes from dogs.

- Community awareness in the area of the following points should be undertaken using public forum or media like community radio.

    - Practicing good personal hygiene, particularly washing hands after handling pets and before eating food should be advised ;
    - Controlling dog parasite infections through repeated treatments and/or regular diagnostic testing, thus are preventing them from shedding eggs into and

contaminating the environment;

- Avoiding dog to free movement and being contact with wild and domestic animals, and proper management of feeding not allow carcass of a dead animal and condemned offal's feeding;
- Grooming dogs regularly to minimize the risk of coat contamination with worm eggs;
- Minimize environmental contamination with infective parasite stages by: avoiding disposal of the faeces or in recyclable waste and with regularly cleaning up of dog faece
- Keeping children away from areas that may be contaminated with dog faeces and potential health hazard association to humans, especially in children whose play habits and attraction to dogs put them at increased risk

7. REFERENCES

Alemu, A., Atnafu, A., Addis, Z., Shiferaw, Y., Teklu, T., Mathewos, B., Birhan, W., Gebretsadik, S. and Gelaw, B. (2011). Soil transmitted helminths and schistosoma mansoni infections among school children in zarima town, northwest Ethiopia. *BMC Infectious Diseases*, **11**:189

Anene, B.M., Nnaji, T.O. and Chime, A.B. (1996). Intestinal parasitic infections of dogs in the Nsukka area of the Enugu State, Nigeria. *Preventive Veterinery Medicine*, **27**: 89-94.

Angulo-Madero, R., ´guila, C.A., Puente, de la. and Guille´n-Llera, J.L. (1987). Contaminacio´n de suelos de parques pu´ blicos por Toxocara canis. *Rev. Iber. Parasitol. Extraordinario.*, 165–171.

Asano, K., Suzuki, K., Nakamura, Y., Asano, R. and Sakai, T. (2003). Risk of acquiring zoonoses by the staff of companion-animal hospitals, Japan. *Kansenshogaku Zasshi,* **77(11**): 944-947.

Assefa, T., Woldemicael, T. and Dejene, A. (1998). Intestinal parasitism among students in three localites in South Wello, Ethiopia. *Ethiopian Journal of Health Division*, **12**:231-235.

Ballweber, R.L., Xiao, L., Bowman, D.D., Kahn, G. and Cama, A.V. (2010). Giardiasis in dogs and cats: update on epidemiology and public health significance. *Trends Parasitology,* **26**:180–189

Barriga, O.O. (1991). Rational control of canine toxocariasis by the veterinary practitioner. *Journal of American Veterinary Association*, **198**: 216 – 21.

Bowman, D.D., Lynn, R.C. and Eberhard, M.L. (2003). Georgis' Parasitology for Veterinarians, St Louis, Elsevier Science (USA).

Bugg, R.J., Robertson, I.D., Elliot, A.D. and Thompson, R.C.A. (1999). Gastrointestinal parasites of urban dogs in Perth, Australia. *Veterinary Journal,* **157**:295-301.

Burke, T.M. and Roberson, E.L. (1985). Prenatal and lactational transmission of *Toxocara canis* and *Ancylostoma caninum:* experimental infection of the bitch before pregnancy. *International Journal for Parasitology* **15**:71-75.

Caumes, E. (2006). It's time to distinguish the sign "creeping eruption" from the syndrome "cutaneous larva migrans". *Dermatology,* **213**(3): 179-181, 1018-8665.

Cisneros-Jimenez, B.E. and Rendon-Maya, C. (2007). “Helminths and Sanitation”. Communicating Current Research and Educational Topics and Trends in Applied Microbiology. *A. Méndez-Vilas (Ed.),* México.

Claerebout, E.S., Casaert, A.C., Dalemans, N.D. and Wilde, L. (2009). *Giardia* and other intestinal parasites in different dog populations in Northern Belgium. *Veterinary Parasitology*, **161**: 41-46.

Coelho, W.M.D., Amarante, A.F.T., Apolinario, J.C., Coelho, N.M.D. and Bresciani, K.D.S. (2011). Prevalence of Ancylostoma among dogs, cats and public places from Andradinacity, São Paulo State, Brazil. *Revista do Instituto de Medicina Tropical de São Paulo* (in press).

Dado, D., Izquierdo, F., Vera, O., Montoya, A., Mateo, M., Fenoy, S., Galva´n, A.L., Garcı´a, S., Garcı´ a, A., Ara´nguez, E., Lo´ pez, L., del A´guila, C.and Miro, G. (2011). Detection of Zoonotic Intestinal Parasites in Public Parks of Spain. Potential Epidemiological Role of Microsporidia. *Zoonoses and Public Health*, **59**: 23–28

Degefu, H., Tefera, A. and Yohannes, M. (2011). Zoonotic helminth parasites in faecal samples of household dogs in Jimma Town, Ethiopia. *Journal of Public Health and Epidemiology* 3**(4)**: 138-143,

Dejenie, T. and Petros, B. (2009). Irrigation Practices and Intestinal Helminth Infections in Southern and Central Zones of Tigray. *Ethiopian Journal of Health Division* **23**(1)

Diba, V.C., Whitty, C.J.M. and Green, T. (2004). Cutaneous larva migrans acquired in Britain. *Clinical and experimental dermatology,* **29**(5): 555–556, 0307-6938.

Dubin, S., Segall, S. and Martindale, J. (1975). “Contamination of soil in two city parks with canine nematode ova including toxocara canis; a preliminary study.” *American Journal of Public Health,* 65 (**11**): 1242-1245

Dunsmore, J.D. and Shaw, S.E. (1990). *Clinical Parasitology* of Dogs, Sydney. The University of Sydney Post Graduate Foundation in Veterinary Science.

Dunsmore, J.D., Thompson, R.C. and Bates, I.A. (1984). Prevalence and survival of *Toxocara canis* eggs in the urban environment of Perth, *Australia. Veterinary Parasitology,* **16**, 303-311.

Duwel, D. and Strasser, H. (1978). Birth of helminth-free canine pups through maternal fenbendazole therapy. *Dtsch Tierarztl Wochenschr*,**85**(6): 239-241.

Elmore, A.S., Jones, L.J., Conrad, A.P., Patton, S., Lindsay, S.D and Dubey, P.J. (2010). Toxoplasma gondii: epidemiology, feline clinical aspects, and prevention, USA. *Trends in Parasitology.*

Endrias, Z., Yohannes, S. and Berhanu, M. (2010). Prevalence of helminth parasites of dogs and owners awareness about zoonotic parasites in Ambo town, Central Ethiopia. *Ethiopia Veterinarians Jornal,* 14(**2**): 17-30.

ESCCAP, (2010). Guideline No. 1, Worm Control in Dogs and Cats. Second Edition Published in September 2010.

FAO, (1982). *Echinococcus/hydatidosis: surveillance, prevention and control. FAO/UNEP/WHO guidelines*. FAO Animal Production and Health Paper No. 29. Rome.

Fok, E., Szatmri, V., Busk, K. and Rozgonyi, F. (2001). Prevalence of intestinal parasites in dogs in some urban and rural areas of Hungary. *Vet. Quart*., **23**: 96-98.

Foreyt, J.W. (2001). Vetrinary parasitology. Referance manual fifth edition. Iowa state university, 19

Gasser, R.B., Lightowlers, M.W., Rickard, M.D. and Dawkins, H.J.S. (1990). Serological screening of farm dogs for *Echinococcus granulosus* infection in an endemic region. *Australia. Veterinary Parasitology,* **67**(4): 145-147.

Gastro-Intestinal Nematodes. available at (http://www.advocate-spot-on.com/fileadmin/media/advocate/pdf/Advocate_TM_7_Nematodes.pdf). accessed in April 20, 2013.

Ghadirian, E., Viens, P., Strykowski, H. and Dubreuil, F. (1976) "Epidemiology of toxocariasis in the Montreal area. Prevalence of Toxocara and other helminth ova in dogs and soil." *Canadian Journal of Public Health*. **67**(6): 495-498

Gothe, R. and Reichler, I. (1990). *Toxocara canis*: frequency of detection and extent of infection in bitches of various breeds and husbandry and their litters in South Germany. *Tierärztliche Praxis* **18**, 293-300.

Guidelines for Veterinarians: Prevention of Zoonotic Transmission of Ascarids and Hookworms of Dogs and Cats. Division of Parasitic Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention, in cooperation with the American Association of Veterinary Parasitologists, available at http://www.cdc.gov/ncidod/diseases/roundworm/roundworm.htm. Accessed in April 8, 2013.

Habluetzel, A., Traldi, G., Ruggieri, S., Attili, A.R., Scuppa, P., Marchetti, R., Menghini, G. and Esposito, F. (2003). An estimation of *Toxocara canis* prevalence in dogs, environmental egg contamination and risk of human infection in the Marche region of Italy. *Veterinary Parasitology*, **113**: 243-252.

HTAO, (2013). Hosanna town agricultural office annual reports of animal's population found in the town

Itoh, N., Kanai, K. and Hori, Y. (2009). Prevalence of *Giardia intestinalis* and other zoonotic intestinal parasites in private household dogs of the Hachinohe area in Aomori prefecture, Japan. *Journal of Veterinary Science*, **10:** 305 – 308.

Jenkins, D.J., Mckinlay, A., Duolong, H.E., Bradshaw, H. and Craig, P.S. (2006). Detection of Echinococcus granulosus coproantigens in faeces from naturally infected rural domestic dogs in south eastern Australia. *Australian Veterinary Journal,* **84:** 12-16.

Jones, O., Kebede, N., Kassa, T., Tilahun, G. and Macias, C. (2011). Prevalence of dog gastrointestinal parasites and risk perception of zoonotic infection by dog owners in Wondo Genet, Southern Ethiopia. *Journal of Public Health and Epidemiology,* **3**(**11**): 550-555.

Katagiri, S. and Oliveral-Sequeeria, T.C.G. (2008). Prevalence of Dog intestinal parasites and risk Perception of zoonotic infection by dog owners in Sao Paulo state, Brazil. *Zoonoses and public health*, **55**: 406-413.

Kazacos, K.R. (2000). Protecting children from helminthic zoonosis. *Contemp Pediatr,* **17(**3**)**:1-24.

Kebede, N., Mitiku, A. and Tilahun, G. (2009). Hydatidosis of slaughtered animals in Bahir Dar Abattoir, Northwestern Ethiopia. *Tropical Animal Health and Prodroduction,* **41**: 43-50.

Khante, G.S., Khan, L.A., Bodkhe, A.M., Suryawanshi, P.R., Majed, M.A., Suradkar, U.S. and Gaikwad, S.S. (2009). Epidemiological survey of Gastro-intestinal parasites of non-descript dogs in Nagpur City. *Veterinary World,* 2 **(1**): 22-23.

Knobel, D.L., Laurenson, K.M., Kazwala, R.R., Boden, A.L. and Cleaveland, S. (2008). A crosssectional study of factors associated with dog ownership in Tanzania. *BMC Veterinary Research*, **4**: 5.

Kuma, G.S. and Smith, H. (2000). Pets, Poop and Parasites. *Microbiology today,* **27**: 84-86.

Landmann, J.K. and Prociv, P. (2003). Experimental human infection with the dog hookworm, *Ancylostoma caninum. The Medical Journal of Australia,* **178**: 69-71.

Legesse, Y.B. (2001). Preliminary observational study on captive civet cats (Civettictis civetta) in western Ethiopia. DVM thesis in Addis Abebe University, collage of veterinary medicine.

Luty, T. (2001). Prevalence of species of *Toxocar*a in dogs, cats and red foxes from the Poznan region, Poland. *Journal of Helminthology,* **75**: 153-156.

Lynch, J.A. (1987). Zoonoses Involving Family Pets -Bacterial and Fungal Pathogens. *Canada Veterinarians Journal,* **28**: 266-267.

Macpherson, C.N.L. (2005). Human behaviour and the epidemiology of parasitic zoonoses. West Indies. *International Journal for Parasitology,* **35:** 1319–1331

Macpherson, C.N.L., Meslin, F.X., Wandeler, A.I. (2000b). Dogs, Zoonoses and Public Health. CAB International, Wallingford (pp. 382).

Malgor, R., Oku, Y., Gallardo, R, and Yarzabal, I. (1996). High prevalence of *Ancylostoma* species infection in dogs associated with endemic focus of human cutaneous larva migrans in Tacuaremba Uruguay. *Parasite* **3:**131-134.

Marı´a, F., Fontanarrosa, D.V., Julia, B. and Diego, E. (2006). An epidemiological study of gastrointestinal parasites of dogs from Southern Greater Buenos Aires (Argentina): Age, gender, breed, mixed infections, and seasonal and spatial patterns. *Veterinary Parasitology*, **136**: 283-296.

Mazgajska, H. (2001). Eggs of Toxocara species in the environment and their public health implications. *Journal of Helminthology*, **75**: 147 – 151.

McGlade, T.R., Robertson, I.D., Elliot, A.D., Read, C. and Thompson, R.C. (2003a). Gastrointestinal parasites of domestic cats in Perth, Western Australia. *Veterinary Parasitology,* **117**: 251-262.

Mehrabani, D., Oryan, A. and Sadjjadi, S.M. (1999). Prevalence of Echinococcus granulosus infection in stray dogs and herbivores in Shiraz, Iran. *Veterinary Parasitology,* **86**: 217-20.

Molina, C.P., Ogburn, J. and Adegboyega, P. (2003). Infection by *Dipylidium caninum* in an infant. *Archives of Pathology* and *Laboratory Medicine,* **127**: 157-159.

Oliveira-Sequeira, T.C., Amarante, A.F., Ferrari, T.B. and Nunes, L.C. (2002). Prevalence of intestinal parasites in dogs from Sao Paulo State, Brazil. *Veterinary Parasitology,* **103**: 19-27.

Overgaauw, P.A. (1997a). Aspects of *Toxocara* epidemiology: human toxocarosis. *Critical Reviews in Microbiology* **23:** 215-231.

Overgaauw, P.A. (1997b). Aspects of *Toxocara* epidemiology: toxocarosis in dogs and cats. *Critical Reviews in Microbiology* **23**: 233-251.

Overgaauw, P.A. (1997). Prevalence of intestinal nematodes of dogs and cats in The Netherlands. *Vet. Q.,* **19**: 14-17.

Pandey, V.S., Dakkak, A. and Elmamoune, M. (1987). Parasites of stray dogs in the Rabat region, Morocco. *Journals of Tropical Medicine and Parasitology,* **81**: 53-55.

Parada, L., Cabrera, P., Burges, C., Acuna, A., Barcelona, C., Laurenson, M.K., Gulland, F.M., Agulla, J., Parietti, S. and Paolillo, E. (1995). Echinococcus granulosus infections of dogs in the Durazno region of Uruguay. *The Veterinary Record,* **136**: 389-391.

Patricia, Y.R. and Bruno, B.C. (2005). Hedgehog Zoonoses University of California, Davis, Davis, California, USA. *Emerging Infectious Diseases,* **11**: 1

Paulos, D., Addis, M., Fromsa, A. and Mekibib, B. (2012). Studies on the prevalence of gastrointestinal helminthes of dogs and owners awareness about zoonotic dog parasites in Hawassa Town, Ethiopia. *Journal of Public Health and Epidemiology* ***4(8)**:205-209*

Payne, P.A. and Ridley, R.K. (1999). Strategic use of ivermectin during pregnancy to control *Toxocara canis* in greyhound puppies. *Vetetrinary Parasitology,* **85**(**4**): 305-312.

Payne-Johnson, M., Maitland, T.P., Sherington, J., Shanks, D.J., Cements, P.J., Murphy, M.G., McLoughlin, A., Jernigan, A.D. and Rowan, T.G. (2000). Efficacy of selamectin administered topically to pregnant and lactating female dogs in the treatment and prevention of adult roundworm (*Toxocara canis*) infections and flea

(*Ctenocephalides felis felis*) infestations in the dams and their pups. *Veterinary Parasitology,* **91**(3-4): 347-58.

Perspectives on Zoonotic Diseases. Rocky Mountain Regional Center of Excellence For Biodefense and Emerging Infectious Diseases. Available at http://www.extsoilcrop.colostate.edu/Soils/powerpoint/cla/ZoonoticDiseases.pdf Accessed inJune 8, 2012.

PIJAC, (2012). Pet Industry Joint Advisory Council. *Pet Zoonoses Committee*. Washington, DC. Available at (http://www.pijac.org/about/committees/zoonoses).

Pfukenyi, D.M., Chipunga, S.L., Dinginya, L. and Matenga, E.A. (2010). Survey of pet ownership, awareness and public knowledge of pet zoonoses with particular reference to *roundworm*s and *hookworms* in Harare, Zimbabwe. *Tropical Animal Health and Prod*ucion, **42**(2): 247-252.

Pullola, T., Vierimaa, J., Saari, S., Virtala, A.M., Nikander, S. and Sukura, A. (2006). Canine intestinal helminths in Finland: Prevalence, risk factors and endoparasite control practices. *Veterinary Parasitology*, **140:** 321-326.

Riley, P.Y. and Chomel, B.B. (2005). Hedgehog Zoonoses. University of California, Davis, Davis, California, USA. *Emerging Infectious Diseases,* **11:1**

Roddie, G., Stafford, P., Holland, C. and Wolf, A. (2008). Contamination of dog hair with eggs of Toxocara canis. *Veterinary Parasitol*ogy, **152**: 85-93.

Rubel, D., Zunino, G., Santillan, G. and Wisnivesky, C. (2003). Epidemiology of *Toxocara canis* in the dog population from two areas of different socioeconomic status, Greater Buenos Aires, Argentina. *Veterinary Parasitology,* **115**: 275-286.

Schantz, P.M. (1989). *Toxocara* larva migrans now. The American *Journal of Tropical Medicine and Hygiene,* **41**: 21-34.

Schantz, P.M. (1991). Parasitic zoonoses in perspectives. *International Journal of Parasitology*, **21**: 161-170.

Schantz, P.M. (2002). Zoonotic ascarids and hookworms: The role for veterinarians in preventing human disease. Compendium on continuing education for the practicing veterinarian, **24**(1): 47-52.

Senlik, B., Cirak, V.Y. and Karabacak, A. (2006). Intestinal nematode infections in Turkish military dogs with special reference to *Toxocara canis*. *Journal of Helminthol.,* **80**: 299-303.

Sloss, M.W., Kemp, R.L., Zajac, A.M., (1994). Veterinary Clinical Parasitology, 6th edition, Iowa State University Press, Iowa.

Smith, K.A., Campbell, C.T., Murphy, J. and Stobierski, M.G. *(*2010). Compendium of Measures to Control *Chlamydophila psittaci* Infection Among Humans (Psittacosis) and Pet Birds (Avian Chlamydiosis). *National Association of State Public Health Veterinarians (NASPHV).*

Smith, A. and Whitfield, Y. (2012). Household Pets and Zoonoses. In Canada, *National Collaborating Centre for Environmental Health.*

Snow, K.R., Ball, S.J. and Bewick, J.A. (1987). “Prevalence of Toxocara species eggs in the soil of five east London parks.” *Veterinary Record*, **120**(3): 66-67

Soulsby, E.L.J. (1982). Helminths, Arthropodes and Protozoa of Domestic Animals. 7th edition. The English Language Book Society and Bailliere Tindall, London, pp.809.

Stoye, M. (1992). Biology, pathogenicity, diagnosis and control of *Ancylostoma caninum* . *Dtsch Tierarztl Wochenschr,* **99(**8)**:** 315-321.

Swai, E.S., Kaaya, E.J., Mshanga, D.A. and Mbise, E.W. (2010). A Survey on Gastro-Intestinal Parasites of Non-Descript Dogs in and Around Arusha Municipality, Tanzania. *International Journal of Animal Veterinary Adv*., **3**: 63-67.

Taylor, M.H., Coop, R.L. and Wall, K.L (2007). Veterinary parasitology. 3rd edition. Black well publishing, UK.

Tesfa-Michael, T., and Teklemariam, A. (1983). Intestinal helminthic infecton in Lake Zway Isands, central Ethiopia. *Ethiopian Medical Journal*. **21**: 149.

Thienpoint, D., Rochette, F. and Vanporijs, O.F.J (1998). Diagnosing Helmnthiasis by Coprological samples. 2nd edition. Janson Research foundation. Beerse, Belgium.

Thompson, R.C.A., Lymbery, A.J., Hobbs, R.P. and Elliot, A.D. (1988). Hydatid disease in urban areas of Western Australia: an unusual cycle involving western grey kangaroos (Macropus fuliginosus), feral pigs and domestic dogs. *Australian Veterinary Journal* **65:** 188-190.

Thrusfield, M.V. (2005). Veterinary Epidemiology. 3rd Edn., Blackwell Science, Oxford, London. pp: 234-238.

Tile, D. (2012). The welfare of working equines and their socio economic dimension in Hosanna, southern Ethiopia. M.Sc thesis, Jimma University

Traub, R.J., Robertson, I.D., Irwin, P., Mencke, N. and Thompson, R.C. (2002). "The role of dogs in transmission of gastrointestinal parasites in a remote tea-growing community in northeastern India." *American Journal of Tropical Medicine and Hygiene*, **67**(5): 539-45.

Ugbomoiko, S.U., Ariz, L. and Heukelbach, J. (2008). Parasites of importance for human health in Nigerian dogs: high prevalence and limited knowledge of pet owners, Nigeria. BMC *Veterinary Research,* 4:49

Ugochukwu, E.I. and Ejimadu, K.N. (1985). Studies on the prevalence of gastrointestinal helminths of dogs in Calabar Nigeria. *International Journal of Zoonoses*, **12**:214-218.

Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, J.M. and Jennings, J.W. (1987). Veterinary Parasitology. 3rd edition. Longman Scientific and Technical, Burnt Mill, Harlow, UK., pp: 238.

Vanparijs, O., Hermans, L. and Van Der Flaes L. (1991). Helminth and Protozoan parasites in dogs and cats in Belgium. *Veterinary Parasitology,* **38**: 67-73.

Visco, R.J., Corwin, R.M. and Selby, L.A. (1977). Effect of age and sex on the prevalence of intestinal parasitism in dogs. *Journal of the American Veterinary Medical Association,* **170:** 835-837**.**

Weese, S.J., Peregrine, S.A., Anderson, C.E.M. and Fulford, B.M. (2011). Companion Animal Zoonoses. Parasitic Diseases. Blackwell Publishing Ltd.

Witold, K., Andrzej, M., Barbara, K., Irena, D.K., Marian, S. and Katarzyna, S. (2012). Risk factors for the spread of parasitic zoonoses among dog owners and their families in rural areas. *Poland. Annals of Agricultural and Environmental Medicine,* **19**(1): 79-84. http//:www.aaem.pl.

Wolf, A. and Wright, I.P. (2003). Human Toxocariasis and direct contact with dogs. *Veterinary Records,* **151**: 419-422.

Won, K.Y., Deanna, K-M, Schantz, P.M. and Jones, J.L. (2008). National Seroprevalence and Risk Factors for Zoonotic *Toxocara* spp. Infection *Amercan Jornal of Tropical Mededicen and Hygine,* **79**(4): 552–557.

WHO, (2011). Helminth control in school age children: a guide for managers of control programmes - 2nd editions.

WHO, (1959). *Zoonoses*. Second report of the joint WHO/FAO Expet Committee.

Yacob, H.T., Ayele, T., Fikru, R. and Basu, A. (2007). Gastrointestinal nematodes in dogs from Debre Zeit, *Ethiopian veterinary Parasitologe,* **148**: 144-148.

8. ANNEXES

Annex I: Materials and Procedures of Parasitological Techniques

1. List of Materials used to diagnose intestinal helminthes in dog, human and soil during study period in Hosanna town.

During stool collection : plastic containers(50ml) with cup and graduated(Test tube of 50ml), Permanent-ink marker pens and Formalin 40% (diluted to 10% formalin)

During processing or analysis of stool specimen: Gloves, Gauze, Balance, Measuring cylinder or other container graded by volume, a tea strainer, Test tube(15ml), Tap water or saline water, Floatation solution (Saturated salt solution = 1.2 density), Diethyl ether (for sedimentation technique), Centrifuge, Cover slips, Permanent-ink marker pens, Micro slides, McMaster counting chamber, Pasteur pipette and Microscope.

For cleaning recyclable materials: brushes, Powdered soap(aerial), sodium hypochlorite (bleach), alcohol and rinsing water

For data registration: pen, pencils, papers (A4 and squired) and note pad

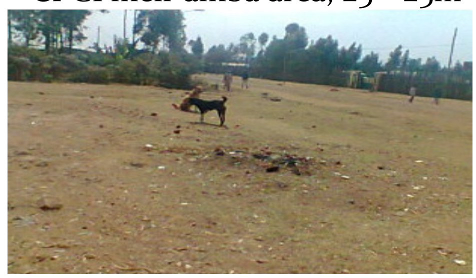
Study area, distances in meter per area, ways of collection and processing of soil samples in selected area of hosanna town

CPG3 Arada area,30length *30 wide in meter.

CPG2 Sechiduna area, 45length * 30wide in m.

Gofer-meda area, 30 *25m

CPG1 meli-amba area, 25 * 25m

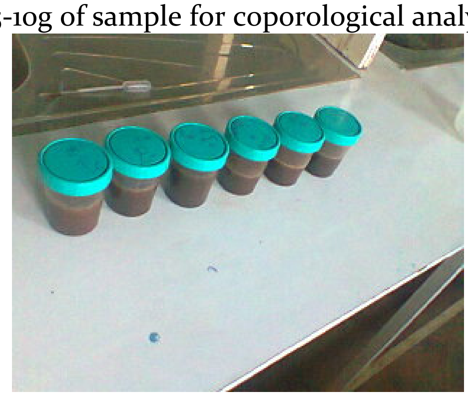


Abattoir area, 20 *20m

Market area, ways of collection from 50*50m

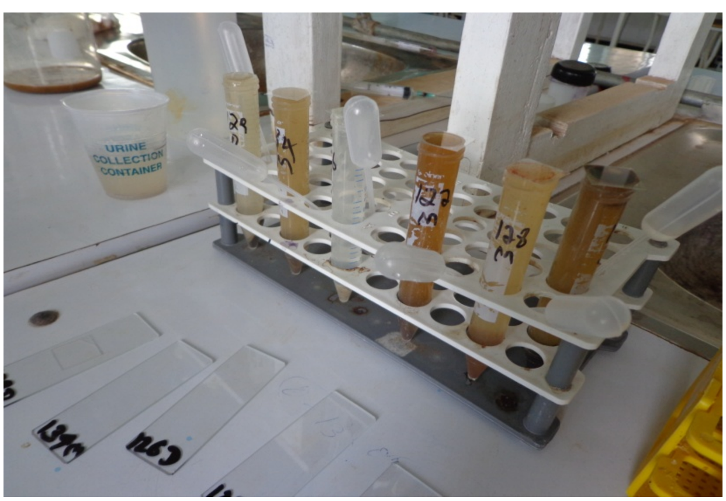
Processing in lab

5-10g of sample for coporological analysis were used



Study population of both breeds of dogs and some approaching behaviors of children in hosanna town during study period.

Procedure of parasitological techniques performed in the Hosanna Health Science Collage laboratory during specimen analysis.



Floatation technique

Floatation technique is a qualitative test for the detection of nematode and cestode eggs in the faeces. It is based on the separating of eggs from faecal material and concentrating them by means of a flotation fluid with an appropriate specific gravity.

Fecal samples were collected from different households that own dogs in hosanna town and transported or submitted to laboratory for preparation and evaluation. In the lab saturated salt solution (20 - 50 ml) was added to all each samples from dog, dog owners' children and soil were mixed very well or homogenized to avoid false negative result during sieving the eggs might be discarded. Saturated salt solution is prepared by using 400 g NaCl, and 1000 mL distilled water to create a solution with a specific gravity of 1.20. Then from mixed solution approximately 4 or 5 ml were sieved or filtered through tea strainer into a second test tube (15ml), and then add saturated salt solution until it was 0.5 cm from the top. The samples was then centrifuged at 300 for 5-10 min. After centrifugation, saturated salt solution was used to fill the tube until a convex meniscus formed. A 22 * 22 mm cover slip was then placed over the top of the tube. The cover slips were lifted vertically off the tube and placed on a glass slide. The slides were examined using a standard light microscope (100 magnifications). Quality control is ensured by strict adherence to standard operating procedures and laboratory hygiene.

Sedimentation technique

The sedimentation technique is a qualitative method for detecting trematode eggs and cestode eggs in the faeces. Most trematode eggs are relatively large and heavy compared to nematode eggs. This technique concentrates them in sediment.

With an applicator stick, 1g of the stool /soil sample was emulsified in 4ml of 10% formol ether contained in a tube. Additional 4ml of 10% formol ether was added to the tube and homogenized. The emulsified soil/faeces was sieved by and collected in a tube (15ml). The suspension was transferred to a centrifuge test tube into which 4ml of diethyl ether was added. After centrifugation, remove (pipette, decant) the supernatant very carefully and re suspend the sediment in 5 ml of water then allow to sediment for 5 minutes and also discard the supernatant very carefully and then transfer the sediment to a microslide and cover with a coverslip. Then finally, slides are examined using a standard light microscope (100 magnification).

McMaster egg counting technique

The McMaster counting technique is a quantitative technique to determine the number of eggs present per gram of faeces (e.p.g.). A flotation fluid is used to separate eggs from faecal material in a counting chamber (McMaster) with two compartments. The technique described below will detect 50 or more e.p.g. of faeces.

Fecal samples were submitted to Laboratory for preparation and evaluation. These techniques have some similarity with flotation technique through taking a sub-sample from floats or top of solution with a Pasteur pipette and then fill both sides of the McMaster counting chamber with the sub-sample by allowing the counting chamber to stand for 5 minutes. Examine the sub-sample of the filtrate under a microscope at 10 x 10 magnifications and Count all eggs within the engraved area of both chambers. Finally calculate the number of eggs per gram of faeces by add the egg counts of the two chambers together and multiply the total by 50. This gives the e.p.g. of faeces. (Example: 12 eggs seen in chamber 1 and 15 eggs seen in chamber 2 = (12 + 15) x 50 = 1350 e.p.g.) (http://www.fao.org/wairdocs/ILRI/x5492E/x5492e05.htm#TopOfPag).

Annex II: Questionnaire Format for Pet Owners in Hosanna Town /Interview Questions

Date of Interview: _____________

Questionnaire number: _________

Tick on the box or make circle in front of the response or fill in the blank spaces.

Part I) Socio-demographic data.

1. Name of the owner respondents: ______________ Keble: ________
2. Age of respondent: ______
3. Sex of respondent: □Male, □Female
4. Educational status □Illiterate, □Primary, □Secondary, □College and above
5. Occupation: □Government Employee, □Private Business, □Daily Laborer, □Farmer, □Student.
6. Religion: □Muslim, □Orthodox, □Protestant, □Catholic □Others _______________
7. Please tell us the number of people, who mostly look after the dog/cat i.e. feeds the dog, walks the dog or decides on worming regime?

Sex	No	Young (≤14years old)	Adult(15-35years)	Old (≥35years old)
Male				
Female				

Part II) Pet's management practice in the study area

8. Your dog's name:___________
9. How old is your dog? ___________ Sex? □Male, □female
10. Don't know□Breed of your dog? □local, □exotic,
11. If exotic from where did you bring? ______________
12. How many dogs are in your household? ___________
13. For what purpose do you own (use) the dog? □Guard, □ hobby, □both guard & hobby, Other___
14. Where do you house your pet? □Kennel, □share with the family, □mixed with other animals, □loose in open air.
15. Has your dog been treated for gastrointestinal (gut) worms, such as roundworms, in the

last 12 months? □Yes, □No and □Unsure

16. Where does your dog spend the majority of its time? □All the time in the house □Mostly in the house □Half inside, □Mostly outside □All the time outside □Unsure

17. Where does your dog **most commonly** defaecate (pass its stools)?

□**In my home/yard on**:

□Soil/sand, □dirt, □Grass, □Garden bed, □Kennel and □Litter tray

□**Outside my yard at**:

□Park □Beach □Bush □scrub □Street □verge □Neighbors yard □Other please specify:

18. If your dog defaecates in your home/yard, approximately how often do you pick-up the faeces or droppings or empty the litter tray? □Daily, □3-5 times a week, □once a week, □Never and □Other please specify

19. If you pick-up the faeces/droppings or empty the litter tray, what do you do with them? □Placed in a waste bin, □Put on or buried in the garden, □Put in compost heap, □compost tumbler and □Not applicable.

20. In the past 12 months have you fed your dog meat (**Other** than processed meat from a can or pet sausage)? □Yes, □No

21. Where did you obtain this meat? □Licensed butcher, □Supermarket, □Not licensed butcher, □Other please specify and □Unsure or can't remember

22. What type of meat did you feed? □Fed raw, □Fed after cooking and □other

23. In the past 12 months have you fed your dog offal □liver, □kidney, and □lungs?

24. Do children play with dogs? □Yes, □No

Part III) Parasite awareness (you may tick as many boxes as is necessary)

25. Are you aware of any internal parasites that dogs can transmit to humans? □Yes, □No

26. If you are aware that some parasites may be transmitted to people, where did you receive this information? □ Medical doctor, □Veterinarian, □Friends or family, □Health Department, □Television, □Radio, □Magazines, □Newspapers, □Posters & □Other please specify__________.

27. If you are aware that parasites can be caught from dogs, how can people become infected? □Patting/cuddling the dog, □Letting the dog lick you or saliva, □Touching objects the dog has contacted (e.g. bedding), □From picking up the dog faeces or stools, □Contacting soil, lawn or plants with which the dog has also had contact& □Other please specify______________

28. Please give us one traditional saying about dog /cat?

____

____.

Thank You Very much for giving these time & information