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LEISHMANIASIS AND ITS CONTROLS APPROACHES IN ETHIOPIA: MINI REVIEW

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AUTHOR'S CONTRIBUTION

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ABSTRACT

Introduction: Leishmaniasis is an infectious and disfiguring vector-borne disease caused by protozoan of the genus *Leishmania* under family *Trypanosomatidae* but with different subgenus transmitted by infected phlebotomine sand flies. In general, the disease divided into cutaneous leishmaniasis, which attacks the skin and mucous membranes and causes disfigurements, and visceral leishmaniasis (calazar), which attacks internal organs. The narrative review which covers all information about leishmaniasis disease prevention and control is needed to bridge the gap between different interventions being applied. In Ethiopia there are no single approaches to prevent and control Leishmaniasis which is being challenged for disease elimination with single and integrated methods.
Objective: The main objective of this review is to dig out and suggest the best leishmaniasis control approaches for planning future control strategies in Ethiopia.
Methods: Articles (research and review) published on peer-review journals through Google scholar about leishmaniasis distribution and transmission, challenges and control efforts, and future needs were reviewed. Most specifically as one health concept, all related disciplines in Ethiopia and their role in controlling the disease are reviewed and discussed to direct future strategic plans in controlling the leishmaniasis disease.
Conclusion: A single intervention could not achieve the goal of control. One health approach is a holistic view of distinct best control approach with many disciplines of human medicine, veterinary medicine, environmental science, and agriculture and wildlife conservation through the linkage of their responsibilities. One health approach is a new paradigm that began to dominate ideas, clinical practice and epidemiological research on human disease. Entomologist engagement in this approach increases the quality of control through identifying the vector and vector human interaction with possible breeding sites. This will help to develop systemic institutionalized medical education and health care systems to increase the distance between human, vectors and animal reservoir hosts.

Keywords: Leishmaniasis; control approaches; sand fly; Ethiopia.

1. BACKGROUND

Leishmaniasis is an infectious and disfiguring vector-borne disease caused by protozoan of the genus *Leishmania* under family *Trypanosomatidae* but with different subgenus transmitted by infected phlebotomine sand flies [1]. The disease comprised both zoonotic and anthroponotic transmission [2]. Leishmaniasis is mostly known as endemic in 98 countries with greater than 350 million at-risk people [1] and 900,000–1.3 million estimated new cases and 20,000 to 30,000 deaths occur annually [2]. There are

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four clinical forms Leishmaniasis disease in human: cutaneous *leishmaniasis*, mucosal *leishmaniasis*, diffuse cutaneous *leishmaniasis* and visceral *leishmaniasis* [3]. Cutaneous l*eishmaniasis* which is less severe involves the skin and manifests self healing ulcers. Cutaneous leishmaniasis that produce skin lesions mainly on the face, arms and legs and self healing form creating serious disability and permanent scars. Mucocutaneous that affects the mucous membranes resulting in disfiguring lesions of the nose, mouth and throat mucous membranes. The most severe form of the disease known as Visceral leishmaniasis is affecting visceral organs and can result in 100% mortality of infected patients if not treated [3,4]. Diffuse cutaneous *leishmaniasis* (DCL) is difficult to treat due to disseminated lesions. In this case, the disease resembles leprosy, does not heal spontaneously and is related to a defective immune system. Relapses are often known characteristics of diffuse cutaneous Leishmaniasis after treatment. Mucosal leishmaniasis causes disfiguring lesions to the face, destroying of the mouth, nose and throat membrane [5]. The most severe form of Leishmaniasis disease is Visceral ('kala azar') characterized by irregular fever, weight loss, swelling of the liver and spleen and anaemia. This form involves the internal organs and includes up to a year incubation period [6]. Leishmaniasis disease is widely distributed throughout the world at the range over the inter-tropical zones of America, Africa, and broadens into temperate regions of South America, southern Europe and Asia [7,8]. Due to migration of people from rural to urban areas, climate change and human intervention, deterioration of socioeconomic conditions, the presence of HIV co-infection, mostly in the last two decades, there has been a worry in the increase of Leishmaniasis incidence [9]. It is also considered an emergent and re-emergent disease and is prevalent in tropical and sub- tropical areas. The increase in international travel is the main factor for Leishmaniasis occurrence in people living in non endemic areas [10]. People living in a significant portion of Ethiopia are affected by the disease. The disease of leishmaniasis in Ethiopia resulted from Economic impact that limited the high cost of treatment and time lost during hospitalization. The disease affects poor communities in the rural areas mostly during harvesting seasons [2]. Control strategies and prevention measures for leishmaniasis failed in case management, case detection and treatment, vector and reservoir control. Controlling sand fly in domestic and per domestic transmission habitats is an effective strategy for reducing human leishmaniasis [11]. There are also many other control methods being used in Ethiopia like personal protection, chemicals, environmental management and Health education [12,8]. The Ministry of Health established a Team near to high VL endemic regions as a strategic plan. The deployed team was to play a role in strengthening early case detection, Outbreak identification and response, community awareness and surveillance. The main focus of the team was prevention and control of VL through treatment of infected human cases alone in Ethiopia. The health of animal reservoir host control should be included within the vector control strategic plan to be effective in Leishmaniasis control [2]. Thus, the main objective of this review is to dig out and suggest the best leishmaniasis control approaches for planning future control strategies in Ethiopia.

This review also indicated the parasite and its vector, Epidemiology and history, geographic distribution, Burden, public health significance, challenges and the past and present efforts related to leishmaniasis in Ethiopia. Most specifically, many disciplines have worked so far in Ethiopia and their role in controlling the disease is reviewed and discussed to direct future strategic plans in controlling the disease. The responsibilities of these disciplines and how they cooperate and work together under one health concept is discussed.

2. LEISHMANIASIS EPIDEMIOLOGY

The broad Leishmaniasis distribution can be subdivided into new and old worlds. The new world includes America and the Old world includes Africa, Asia and Europe [13]. The species of Leishmania are associated with one or other of the two. The vector of Leishmania is known to transmit both Anthroponotic and Zoonotic disease [14].

From 31 species causing Leishmaniasis, about 21 species are causing Human infection from mammals. In Ethiopia, the Leishmaniasis (L) *Donovani complex*: *L. donovani* and *L. infantum* are the most known species to cause Visceral Leishmaniasis [15]. Visceral leishmaniasis disease is transmitted from human to human, human to animal, animals to animals or animal to human through the vector because of a complex life cycle. Understanding the complex life cycle of Leishmaniasis will be the basic and most important to tackle challenges in Visceral Leishmaniasis prevention [2].

In the world there are many *Leishmania* reservoirs. It is most commonly found in mice and hamsters, sloths, opossums, small forest rodents such as the hydrax and peri-domestic dogs. Epidemiologically, dogs are known as a reservoir host in the VL transmission because of their close relationship or coexistence with humans. The immunological status (inability) of the dogs for the disease is also another factor to transmit the disease. The dogs infected with Leishmaniasis can not show any symptoms in most of the endemic areas [16] and the most commonly affected species. *L. infantum* is mostly known to cause canine leishmaniasis. The disease is also observed occasionally in cats, horses, donkeys, and mules infected with various species of Leishmania. Clinical cases have been reported in rodents and wi8ld animals, captive wild species, bush dogs, wolves and non-human primates. In Ethiopia, mountain hyraxes are known to be the main reservoir host for *L. aethiopica* [7]. The spread of Leishmaniasis diseases includes the southern lowland like south-western savannah and the southeastern semi-arid lowlands. The Omo and Abaroba plains and the Woyto, Kijawa (Gambella) and Segen River valleys in the SNNPR, Afder and Liben in the Somali regional state. Northern lowland, Metema and Humera plains, TahtayAdiabo and MirabArmacheho and Welkaite in Amhara and Tigray regional state. The Highlands, Cuttaber (Dessie), Gibdo and RayaKobo in Amhara, Aleku (Wellega), Sebeta and Bale in Oromia, and Ochollo (GamoGofa) and Sidamo in SNNPRs [11]. Socio economic factors, population movement and Environment and climate changes are the main determinant factors associated with the spread of the disease in Ethiopia. Epidemiological data, clinical features and Laboratory test results are the main primary criteria to diagnose leishmaniasis disease [13]. Parasitological diagnosis which is the gold standard, microscopy and culture as conventional techniques are the standard approach left being used in leishmaniasis diagnosis in endemic areas. Molecular diagnoses are more sophisticated techniques rarely available and more expensive to use than other methods of diagnosis [17].

3. PARASITE AND VECTOR

Leishmaniasis disease is known from family Trypanosomatidae and order Kinetoplastida belongs to the genus Leishmania [18]. There are two main groups of leishmaniasis parasites; the species of the old world that is occurring in Europe, Africa and Asia, and the new world species occurring in America [1]. Of 53 species of leishmaniasis parasite identified from different regions of the leishmaniasis world, 31 species are described as a parasite of mammals and 20 species as a parasite of human beings. Zoonotic leishmania is a disease that mainly infects humans with very complex vibration in domestic and wild mammal reservoir hosts and anthroponotic parasites are known with the transmission of human to human at the presence of the vector [7].

There are two morphological forms of Leishmania parasites, the flagellate form which is called Promastigotes and the flagellated form called amastigotes [14]. The promastigote form develops inside the mid guts of the leishmaniasis vector, Sand fly. Metacyclic-promastigotes are regurgitated with immune modulator parasite-derived and many other salivary components during blood feeding. Rapid phagocytosis takes place by responsible cell types found in the local environment. These cells are neutrophils, tissue resident macrophages or dendritic cells (DC) or monocyte derived DCs (moDCs) [19]. The metacyclic-promastigote transformed to non motile amastigote form after the establishment of an intracellular niche. Within the host cell, there should be replication of the amastigote, followed by rupturing too many amastigote and allowing reinfection to phagocytes [1]. To indicate complete transmission the infected phagocytes taken up by another sand fly during blood meal and the amastigote transformed into promastigote in the vector mid-gut. Leishmania parasites also infect mononuclear phagocytes leads to produce various chemokines that support in recruitment of neutrophils [20].

The infectivity of the parasite in mammalian hosts is promoted by an important molecule known as LPG which also provides an opportunity for the parasite to survive inside phagosomes by altering [7]. Leishmania parasite can hide itself in skin and lymph node fibroblasts and infected inflammatory moDCs may facilitate parasites to reach the draining lymph node. Lysosome fusion occurs with the help of GTPase RAB7 is observed in mature DCs only [19].

The distribution of leishmaniasis species determines the type of disease that is caused in an area. Among these species *L. donovani* is known to cause visceral leishmaniasis in South Asia and Africa and *L. infantum* causes the same disease in the Mediterranean, the Middle East, Latin America and parts of Asia. Leishmania major causes cutaneous leishmaniasis in Africa, the Middle East and parts of Asia; while *L. tropica* causes this disease in the Middle East, the Mediterranean and parts of Asia, and *L. aethiopica* causes cutaneous disease in the horn of Africa [5]. In South America, again several species of Leishmania cause a cutaneous form of the disease. *L. donovani* and *L. ethiopica* are the most known parasites in Ethiopia to cause visceral and diffuse cutaneous leishmaniasis respectively [7].

The disease Leishmaniasis is caused by the protozoan parasite transmitted by the bite of infected female sand flies [17]. Over 600 sand fly species known that are divided into five genera responsible for transmission of leishmaniasis are classified as old and new worlds. Old world species include: Phlebotomus and Sergentomyia and new world: Lutzomyia, Brumptomyia, and Warileya [1] are the vectors that are proven for transmission of human leishmaniasis from species to subspecies of the genus Phlebotomus and Lutzomyia. One species of sand fly can transmit only one parasite which is more specific [21]. The development of leishmania parasite within the vector sand flies is an inevitable stage for the transmission of leishmaniasis among various hosts. During blood meal on mammalian hosts Female sand flies acquire leishmania parasites. The amastigote forms an intracellular parasite found in macrophages and other phagocytes and presents itself in the skin taken up by sand flies through the cutting action of mouthparts. Because of this sand flies are said to be pool feeders [7].

4. GEOGRAPHICAL DISTRIBUTION

The spread of Leishmaniasis disease is covered most distinctly from tropics to sub-tropics of Africa, South to Central America, the Middle East, Southern Europe and Asia to be known in different geographical regions of the world [6]. The sand fly species that act as vectors, their ecology and the conditions of internal development of the parasite determines Geographical distribution of disease [15]. Visceral Leishmaniasis is found in Tigray, Amhara, Oromia, Afar, Somali and SNNPR, whereas CL is prevalent in Tigray, Amhara, SNNPR, Addis Ababa and Oromia regions [22]. Micro ecological conditions, the main determinant factors for vector population, the vector itself, the parasite and the reservoir hosts are associated with the focal distribution of leishmaniasis and transmission. Urbanization, domestication of the transmission cycle, development of agriculture and settlement near forested areas are expressed in terms of Environmental changes that can affect the incidence of leishmaniasis [7]. Other factors like rain fall, atmospheric temperature and humidity (climate sensitive disease) are important to affect the distribution of leishmaniasis parasites. Human activities like land degradation leading to Global warming are expected to affect the epidemiology of leishmaniasis [23].

5. HISTORY OF LEISHMANIASIS IN ETHIOPIA

In Ethiopia leishmaniasis, typically cutaneous, has been known since 1913 and is endemic in most regions [3]. Even though CL is known first to have appeared in Ethiopia, VL is the fatal health problem and the first case was documented in 1942 in southern parts of the country in the lower Omo plains with the most important endemic foci Humera and Metema plains in the northern west. The disease has spread to become endemic and prevalent mostly in lowlands and arid areas with the *L. donovani* parasite. Estimated annual incidence of this disease is about 4,000 cases. *L. aethiopica*, *L. tropica*, and *L. major* are the most responsible species to cause cutaneous Leishmaniasis (CL) in the country. L. aethiopica causes both diffuse and localized leishmaniasis that is found in the highland parts of the country. The first case report of diffuse cutaneous Leishmaniasis was in 1960 which is becoming high in the high lands currently [24]. *L. aethiopica* occurs only in Ethiopian and Kenyan highlands with the reservoir-host hyrax and the vector *P. larroussius*. Localized, Mucosal and diffuse cutaneous Leishmaniasis are the known three clinical forms of CL. In Silti district, an outbreak of 300 CL cases took place between 2003 and 2005. There are an estimated 50,000 cases yearly, but only 450 cases were reported in 2008 [3]. There are three clinical forms of CL in Ethiopia: localized CL, Mucosal (ML) and DCL, all mainly caused by *L. aethiopica*. CL is most common in children, with the highest prevalence occurring between 10 and 15 years of age. The vector is associated with Red Acacia and balanites trees in the north, and termite hills in the south [25]. Because of an extensive program of agricultural development with an annual influx of migrant workers in the Tigray region, the case of Leishmaniasis in Ethiopia has increased since 1970. In 1940s south western foci, the lower Omo plains that includes Aba Roba focus, the oldest and known in which the first VL identified. Most of the population in this area has been exposed to the disease and acquired immunity [15]. In 1995 VL appeared to be more serious, claiming the lives of about 100–200 temporary farm labourers in Metema and Humera plains. An outbreak of VL has occurred in Amhara region (Libokemkem) with 2,500 cases and initially a very high mortality between 2005 and 2008, where VL had not been reported before. More than 2,500 cases of Visceral Leishmaniasis (VL) were treated each year starting from 1998/1999. It was also known in the lowlands of the northeastern Rift Valley of Ethiopia (Awash Valley) with high population immunity. The known VL Epidemiology changed to a new epidemiological pattern that was seen in Libokemkem and Fogera district, affected by the recent epidemic at High lands on one peasant association in 2003. The incidence was decreased by 2007 in these areas [26]. In Ethiopia a national Leishmaniasis task force was established aimed to eliminate VL by 2015 after the reorganization of MoH in 2007. Efforts made by the MoH so far to control VL are notwithstanding its upsurge and, hence, VL is developing both on a spatial and temporal basis [15]. By understanding the current condition with Leishmaniasis, this reviews all previous work done to indicate other preferred control methods to tackle this disease.

6. PUBLIC HEALTH SIGNIFICANCE OF LEISHMANIASIS

Leishmania species can be carried by the People for a long period of time with any clinical symptoms. The incubation period of Leishmaniasis specifically for cutaneous leishmaniasis can be 1-2 weeks if it is short or very long when it is caused by new world species in humans. It may take up to a year if the disease is caused by old world species. The incubation period for visceral leishmaniasis is 10 days to several years; most cases seem to become apparent in two to six months. Their clinical signs and disease forms are also different [27]. All types of Leishmania lead to big health problems in endemic areas, especially in rural areas of Ethiopia. Painless skin lesions are unless they cause secondary infection. Skin lesions may result in regional lymphadenopathy that occasionally persists after the lesion has healed. A rare form of skin disease called diffuse cutaneous leishmaniasis that is caused by *L. amazonensis* and *L. mexicana*. It causes skin lesions that tend not to ulcerate, but appear as nodules, papules and tubercles that spread widely on the skin [7]. These lesions may cause damage to deep tissues, and can persist indefinitely. Another form is muco-cutaneous that occurs after the occurrence of cutaneous leishmaniasis healed and can develop skin lesions. It also usually includes erythema and ulceration at the nares at the first, Frequent Nose bleeding and itching in the nose, destructive inflammation following the early sign with ulcers and nodules spread to the nasal septum. In some cases, Genitalia and oral cavity, pharynx or larynx may also be involved [27].

An insidious and chronic form is visceral leishmaniasis disease among the inhabitants of endemic regions. Prolonged undulant fever, weight loss, decreased appetite, signs of anemia and abdominal distension including splenomegaly and hepatomegaly are the most known symptoms. Sometimes primary granuloma may appear on the skin before systemic signs become evident, particularly in Africa. Bleeding tendency that involves petechiae/hemorrhage may be caused by Thrombocytopenia on the mucous membrane [10]. Coughing, chronic diarrhea, darkening of the skin, lymphadenopathy, edema and signs of chronic associating with particular organisms are other reported signs of visceral leishmaniasis [13], typical symptoms shown on People who are immunocompromised. If early treatment is not given visceral leishmaniasis, most fully symptomatic cases are eventually fatal, often from secondary infections and other complications. Some people who recover from visceral leishmaniasis develop PKDL. People with successfully treated infections may continue to carry the parasite, and the disease may recur if they become immune suppressed. Usually within six months of visceral leishmaniasis, PKLD is common in Africa, and often disappears spontaneously within a year if the mucous membranes are not involved. In other countries like the Indian subcontinent, this syndrome is not very common, occurs one to many years after visceral leishmaniasis has been cured, and may require prolonged treatment to resolve [27].

7. DIAGNOSIS AND TREATMENT

Leishmaniasis can be diagnosed by direct observation of the parasites specifically for cutaneous PCR, immune-histo-chemistry or culture, as in animals. A delayed hypersensitivity test, the leishmaniasis skin test, may be useful in the diagnosis of cutaneous and muco-cutaneous leishmaniasis, especially outside endemic areas. Parasitological techniques including direct observation of parasites and detection of nucleic acid by PCR [27]. Because of Cross-reactivity with the agents of other diseases, such as leprosy, Chagas disease, malaria and schistosomiasis, serological tests are very important. Leishmaniasis can be treated with pentavalent antimonials where the parasites are sensitive to these drugs, allopurinol, liposomal amphotericin B, paromomycin and miltefosine. but drug resistance is a major problem in some areas. Cryotherapy, thermotherapy, photodynamic therapy, CO2 laser treatment or curettage have also been employed in some cases, either alone or in combination with drugs. Some cutaneous lesions that are improving may simply be observed, if they are caused by relatively benign organisms [7].

8. BURDEN OF LEISHMANIASIS

The burden of leishmaniasis in the area where it is largely known is likely be underestimated and being increased because of increasing migration, climate change and impaired community, resulting from different aspects of living standard of the community including malnutrition and co-infection with HIV [7]. Even though there is a dearth of recent information on the distribution and burden of VL in Ethiopia, the case reporting system is very poor [26]. An estimated annual incidence of visceral leishmaniasis in Humera is between 1,500 and 2,000 which is a devastating epidemic [27]. According to Tefera*et al.* 2015 research study on visceral leishmaniasis in Metama, the diseaseburden is decreasing and male is highly affected because of high exposure to the leishmaniasis vector [28]. According to WHO Ethiopia 2015 report, VL case is 2,141, CL is 528 and PKDL is 11, where there is no case report of MCL. The table below shows the overall incidence and case report of WHO, Ethiopia 2015.

Table 1. Epidemiology, cases and incidence of all forms of Leishmaniasis in Ethiopia (as of 2015 WHO) to indicate the disease burden [29]

Epidemiology	VL	CL	PKL	MCL
Endemicity status	Endemic	Endemic	Endemic	Endemic
Number of New cases	2,063	No data	11	6
Number of Relapse case	67	No data	0	0
Total Number of cases	2,141	528	11	0
Imported cases (%)	73.4%	No data	N/A	N/A
Incidence rate/1000population in endemic areas	6.28	1.05	N/A	N/A
Population at Risk	3%	5%	N/A	N/A

9. THE PAST AND PRESENT EFFORTS

Efforts given to control the diseases are either nonexistent or remain sub-optimal and are repeatedly conducted in response to epidemic outbreaks. The most likely known measures needed to control leishmaniasis comprise standardized surveillance and way of reporting, prompt and effective treatment, community education and targeted distribution of LLINs [5]. As the WHO 2017 report on the burden of Leishmaniasis in Ethiopia shows, there were established in 2006 and 623 Leishmaniasis Health facilities in Ethiopia and in 2013 the latest national Guideline was prepared. Though, Integrated type of surveillance was undertaken, there are no vector and Reservoir host control programs being applied for Leishmaniasis. In addition to this, IRS has not undertaken focusing on the disease and no new strategies or efforts are still available [29].

10. CHALLENGES AND FUTURE NEEDS

Changes in the environment, demography, Human behavior, socioeconomic status and immune genetic profile of affected populations are challenging factors that made the Leishmaniasis epidemiology to be dynamic and the condition of disease transmission not to be constant [3]. In resource-poor countries like Ethiopia, case identification, diagnosis, treatment and preventive measures taken are difficult because of these determinant factors. Leishmaniasis disease has more complex life cycles that involve humans and animals. The disease is transmitted from human to human, human to animal, Animal to animal and Animal to human through the vector. The reservoir host is typically not clearly addressed in Leishmania endemic areas, especially in Ethiopia. Single animal reservoirs for VL are not identified clearly in Ethiopia [2]. The vector distribution in different geographical settings and absence of proper sand fly control strategies in endemic areas makes the vector control difficult [27]. Missing scientific elimination strategy of sand fly is based on the epidemiological vulnerability and effectiveness and feasibility of intervention [2]. Insecticide resistance is another big challenge which is becoming more widely spread in areas where insecticide has been used for a long time. Incomplete knowledge about the vector susceptibility spectrum to insecticide in endemic areas is also another challenge [9].

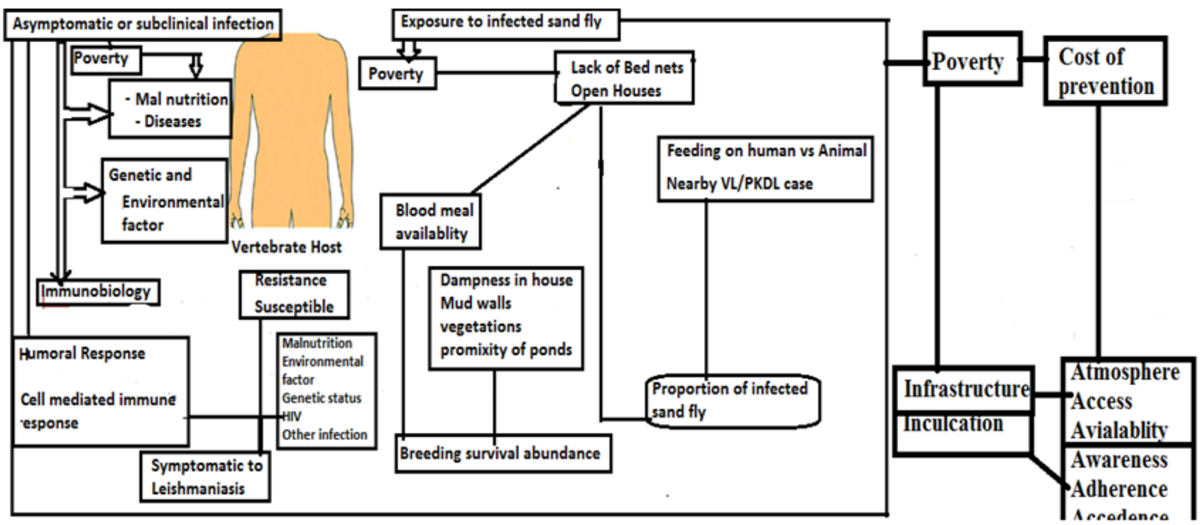

Fig. 1. Factors Associated with the disease transmission and related challenges

Dynamic Transmission complexity of the disease, absence of vector control strategy and community awareness, limited trained health professionals and diagnosis approach in endemic areas are the major challenges to control the disease [18]. Sand fly, a vector of Leishmaniasis control, is challenging because their Larvae develop in largely unknown and complex habitats that make them resistant to available control measures. The behavior patterns of different sand fly adult species are highly diverse and require tailor made control solutions. This can be performed with highly profound knowledge of vector ecology [30]. There are many different sand fly control strategies being applied currently. Combination of different control approaches is very necessary under various conditions [31]. In line with this, giving focus on investigation of the vector ecology and epidemiology will be required to determine the most appropriate control methods particularly [22]. The control methods or approaches include: Larval Source Management, Chemical control, integrated vector control, Environmental management, Treatment and diagnosis and Intersectoral collaboration [31].

11. CONTROL APPROACHES

11.1 Larval source Management (LSM)

Larval Source Management is one of the best control methods used to manage targeted vector breeding sites to reduce Larvae and pupae numbers. Currently larval source management is being used as a supplementary vector control measure and not to be used to replace core vector control interventions, such as LLINs and IRS [32]. Environmental management is effective in controlling Leishmaniasis vectors at known breeding sites of the vector, with field investigation prior to the practice. Knowledge about vector behavior is the basis to manage the environment of sand flies, favorable seasons, active breeding sites, accessibility and productivity by species [33]. Environmental management includes, source reduction that may involves habitat modification, which means a permanent alteration to the environment, e.g. land reclamation or surface water drainage and habitat manipulation, which refers to a recurrent activity e.g. water level manipulation, flushing of streams, the shading or exposure of habitats [32]. Understanding the larvicide impact on the environment in terms of controlling vector's larva and pupa, which involves the regular application of a biological or chemical insecticide to water bodies to direct or address the Way forward to use LSM [34]. The basic advantages of LSM, especially in Leishmaniasis endemic areas is to eliminate or substantially reduce mosquito breeding habitats and diminish the need for repeated application of insecticides. To do with LSM, all Intersectoral from different disciplines can be involved, because it needs collaboration to use all its classes.

11.2 Cross Border Cooperation Approach

Cross border collaboration on Leishmaniasis control is another approach to prevent importation of cases from neighboring and other endemic countries through migration and tourism. Setting up cross border collaboration with joint epidemiological survey and assessment is important to synchronize and harmonize activities of control and prevention of Leishmaniasis in border areas [31]. This approach may also include closer coordination with other neighboring countries at similar eco-epidemiological settings of vector-borne diseases. Health delivery always relies on cooperation through multitude actors in health systems to ensure high quality and sustainable health services. There is no reason to stop cooperation in vector borne disease control at national borders [35]. As it is clearly known, health systems become interconnected and patients and providers move across borders, better coordination of health systems and more cooperation between various actors within them is needed to achieve optimal results in different member states. In Ethiopia disease control through cross border collaboration is less, which is an often neglected approach to involve Community sensitization, mobilization and information sharing [2]. Based on scientific evidence and information available and disseminated without delay, are crucial for an effective and urgent response especially in Ethiopia. IVM will be the best control method if cross border collaboration is included. This may be used by basing on local evidence to collaborate with other different divisions in different sectors in different places to improve Vector control including policy analysis made for identifying the strength and weakness of the approach to prepare effective and consistent IVM strategy in Ethiopia [36]. Cross border collaboration within the country, between endemic and non endemic with different work offices or departments, even between two or more neighboring countries is the most option-less approach to control vector-borne diseases.

11.3 Environment, Agriculture and Health: Sectoral Cooperation

The effective Leishmaniasis control will be achieved in conjunction with other strategies of disease control treatment of affected humans, vaccinations and elimination of reservoir host comprising sand fly control [30]. The problem related with Leishmaniasis disease control could be addressed through shared understanding information of Intersectoral collaboration in the disease endemic area, particularly in Ethiopia. The Intersectoral collaboration may includes all non health and Health sectors like Environmental, Agricultural, social services, national and local veterinary services these stimulated through Ministry of Health [32]. More closely cooperation of many sectors that are concerned exclusively with sand fly borne disease to include those that address environmental and social health determinants is a more acceptable approach in order to give urgent response to the leishmaniasis control problem in Ethiopia. Greater Intersectoral collaboration maximizes health benefits and lowers the environmental and health costs of agricultural activities [36]. Understanding the interference between Animal and human is needed to build capacity for searching and manage associated disease risk which expressed in terms of Zoonotic disease and livelihoods. Among mostly known breeding sites of Sand fly, forest is the one [37]. Agricultural development and families need water in general. So that Agriculture, water and health interact in many ways. Irrigation increase agricultural productivity and disease transmission through creating conducive environment for the vector breeding. Working cooperate with many sectoral will be the best approach of Leishmaniasis control and increase environmental health [38].

Environmental, Agriculture and Health action plan to improve knowledge and communication and review policies that enhance the cooperation between Environment, health and research fields to lower the adverse health impact of agriculture and environment. Management of irrigation and certain agricultural practices could reduce vector breeding; rural development programs or construction projects could prevent vector breeding by adopting new standards or educating communities [36]. In Ethiopia Integration and coordination among vector borne disease control program remain negligible because of inappropriate requisite regulatory and legislative framework for public health, minimal evidence-based decision-making to provide technical guidance to policymakers and program managers, limited operational research and spatio-temporal mapping of vector-borne diseases and need for medical entomologists and vector control specialists [39].

11.4 Medical and Veterinary Professions

Though one health initiative is derived by the veterinarians, how veterinarians' scientific contribution to human public health is not fullyrecognized by medical professions [40]. Animal reservoir host identification is the main problem in controlling vector-borne diseases in Ethiopia. This results in Animal case treatment and prevention not being given and human infection becoming high. Animal reservoir hosts should be identified, diagnosed and treated in areas where human cases live. In this case Veterinarians should play a major role in recognizing, diagnosing and responding to Leishmaniasis in reservoir hosts [2]. Closer moving of Domestic animal and human populations with traditional wildlife habitats increases the risk of cross species transfer Leishmania infection agents. To avoid these associated disease problems, medical and veterinary professions should work together to enhance the control of Leishmaniasis through treating and diagnosing the reservoir host and human [38]. In general collaboration and communication between veterinary and medical professionals in Leishmaniasis control has not been largely undertaken, which is considered a neglected approach [2].

12. CONCLUSIONS

Leishmaniasis is an infectious disfiguring vector borne protozoan disease that is caused by the obligate intracellular protozoan of the genus *Leishmania*. The protozoan parasite is transmitted from one host to another through the bites of female sand fly and the primary reservoir hosts of Leishmania are sylvatic mammals, such as forest rodents, hyraxes and wild canids, and among domesticated animals; dogs are the most important species in the epidemiology of this disease. Leishmaniasis has a wider geographical distribution pattern with growing public health concern for several countries, including Ethiopia, and this is mainly due to risk factors such as environmental, demographic and human behavior contributing to the changing landscape of leishmaniasis. Bed net distribution and insecticide spraying is being applied for Leishmaniasis control in the context of malaria without a leishmaniasis vector control program. This results in a high prevalence of Leishmaniasis diseases in the country due to the complex biological system of transmission. A single intervention could not achieve the goal of control. One health approach is a holistic view of distinct disciplines of human medicine, veterinary medicine, environmental science, and agriculture and wildlife conservation through the linkage of their responsibilities. Entomologist engagement in this approach increases the quality of control through identifying the vector and vector human interaction with possible breeding sites. One health approach is a new paradigm that began to dominate ideas, clinical practice and epidemiological research on human disease. One health concept is often a neglected concept in Ethiopia to control Leishmaniasis, but it is a worldwide strategy. Expanding interdisciplinary collaboration and communication in all aspects of the health care for man, animal and environment is a successful approach in developing countries like Ethiopia. This will help to develop systemic institutionalized medical education and health care systems to increase the distance between human and animal reservoir hosts.

DISCLAIMER

There are no products used or human and animal issues during this review work. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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