



TRANSMISSION DYNAMICS OF TUNGIASIS IN ETHIOPIA

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Abstract- Parasitic disease Tungiasis is a skin infection of *Tunga penetrans* occurs in mammals including human, frequently found in pets and pig. In this article, we have studied prevalence of Tungiasis in Ethiopian city Jimma and Wolaita Soddoo. During the study subjected animals were, examined clinically, the collected data is analyzed using SPSS at confidence level of 95%. In result we found the much higher prevalence of Tungiasis in Sheep as compared to goat. The risk of Tungiasis infection in human is very high where human come in close contact with pets including household dogs.

Keywords- Tungiasis, Parasitic disease, *Tunga penetrans*, SPSS

Introduction

Tungiasis is a parasitic skin disease caused by the female sand flea *Tunga penetrans*. Both the male and the female flea are hematophagous, but only the female penetrates into the skin of the host, which results in parasite hypertrophy and egg production [1]. Eventually, the flea dies and is sloughed from the epidermis by tissue repair mechanisms. This process may last up to six weeks [2]. If embedded fleas are not removed appropriately, lesions almost invariably become superinfected [3]. This ectoparasitosis occurs in many parts of Latin America, the Caribbean, and sub-Saharan Africa. In Brazil, it can be found both in northern and southern regions. The distribution of tungiasis is patchy, and the disease occurs predominantly in impoverished populations [4-6]. In economically disadvantaged communities, the ectoparasitosis is associated with considerable morbidity [7].

Tunga penetrans parasitizes a broad spectrum of mammals. Domestic animals such as dogs, cats, and pigs are frequently affected. Peridomestic rodents such as *Rattus rattus* are also important reservoirs [11]. It is not known to which extent the occurrence of different animal reservoirs or behavioral characteristics of the human population contribute to the highly diverging prevalence rates reported in the literature. Similar to other parasitic diseases, such discrepancies may also result if attack rates vary over time and if prevalence rates are determined during different seasons of the year. In fact, in northeastern Brazil, local residents claim that tungiasis becomes a scourge every year during the cashew nut harvest, which coincides with the dry season (September).

Transmission of Tungiasis is strictly by infection of *Tunga penetrans*. The flea is able to jump only 20 cm. Hence Tungiasis infections are mostly found on the periungual region of the toes. Rate of incidence and transmission via the ejected eggs among the people, is greatly increased among poor communities because of lack of adequate housing. During the peak of the dry season the rate of infection is high [4]. Only the adult feeds on the mammals and the female stay attached to the host.

Ensuring high quality health care will remain unattainable in most developing countries is due to the lack of interventions targeted at reducing the public health problems. This may be due to the lack of resources or because of neglectance. The frequent occurrence of the parasitic skin disease tungiasis is as a result of deprivation, social neglectance, and inadequate health care behavior [4]. Tungiasis occur in many resources in poor communities in Latin America, the Caribbean and Sub-Saharan Africa. In the endemic area prevalence ranging from 15-50% but cases in other areas is sporadic. The exact prevalence of this disease in different Ethiopian communities is not available. There is a considerable seasonal variation in the intensity of infestation indicating that transmission varies during the year [4]. In the semi-arid Northeast Brazil, attack rates decrease as soon as the rainy season begins and re-increase when the weather becomes dryer. Environmental determined patterns in off-host propagation and development of *T. penetrans* seem to underlie the seasonal variation of attack rates.

Materials and Methods

Study Areas

Jimma

Jimma is the largest city in south west of Ethiopia. Located in the Jimma Zone of the Oromia region, the city has a latitude and longitude of 704°N 36° 50' E. It is 356 kms far from Addis Ababa and has an altitude of 1760 meters above the sea level with mean annual rain fall of 17 mm throughout the year and the annual temperature range is between 10°C-30°C.

According to the study of 2007 census of socio demographic characteristics, the total population of Ethiopia was about 76,946,000 of which 38,463,000 were males and 38,483,000 were females. Based on figure from census 2005, Jimma zone has estimated total population of 2,713,730 of which 1,382,460 are males and 1,391,270 are females.

From Jimma two rural kebele and two urban kebele were selected

using lottery technique. The kebele thus selected are the following.

Jimma Rural

1. Almeyehu mecha
2. Bulbul

Jimma Urban

1. Bossa kito
2. Bossa addis ketema

Wolaita Soddo

Wolaita soddo is 390 Km away from the capital Addis Ababa, Southern part of Ethiopia. Wolaita sodo is located at latitude of 80° 50'N and longitude of 37° 51 45'E. The altitude ranges from 1100-2500 m.a.s.l. This is one of the 13 zones in Southern Ethiopia. Some part of Wolaita soddo is situated in the rift valley and temperature varies from 20 to 42°C.

Wolaita Urban-Gola Kebele and Hibre Teseb Kebele

Wolaita Soddo Rural-Delbo Kebele and Sora Koyo (Bedessa)

Ethical Consideration

Letter of support and permission was written to the Local Administrators from the Jimma University and permission was obtained. Permission was obtained from the Head of the Jimma specialty hospital. Ethical clearance was obtained from the Jimma University Ethical Committee. The participants were informed on the purpose of the study. Privacy and confidentiality was maintained. Honesty was maintained during data collection analysis and interpretation. Written informed consent form and information sheets were prepared in English and translated to local language Oromifa and Amharic were given to the subjects selected for the study. They were informed their right for voluntary participation and withdrawal from the study. Written informed consent was obtained from participants and parents/guardians for those below 18 years of age.

Sampling Technique

One Kebele was randomly selected from each Kefitegna and the sample was distributed to these Kebeles proportional to their population size. A stratified random sampling technique is adopted if kebele is with high population. All house-holds were selected from each stratum and a list of households in the Kebele was prepared and from that every 10th person was taken by simple random sampling by using computer software to study the prevalence of the disease. Data were collected using the standard questionnaire. The list of household animals of the area was taken and animals were examined for Tungiasis. The rodents were caught using rodent trap and were examined for tungiasis.

Data Collection

A standard questionnaire was prepared based on the WHO questionnaire in order to tap information on baseline characters and life style of the study population. Clinical evaluation of the afflicted subjects was conducted to reveal the severity of the infection and sufficient photographs had been taken. The quality of the work was ascertained by the regular visit and direct supervision by Principal Investigator and Co-investigators.

Clinical Examination

Whole body surface of different animals were examined for the presence of vital, egg-producing, involuting, or dead fleas and lesions produced by the fleas, especially on the soft body part like udder, genital area and between hooves. During the examination of the animal, location and number of lesions and clustering of lesions were noted, and the following signs and symptoms were observed: Circular lesion with dark or reddish spot in the centre with the loss of hairs, presence of tungiasis egg, difficulty in walking and projected lesion with hyper keratinisation of the skin.

Statistical Analysis

The data collected were entered in computer daily and data were analyzed using frequency distribution, Fisher's Exact test and Pearson Chi - square using SPSS version-16. Data is interpreted at 95% level of confidence.

Results and Discussion

Socio-demographic Characteristics

This study covered house-holds with a total population of 2795 distributed in eight different kebeles of two distant areas, Wolaita sodo situated in the southern part of Ethiopia and Jimma located in the south western part of Ethiopia. All kebeles included in the study are located in high altitude except one kebele in Wolaita sodo, the Bedessa kebele which is located in a rift valley. For easy listing, we coded each area as following. Area 1 to Area 4 belongs to Wolaita soddo and area 4 to area 8 to Jimma. Wolaita and Jimma are two distant areas on southern and south western part of Ethiopia. Area 1 - Delbo kebele and area 2 Sora koyo (Bedessa) represents Wolaita rural. Area 3 Gola kebele and Area 4 Hebre represents Wolaita sodo urban. Almeyehumecha (Area5) and Bulbul (Area 6) belongs to Jimma rural. Bosa addis and Bosa kito, Area7 and 8 are Jimma urban kebeles. This study covers all age groups from age 1year to 85 years [Table-1]. It was noticed that the number of elderly people above 50 years were less compared to other age groups and above 70 years were very less. In the rural villages of Ethiopia people used to keep household animals inside their kacha houses because of the fear of theft or wild animal attack.

Table 1- Prevalence of Tungiasis in animal reservoirs

Animals Studied	Jimma Rural			Jimma Urban			Wolaita Rural			Wolaita Urban		
	n	Pos	%	n	Pos	%	n	Pos	%	n	Pos	%
Dog	42	0	0	38	0	0	48	0	0	32	0	0
Cat	16	0	0	12	0	0	17	0	0	9	0	0
Horse	14	0	0	18	0	0	21	0	0	9	0	0
Donkey	16	0	0	12	0	0	28	0	0	21	0	0
Cow/ox	126	0	0	54	0	0	148	0	0	36	0	0
Sheep	152	36	23.7	88	13	14.8	122	34	27.9	88	26	29.5
Goat	123	4	3.20%	58	0	0	28	0	0	12	0	0
Rat	12	0	0	16	0	0	0	0	0	8	0	0

Our studies on household animals [Table-1] indicate that there is high prevalence of tungiasis in sheep and very rarely in goat. In Jimma rural prevalence rate in sheep was 23.7%, Jimma urban 14.8%, Wolaita rural 27.9% and Wolaita urban 29.5%. The prevalence rate of tungiasis in goat was 3.2% in Jimma rural and all other areas it was negative. In Tungiasis positive animals, lesions were seen in between the hooves [Fig-1].



Fig. 1- Different stages of Tungiasis lesions in between the hooves of sheep

The shortcomings of the existing studies are that they are cross-sectional examinations and do not allow to assess to which degree individuals of a community have been exposed. However, the understanding of factors governing local transmission is crucial for the planning of control measures. Precise assessment of transmission would also be helpful in identifying individuals who disproportionately contribute to the spread of the ectoparasites and/or who are most vulnerable for the development of severe disease. Seasonal variation of prevalence and infestation intensity indicates changes in the dynamics of the flea population that are related to climatic variables. Conceivably, high humidity in the soil impairs the development of free-living stages of *T. penetrans*. Furthermore, heavy rains may simply wash away eggs, larvae, pupae, nymphs, and adults. Interestingly, in rural communities in Ceará, the local population irrigates the soil of their compounds to reduce attack rates.

Tungiasis is a zoonosis and affects a broad range of domestic and peridomestic animals. *Tunga penetrans* causes tungiasis in humans, pigs, dogs, cats, rats, sheep, cattle, donkeys, monkeys, elephants and other mammals [1,2]. Where humans live in close contact with these animals and where environmental factors and human behavior favor exposure, the risk for infection is high [5]. In Brazil, dogs are commonly infested with prevalence reaching 67.0% in urban slum [10]. It is known that animal reservoir play an im-

portant role for transmission dynamics in endemic communities. Several authors reported severe disease in pigs from different African countries, such as from Sao Tomee Principe, Zaire, Cameroon, and Tanzania [12,13]. Previous reports on animal reservoir suggest that the animal reservoirs changes from place to place depending on the availability of the preferred host [14].

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