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Review Article

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Review On toxoplasmosis and its zoonotic importance in Ethiopian

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Abstract

Toxoplasmosis is an infection caused by a single-celled protozoan parasite called Toxoplasma gondii. While the parasite is found throughout the world.Some reports indicate a high prevalence of *T. gondii* infections in Africa. Toxoplasmosis results from infection with a common parasite found in cat faeces and contaminated food. It can cause serious complications for pregnant women and people with weakened immune systems.Toxoplasmosis is usually asymptomatic in immune-competent adults, but can cause mortality in the very young and the immune-compromised. In addition to serious eye disease, toxoplasmosis can cause severe lung or brain disease for a person with weakened immunity. Rarely, the infection can show up in other tissues throughout the body. Lung infection may cause: Breathing problems.In this paper published articles on toxoplasmosis in humans and other animals in Ethiopia is reviewed. Few data indicate that the prevalence of *T. gondii* in humans in Ethiopia is very high, up to 41% of children aged 1–5 years were reported to be seropositive. There is little information on seroprevalence data in pregnant women and no data on congenital toxoplasmosis in children. Serological surveys indicate up to 79% of goats and sheep have *T. gondii* antibodies. However, there is no information on losses due to toxoplasmosis in livestock or the presence of viable *T. gondii* in any host in Ethiopia.

Keywords: Ethiopia, Epidemiology, humans, seroprevalence, *Toxoplasma gondii*.

Introduction

Toxoplasmosis is a true zoonotic disease caused by infection with an obligate intracellular protozoan parasite, *Toxoplasma gondii*. In most areas of the world, toxoplasmosis has been found to be highly prevalent in meat producing animals (Tenter et al., 2000).Toxoplasmosisaffects upto one-third of the world's populationproducing a wide range of clinical manifestations or, in most cases, progress asymptomatically (Remington *et al.*, 2001). Humans acquire the infection by the oral route through the consumption of undercooked meat contaminated with cysts, food products or water contaminated with oocysts (Tenter *et al.*, 2000). Contamination of pregnant women may cause serious health problems if the parasite is transmitted to the foetus to cause

congenital toxoplasmosis. The congenital form results in a severe systemic disease because if the mother is infected for the first time during gestation, she can present a temporary parasitemia that will infect the foetus. Congenital toxoplasmosis may cause abortion, neonatal death, or foetal abnormalities with detrimental consequences for the foetus (Ebbesen 2000; Koneman *et al.*, 2004). *T. gondii* tachyzoites have been detected in milk of ewes and goats and some occurrences of human toxoplasmosis have been attributed to the consumption of non-pasteurized goat milk (Skinner *et al*., 1990).

The epidemiological situation of *T. gondii* in domestic ruminants used as a source of milk and meat for human consumption in Ethiopia is found in sharp contrast with the lack of adequate information. No adequate nation-wide survey had been conducted on the prevalence, risk factors, circulating genotypes of *T. gondii* and its role on reproductive problems among domestic ruminants including camels. The available data are limited to the central part of the country mainly focusing to small ruminants, where the seroprevalence range from 22.9%–56% in sheep and 11.6%–74.8% in goats (Demissie and Tilahun, 2002; Teshale *et al.*, 2007; Gebremedihin *et al.*, 2013;Zewdu *et al.*, 2013). Similarly, in human few studies were conducted in Ethiopia. Seroprevalence rate of 60–96.7% have been documented in different groups of people (Negash *et al*., 2008;Shimelis *et al*., 2009; Gebremedihin *et al*.,2013). Certainly, this shortage of information will be a challenge for knowledge based control activities against *T.gondii* among humans and animals in the country.

An overview on Toxoplasmosis

Toxoplasma was first discovered in the desert rodent *Ctenodactylus gundi* by Charles Nicolle and Louis Manceaux at the Institute of Pasteur in Tunis in 1908. At about the sametime, Alfonso Splendore independently discovered *Toxoplasma* in a rabbit at Sao Paulo (Dubey, 2010). The name *Toxoplasma* (toxon = arc, plasma = form, in Greek) was derived from its crescent shape.The discovery of a *T. gondii* specific antibody test, Sabin-Feldman dye test, in 1948 led to the recognition that *T. gondii* is a common parasite of warm blooded hosts with a worldwide distribution. Also the *T. gondii* life cycle was completed by the discovery of the sexual phase of the parasite in the small intestine of the cat. Its medical importance remained unknown until 1939 when *T. gondii* was identified conclusively in tissues of a congenitally-infected infant in New York City. Likewise, the veterinary importance of *T. gondii* became known when it was found to cause abortion storms in sheep in 1957 (Dubey, 2008).*T. gondii* is an ubiquitous parasite found in all classes of warm blooded vertebrates. Nearly one-third of humans have been exposed to this parasite (Dubey, 2004). In immunocompetent adults, acute infection normally results in transient influenza-like symptoms, but in immunocompromised persons retinochoroiditis and encephalitis are more common.

Toxoplasma gondii belongs to the Kingdom Animalia, Phylum Apicomplexa, Class Protozoa, Subclass Coccidian, Order Eucoccidia, Family Sarcocystidae and Genus *Toxoplasma*. It is an obligate intracellular protozoan parasite that has a characteristically polarized cell structure and a complex cytoskeletal and organellar arrangement at their apical end, the conoid, involved in cell invasion and numerous secretory organelles, dense granules, and micronemes (Rorman *et al*., 2006; Dubey, 2010). *T. gondii* was previouslyconsidered that it consists various strains related to three clonal lineage, type I, II, and III, which differ in virulence and epidemiological pattern of occurrence (Howe and Sibley, 1995). While recent studies on *T. gondii* strains in South America revealed that the presence of a higher genetic variability of the parasite (Pena *et al*., 2008).

Epidemiology of Toxoplasmosisin animals and humans in Ethiopia

Toxoplasma.gondii in human have showed variation among different groups of people, where the seroprevalence rate range 74.4% - 96.7% (Gebre–Xabier *et al*., 1993; Woldemichael *et al.*,1998;Yimer *et al.*,2005; Shimelis *et al*., 2009;

Gebremedihin *et al*., 2013). Humans become infected with *T. gondii* mainly by ingesting food or water contaminated with oocysts and by ingesting uncooked meat containing viable tissue cysts. Infected animals usually show cysts of *T. gondii* in different body tissues and human can take infection due to consumption of such raw or undercooked tissues. Sixty three percent human toxoplasmosis infection in Europe is attributed to the consumption of undercooked or cured meat products (Cook *et al*., 2000; Dubey, 2004, 2008;). Consumption of cattle and sheep meat infected by *T. gondii* could be a risk for congental transmission in pregnant woman (Beril *et al*., 1999). Fresh consumed home-made cheeses produced in small family-based farms from contaminated milk without previous milk pasteurization can represent a risk factor for public health (Fusco *et al*., 2007). In humans, vertical transmission has been associated to abortions, stillborns and variable morbidity (Tenter *et al*., 2000). Recently water-born transmission of *T. gondii* was considered uncommon but a large human outbreak linked to contamination of a municipal water reservoir in Canada by wild felids has been reported (Dubey, 2004). Oocysts in soil can be spread mechanically by flies, cockroaches, dung beetles and earthworms. They are known to survive on fruits and vegetables for long periods (Kniel *et al*., 2002)*Toxoplasma gondii*, can infect almost all the homeothermic animals, including human beings throughout the world, the prevalence of the disease in different species varies depending on the epidemic area, socio–cultural habits, geographical and climatic factors.Prevalence rate may also be associated with the presence of cats that excrete oocysts, which after sporulation become infectious to man and animals (Dubey, 2004; Garcia *et al*., 2006). *Toxoplasma gondii* oocyst are shed by domestic cats and other felines resulting in wide spread contamination of the environments, where the sporulated oocysts survive in moist soil for months to years (Ocholi *et al*., 1989; Dubey, 2010).

Factors affecting T. gondii transmission

Toxoplasma gondii oocysts are shed by domestic cats and other felines which are extremely resistant to external influences and can survive in the environment for years causing a wide spread of contamination (Dubey and Odenning, 2001; Sawadogo *et al*., 2005). Tissue cysts survive storage at 4–6^{o}C for up to 2 months. Some tissue cysts survive for several days after the death of an infected animal, even though its tissues have begun decomposing, but cooking at 60^{o}C or higher and freezing at -12^{o}C may kill them (Dubey, 2010). Higher prevalence rates of toxoplasmosis in warm and moist areas compared to those which are cold and dry is attributed to the longer viability of *T. gondii* oocysts in moist or humid environments (Vander Puije *et al*., 2000). Contamination of water.oocysts can remain viable for long periods of time in water and can resist freezing and moderately high water temperatures. They are not killed by chemical and physical treatments currently applied in water treatment plants, including chlorination and ozone treatment (Dumetre *et al*., 2008).Cultural habits of consuming raw or undercooked meat in a population may facilitates the acquisition of *T. gondii* infection from ingesting of tissue cysts(Gebre-xiabier *et al*.,1993.

Status of Toxoplasmosis in Ethiopia

Toxoplasmosis is of particular concern in many African countries because of the high prevalence of HIV and lack of resources to manage it. Particularly in some parts of Ethiopia raw meat eating is deeply established in the culture of the societies. Hence, higher seropositivity to *T. gondii* antibody in Ethiopia is commonly associated with the consumption of raw or undercooked meat that facilitates higher transmission rate of the parasite as indicated by different authors (Mengesha *et al*., 1984; Gebre–xabier *et al*., 1993). Accordingly a wide range of toxoplasma infection has been reported among different groups of people in the country, where the seroprevalence range from 8.2% to 96.7% [Gebremedhin *et al*., 2013]

(Table 2) Nevertheles, there is no information on congenital toxoplasmosis in children.

On the other hand, the limited studies conducted on toxoplasmosis in animals indicated that *T. gondii* seroprevalence range from 6.6% to 74.8% [Teshale *et al.*, 2007](Table 1). Regarding the feral cats at Addis Ababa *T. gondii* seroprevalence were reported 85.4% and 23.9% anti *T.gondii* specific IgG and IgM antibodies respectively. Additionally few studies conducted on the prevalence of oocysts shed by cats 12.5% in Debrebirhan and 13.5% in Bahirdar (Yihinew, 2012) respectively.

The prevalence of *T.gondii* infection in food animals, the habit of consuming raw or undercooked meat, keeping of domestic cats at home and the presence of feral cats can predispose the people to *T.gondii* infection in the country. Particularly those infected with HIV/AIDS persons exposed to serious complication due to the resulting opportunistic infections (Gebre-xabier *et al*., 1993; Gebremedhin *et al.*, 2013).

Table 1: Summary of selected *T. gondii* seroprevalence in animals from some parts Ethiopia

Study sites	Study year	Species	Tests used	n	Prevalence (%)	Reference
Addis Ababa	1985-1987	Sheep	IHA	899	22.9	Bekele and Kasali, 1989
and Debrebirhan	1985-1987	Goat	IHA	753	11.6	
	1985-1987	Cattle	IHA	785	6.6	
NG	NG	Sheep	IHAT	94	25.6	Deconinick *et al*., 1996
Debrebirhan	2000-2001	Sheep	MDAT	375	34	Demissie and Tilahun, 2002
		Goat	IHA	133	35	
Nazareth	1999	Sheep	MDAT	116	52.6	Negash *et al*., 2004
		Goat	MAT	58	24	
Central Ethiopia	2010-2011	Goat	ELISA	927	19.7	Zewdu *et al.*, 2012
	2010-2011	Sheep	ELISA	1130	31.59	Gebremedhin *et al*., 2013
South Omo and East Shewa zone	2005 -2006	Goat	641	74.8	MAT	Teshale *et al.*,2007

(Compiled from published articles)

Table 2: Summary of selected *T. gondii* seroprevalence in humans from some parts of Ethiopia

Study Year	Population examined	Test used	n	Prevalence (%)	Reference
	Filariasis patients	DT	52	50.0	De Roever-Bonner, 1980
	Lymphadenopathy patients	IHAT	61	8.2	Tsega and Belehu, 1980
1981–1982	General population	ELISA	614	42.0	Mengesha *et al.*, 1984
	Males aged 13–16 years	ELISA	20	95.0	Lopez *et al.*, 1992
	Pregnant women aged 17–32	ELISA	94	20.2	Eshete *et al.*, 1993
1990–1991	Six geographic area	ELISA	1016	74.4	Gebre-xabier *et al.*, 1993
1995–1996	Factory workers, aged 18–45 years, HIV study, Addis Ababa	DT LAT	170	80.0 77.6	Woldemichaiel *et al.*,1998
	Patients aged 15–49 years	ELISA	456	95.1	Tedla *et al*., 2011
	People aged 15 days–65 years adama hospital	MAT	65	60.0	Negash *et al.*, 2008
2007	Hospitalized patients Addis Ababa	ELISA	330	93.3	Shimellis *et al.*, 2009
2011	Pregnant women	ELISA	201	83.6	Zemene *et al*., 2012
2011	Pregnant women	ELISA	213	81.4	Gebremedhin *et al.*, 2013
	HIV infected and non-infected people	IgG ELISA IgM ELISA	103	87.4 10.7	Walle *et al.*, 2013
	Abattoir workers			97.6	Yimer *et al*., 2005

Adopted from (Dubey *et al.*, 2012)

Conclusion and Recommendations

Toxoplasmosis represents a significant health threat to both humans and livestock, inducing high morbidity and economic losses in Ethiopia. While the occurrence of *T. gondii* is fairly well documented in most countries, little information is available to quantify the resulting impact for the livestock sector and for public health. Thus, the higher sero-prevalence encountered inanimal used as a food source revealed the potential risk of *T. gondii* infection to people might be through consumption of their raw meat and milk. Therefore, awareness creation works should be conducted among public on the means of transmission and prevention of *T. gondii* infection. The prevalence of *T. gondii* in humans in Ethiopia should further be conducted to determine the source of infection too. Strategic andplanned surveyis needed for *T. gondii* prevalence in different age groups, especially pregnant women. The seroprevalence of toxoplasmosis in the human population in three districts of East Hararghe zone in Ethiopia was considerably high. Water source, age, district and presence of cats at home were found to be risk factors for acquiring *T.gondii* infection. The moderately high level of IgM seropositivity indicates the presence of current infection and possible occurrence of congenital transmission during pregnancy.

Epidemiological studies focusing oncongenital toxoplasmosis, and increasing awareness of the disease through education of the people in the study area, are worthy of consideration in the future.Having better impact data would make it easier to convince decision makers to invest in toxoplasmosis control and prevention. In addition, more in-depth epidemiological studies are needed to inform the design of regional strategies and to guide implementation of control programs involving both the medical and veterinary sectors.Given the involvement of the environment in the transmission cycle, attention should also be given to environmental sampling in order to develop adequate transmission models between animals, the environment and people, providing the basis for a real One Health approach in the control of toxoplasmosis.

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