An Overview of Filariasis

03

Gulzar Ali Junejo, Sana Noor Panhwar*, Altaf Hussain, Majid Hussain Soomro, Zainab Lanjar, Reema Bughio, Shaista Jalbani and Habibullah Janyaro

ABSTRACT

Filariasis is endemic in the tropics and subtropics, caused by nematode parasites, "filariae," which belong to the family “Filarioidea” It consists of many species of slender, long worms that inhabit the tissues of various vertebrate hosts. The adult worms have a width of 0.25-0.30 mm and a length of 80-100 mm. This infection is circulated via arthropod vectors. More than 882 million individuals across 44 countries globally are still at risk of lymphatic filariasis and need preventive treatment to halt the spread of this parasitic disease. In addition, filariae are frequent worms in both animals and humans since parasites belong to the invertebrate class. However, it is difficult to prove that a filarial infection is a zoonosis; this illness may spread spontaneously from animals to people. To generalise and categorise whether the different filariasis are zoonoses. However, generalisations and classifications have been made using mosquito host preferences and the relative vulnerability of humans and other animals to infection. Given the correct circumstances, virtually every animal that is a host for filaria parasites has the potential to infect and spread to humans.

Key words: Filariasis, Zoonosis, Public Health.

CITATION

Junejo GA, Panhwer SN, Hussain A, Soomro MH, Lanjar Z, Bughio R, Jalbani S, Janiryaro H, 2023. An overview of filariasis. In: Abbas RZ, Hassan MF, Khan A and Mohsin M (eds), Zoonosis, Unique Scientific Publishers, Faisalabad, Pakistan, Vol 2: 37-44. https://doi.org/10.47278/book.zoon/2023.50

CHAPTER HISTORY Received: 09-May-2023 Revised: 18-July-2023 Accepted: 25-Aug-2023

Shaheed Benazir Bhutto University of Veterinary and Animal Sciences Sakrand Sindh Pakistan
***Corresponding author:** dr.sananoor409@gmail.com

1. INTRODUCTION

Filariasis is endemic in the tropics and subtropics, caused by nematode parasites, "filariae," which belong to the family "Filarioidea" It consists of many species of slender, long worms that inhabit the tissues of various vertebrate hosts. The adult worms have a width of 0.25-0.30 mm and a length of 80-100 mm (Rebollo et al. 2017; Shukla et al. 2019). This infection is circulated via arthropod vectors. More than 882 million individuals across 44 countries globally are still at risk of lymphatic filariasis and need preventive treatment to halt the spread of this parasitic disease. In addition, filariae are frequent worms in both animals and humans since parasites belong to the invertebrate class (Maldjian et al., 2014). However, it is difficult to prove that a filarial infection is a zoonosis; this illness may spread spontaneously from animals to people. To generalize and categorise whether or not the different filariasis are zoonoses. However, generalisations and classifications have been made using mosquito host preferences and the relative vulnerability of humans and other animals to infection. Given the correct circumstances, virtually every animal that is a host for filaria parasites can potentially infect and spread to humans (Kalyanasundaram et al., 2020).

Filariasis is a disease that is endemic in the tropics and subtropics, and this disease is circulated via arthropod vectors. A group of infectious diseases that can affect both animals and humans. The nematode parasites, or "filariae," consist of several hundred species of slender, long worms residing in various vertebrate hosts' tissues. Filariasis, a parasitic infection, arises due to roundworms belonging to the Filarioide family. All worms are transmitted by blood-feeding insects such as flies and mosquitoes (CDC et al.2010). These diseases are known as helminthiases. The parasitic worms living in human tissue and blood cause filariasis (CDC et al. 2010; Paniker 2007). The adult worms have a width of 0.25-0.30 mm and a length of 80-100 mm. The male worms are smaller than the females, but the females are viviparous and produce microfilariae that might be identified in the cutaneous tissues or fringe blood, based on the species (Paniker 2007).

Several mosquito genera facilitate filariasis transmission, including Culex, Ochlerotatus, Mansonia, Aedes, and Anopheles. Female mosquitoes are sullied after taking a blood feast containing microfilaria from people; the starting stage of hatchlings needs around 12-15 days to frame into the grown-up phase of hatchlings in mosquitoes (Burkot et al.2002). One of the most crippling tropical excused diseases, filariasis has a high prevalence of despair, a slow pace of mortality, and a variety of clinical symptoms. According to the World Health Organisation (WHO), 1.34 billion people are predicted to reside in places where filariasis is prevalent and are at risk of contracting the disease. The disease affects 120 million individuals from 81 different countries (Rebollo et al. 2017). Parasitic infections are particularly dreadful and deadly all around the world. One of the most crippling and undertreated tropical illnesses is filariasis. The illness filariasis, which is native to the jungles and subtropics and is transmitted by arthropod vectors, is the cause of friendly shame. A class of contagious illnesses that can affect both people and animals. The "*filariae,"* often known as nematode parasites, are hundreds of long, slender worms living inside the tissues of other vertebrate hosts. The bulk of this parasite, known to infect people, belongs to the genera *Dipetalonema, Mansonella, Loa, Wuchereria, Brugia,* and *Onchocerca* (Burkot et al. 2002). They can be found in the lymphatic system, connective tissues, muscles, and body cavities of vertebrate hosts, among other locations.

The adult worm may be split into three major groups based on where it lives: the lymphatic group, the cutaneous group, and the body depression group. Table 1 includes a few filarial species infecting people and the illnesses they transmit to their middle hosts as a result of their habitat as adult worms. The infection is carried by intermediate hosts of the order Diptera, which are always blood-sucking arthropods. According to Taylor et al. (2010), two genera, Wuchereria and Brugia, are principally to blame for human lymphatic filariasis. *Setariadigitata* and *S. cervi* in cattle, *Dirofilariaimmitis* and *D. uniforms* in dogs, *Litomosoidescarinii* and *Dipetalonem*a vitae in

gerbils, *Brugiapahangi* in cats, and *Acanthocheilonemaviteae* in birds are the most prevalent animal parasites.

Table 1: Shows Species with their Habitat, Intermediate Host, and Disease

Filarial worm	Habitat	Intermediate host	Disease
Wuchereriabancrofti	Lymphatics	Mosquito sp.	Elephantiasis
Brugiamalayi	Lymphatics	Mosquito sp.	Malayan filariasis
B. timori	Lymphatics	Mosquito sp.	Timor fever
Loa loa	Connective tissue	*Chrysopsis* sp. (*C. dimidiata*) horse flies	Loaiasis
Mansonellaozzardi	Serous membranes	*Culicoides* sp. (*C. furens*) biting midges	Ozzard's filarial
Onchocerca volvulus	Skin	*Simulium* sp. (*S. damnosum*) black flies	Onchocerciasis

2. SIGNS AND SYMPTOMS

Early signs include scrotal lymphedema and a high temperature (Fateh et al. 2019). but also the oedema of the testis, the thickness of the spermatic cord, and enlargement of the lymph nodes that are clinical indicators of filariasis in the testicle (Knott et al. 1939), symptoms of *lymphatic filariasis edema* with thickening of the skin and underlying tissues (WHO, 2013). Additionally, Lymphatic system function is crucial for the lymphatic system's regular operation, which includes maintaining bodily fluid balance and physiological interstitial fluid transfer. Filarial parasites typically target the lymphatics and impede the lymph flow. Lymphedema, a primary condition associated with filarial infection and brought on by the lymphatics' inability to contract, is one of these disorders (Chakraborty et al., 2013).

3. ETIOLOGY

Filariasis is a parasitic illness caused by *Filarioidea* roundworm infection (Centres for Illness Control and Prevention). *Wuchereriabancrofti, Brugiamalayi, Brugiatimori,* and *Setariacervi* are the primary species responsible for filariasis, and it is transmitted by mosquito genera such as *Aedes*, *Anopheles, Culex*, and *Mansonia*. Several studies have found that Dirofilaria species include the intracellular symbiont*Wolbachiabacteriae*, which is critical in the embryogenesis and proliferation of microfilariae as well as the disease's inflammatory pathophysiology (Simón et al. 2017; Dreyer et al. 2000).

4. THE GENERAL LIFE CYCLE OF FILARIAL WORM

The adult filarial worm dwells in the lymphatic system of man, the final host of filarial worms. Adult females discharge live embryos termed microfilariae (290u). *Microfilariae* circulate in the peripheral circulatory system without metamorphosis and can survive for a long time until they are taken up by the intermediate host, culicine mosquitoes, during a blood meal (Nutman et al. 2011). *Microfilariae* are picked up from the peripheral circulation by the vector while feeding on the host, and then Micofilarie reaches the gut where escheatment occurs; it again penetrates the thorax and settles down parallel to the thorax muscle; inside the thorax, microfilariae shorten to become sausage stage (1st stage) moult twice to develop into 2nd and 3rd stage larvae as seen in Fig. 1 L3 moults twice and transform into adult worms in the definitive host, host cycle is mentioned above.

5. ZOONOTIC ASPECT OF FILARIASIS

Since the invertebrate stages of parasites in humans and animals are comparable, it is challenging to confirm that filarial infections are zoonotic diseases that spread naturally from

animals to humans. To generalize and categorise whether or not the different filariasis are zoonoses, however, generalizations and classifications have been made using mosquito host preferences and the relative vulnerability of humans and other animals to infection. The midnight periodic shape of *B. malayi* does not meet the criteria for a zoonotic illness (Laing et al. 1961); the variant of anopheline and aedine carriers are predominantly found in rural areas, where the quantity and diversity of animals are constrained. For the limited instances of infections in domestic animals, including cows, goats, cats, and dogs, it is believed that they most likely originated from humans. At the same time, the subperiodic strain of *B. malayi* is considered to represent zoonosis. Mansonia mosquitoes, which generally feed on people and hosts of wild animals like forest monkeys, are the vectors of this strain (Wharton 1963; WiJers et al. 1977). Rarely do *Onchocerca* infections fit the definition of a zoonosis, even though gorillas and spider monkeys (Caballero and Caballero 1985). These animals are not believed to represent a substantial human onchocerciasis reservoir since they have been naturally infected, and the chimpanzee is a perfect laboratorical host for *O. volvulus* (Duke 1962).

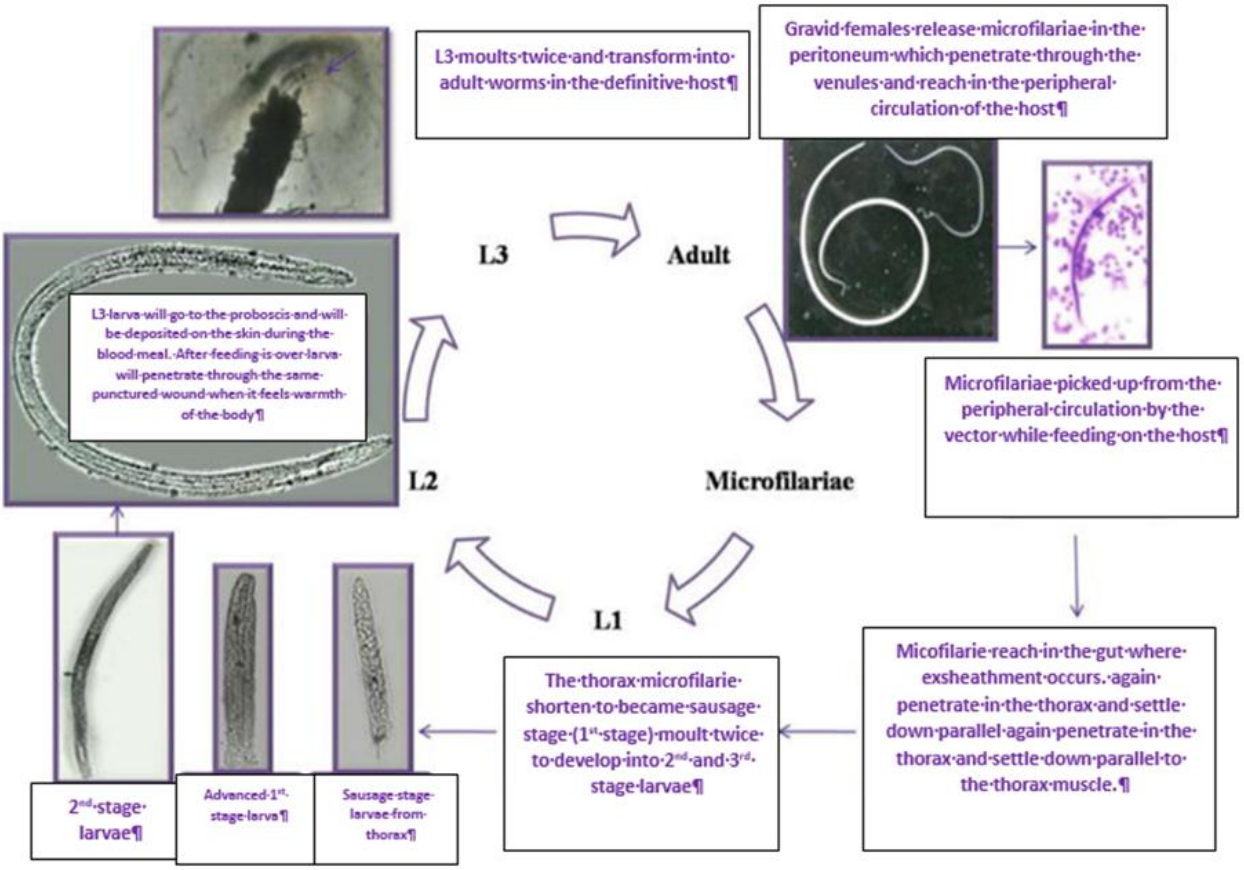

Fig. 1: The life cycle of the filarial worm *Setaria cervi* was given by Prof. Wajihullah and Dr. Sharba Kausar.

Research recorded in West Africa suggested that the transmission of *S. damnosum* may have resulted in the forms of *Onchocerca* associated with 0. Volvulus (Disney and Boreham 1969; Duke 1967). Like *Brugia* species, which cannot be identified from cattle and wild antelope, microfilaria onchocerca and adult worms isolated from humans cannot either (Garms 1983). According to Cameron et al. (1928), these animals may participate in the transmission process. It's probable that in some regions of Africa, the same simulid species is dispersing both human

and bovine *Onchocerca* species. To effectively address these critical problems, deoxyribonucleic acid (DNA) probes designed for parasites of humans or other animals may one day be developed (McReynolds et al. 1986). The circumstances surrounding *L. loa* are similar to those around *O. volvulus*. Despite the possibility of human strains infecting nonhuman primates like the drill, it is not believed that these or any other animals serve as substantial reservoirs of infection for human populations (Ottesen et al. 1984). Fig. 2 shows the dirofilariasis epi-system and essential connections between the implicated species, the climate, and the elements influenced by human behavior.

6. IMPACT ON PUBLIC HEALTH

The parasitic disease filariasis, which is caused by filarial worms, has a significant effect on general health. According to Zeldenryk et al.(2011), it can result in physical impairment, particularly lymphatic filariasis, producing aberrant body part enlargements that cause discomfort, severe impairment, and social shame. According to Wynd et al. (2007), the persistently disabling symptoms of this disorder,

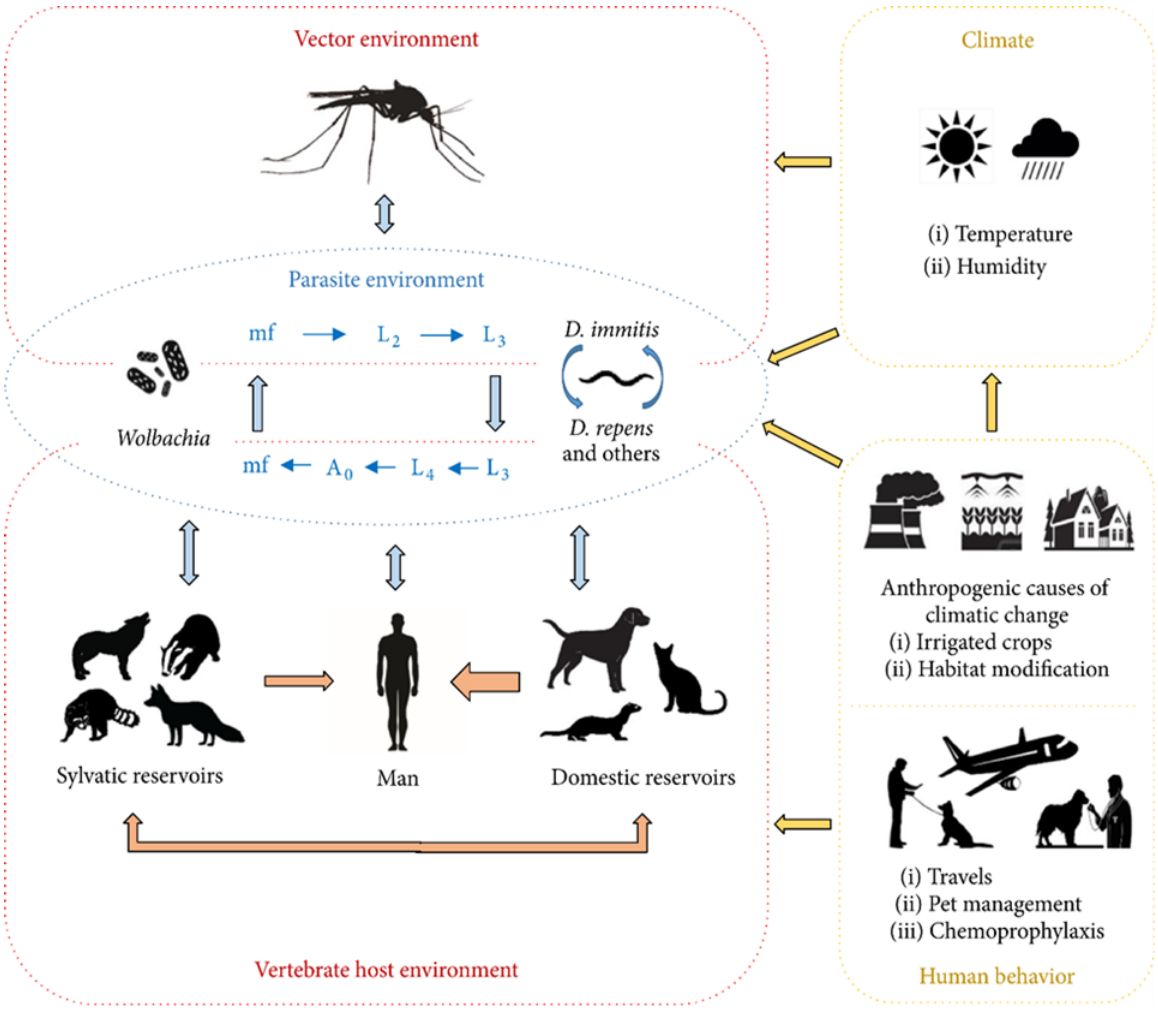

Fig. 2: The system of dirofilariasis, which includes connections between the affected species, climate, and human-influenced factors (Simón et al. 2017).

Which includes inflammation of both limbs, Chest/udder, and external genital organs, and has a significant adverse effect on the general well-being of the person who is affected. It imposes a substantial economic burden on individuals, families, and communities. According to Mathew et al. (2020), the yearly economic impact of lymphatic filariasis is predicted to be around USD 5.8 billion. The disease can lead to loss of productivity, increased healthcare costs, and decreased quality of life (Turner et al. 2016; Sawers and Stillwaggon 2020). Filariasis can lead to social stigma and isolation, particularly in cases of visible physical disability (Abdulmalik et al., 2018; Zeldenryk et al., 2011). According to Eneanya et al. (2019), The social and financial effects of lymphedema and hydrocele can lead to anxiety, difficulty concentrating, sleep issues, and social isolation because of stigma. Over 120 million people in 72 nations in the tropics and subtropics of Asia, Africa, the Western Pacific, and portions of the Caribbean and South America are affected by filariasis, which is common in many tropical and subtropical regions of the world. In nations where the illness is prevalent, it has a significant negative social and economic impact (Newman and Juergens, 2023). Filariasis may spread from animals to people through mosquito bites carrying the disease. Rural locations with less access to healthcare have a higher prevalence of the condition (Otsuji 2011).

7. PREVENTION AND CONTROL

The Worldwide Programme to Eliminate Lymphatic Filariasis was established in 2000 with the eradication of lymphatic filariasis as Public Health issued in 2020 (WHO 2013; CDC 2020). The program has provided approximately 763 million individuals with 5.6 billion treatments, significantly lowering transmission in many areas (WHO 2013). Some techniques to prevent and control filariasis include preventive chemotherapy, vector control measures, and health education programs (CDC 2020). Filariasis has a significant impact on public health, causing physical disability, economic burden, and social stigma and affecting many people in endemic regions. Preventive chemotherapy, vector control measures, and health education programs are strategies to prevent and control filariasis.

8. RESEARCH AND FUTURE DIRECTIONS

Current research into filariasis aims to provide novel diagnostic techniques, therapeutic choices, and possible vaccinations. Preventive vaccination against lymphatic filariasis is currently being researched. Several subunit-candidate vaccination antigens have been tried in lab animals with varying degrees of success (Kalyanasundaram et al., 2020; Samykutty et al., 2010). In a mouse model, a combination vaccination combining BmALT-2 and BmHSP showed significant effectiveness in protecting against a complicated B. malayi infection (Samykutty et al. 2010). The fusion protein vaccine has also been used to optimise the intermediate development in place of a vaccine against human lymphatic filariasis (Melendez et al. 2020). According to Malina et al. (2019), the current anti-filarial are only partially effective against the long-lived microfilariae and need recurrent, protracted therapy over the years. Corallopyronin A is a potential antibiotic for treating filariasis (Katiyar and Singh 2011). Researchers are investigating novel pharmacological targets and prototypes for antifilarial chemotherapy. The Global Programme to Eliminate Lymphatic Filariasis was established in 2000 to eradicate lymphatic filariasis as a public health issue by stopping transmission through the Mass Drug Administration (MDA).

Additionally, providing the best security to people suffering from lymphoedema brought on by the infection is crucial. Despite the remarkable progress, not everyone will be able to meet the initial deadline of 2020. The updated deadline for ending lymphatic filariasis, set by the World

Health Organisation, is 2030. Alternative diagnostic techniques for lymphatic filariasis are being researched, including anti-filarial IgG1 serologic enzyme immunoassay testing. These assays offer an alternative to the microscopic examination of blood smears to find microfilariae. Managing molecular reagents, standard operating procedures (SOPs), and filarial parasites is the responsibility of the Filariasis Research Reagent Resource Centre (FR3). The Parasite Resources Division offers molecular strategies and diagnostic assays to recognize and distinguish all filarial parasites in blood and mosquitoes.

9. CONCLUSION

Filariasis, a mosquito-borne parasitic infection, encompasses a group of diseases causing severe morbidity. Its impact extends beyond physical health, contributing to socioeconomic challenges in affected communities and warranting comprehensive efforts for prevention and control. Continuing filariasis research aims to provide novel diagnostic techniques, therapeutic choices, and possible vaccines. By 2030, The overall Global Programme to Eliminate Lymphatic Filariasiscondition as a public health issue. The Filariasis Research Reagent Resource Centre also offers molecular resources for researchers researching filariasis.

REFERENCES

Abdulmalik Jet al., 2018. Emotional difficulties and experiences of stigma among persons with lymphatic filariasis in Plateau State, Nigeria. Health and Human Rights 20(1):27.

Burkot et al.,2007.Productivity of natural and artificial containers for Aedes polynesiensis and Aedes aegypti in four American Samoan villages. *Medical and Veterinary Entomology*, *21*(1), 22-29.

Caballero and Caballero E, 1958. Estudios helmintológicos de la region oncocercosade México y de la república de Guatemala. Nematoda 8.

Cameron TWM, 1928. On a species of Onchocerca from the ox in West Africa. Journal of Helminthology 6(3): 161-164.

CDC, 2020; Centers for Disease Control and Prevention **Neglected** tropical diseases**.**

Chakraborty et al., 2013.Lymphatic filariasis: perspectives on lymphatic remodelling and contractile dysfunction in filarial disease pathogenesis. Microcirculation 20(5): 349-364.

Disney RHL and Boreham PFL, 1969. Blood gorged resting blackflies Cameroon and evidence of zoophily in Simuliumdamnosum. Transactions of the Royal Society of Tropical Medicine and Hygiene 63(2).

Dreyer G et al., 2000. Pathogenesis of lymphatic disease in bancroftian filariasis:: a clinical perspective. Parasitology Today 16(12): 544-548.

Duke BOL, 1962. Experimental transmission of Onchocerca volvulus from man to a chimpanzee. Transactions of the Royal Society of Tropical Medicine and Hygiene 56(4).

Duke BOL, 1967. Onchocerca-Simulium complexes: IV.—Transmission of a variant of the forest strain of Onchocerca volvulus. Annals of Tropical Medicine & Parasitology 61(3): 326-331.

Eneanya OA et al., 2019. The social, physical and economic impact of lymphedema and hydrocele: a matched cross-sectional study in rural Nigeria. BMC Infectious Diseases 19(1): 1-16.

Fateh R et al., 2011. Unraveling the Secrets of Filariasis (Medical Mystery) (From Cure to Elimination).

Garms R, 1983. studies of the transmission of onchocerca volvulus by species of the similium damnosum complex occurring in Liberia.

Kalyanasundaram R et al., 2020. Advances in vaccine development for human lymphatic filariasis. Trends in Parasitology 36(2): 195-205.

Katiyar D and Singh L, 2011. Filariasis: Current status, treatment and recent advances in drug development. Current Medicinal Chemistry 18(14):2174-2185.

Knott, J. 1939. A method for making microfilarial surveys on day blood. *Transactions of the royal society of tropical medicine and hygiene*, *33*(2).

Laing AB et al., 1961. Studies on filariasis in Malaya: further experiments on the transmission of Brugia malayi and Wuchereria bancrofti. Annals of Tropical Medicine & Parasitology 55(1): 86-92.
World Health Organization (WHO) 2013. Lymphatic Filariasis: the disease and its control. Fifth report of the WHO expert committee on filariasis.
Maldjian C et al., 2014. Lymphatic filariasis disseminating to the upper extremity. Case Reports in Radiology 2014.
Malina et al., 2019.Yeast mitochondria: an overview of mitochondrial biology and the potential of mitochondrial systems biology. *FEMS yeast research*, *18*(5), foy040.
McReynolds et al., 1986. Cloning and comparison of repeated DNA sequences from the human filarial parasite Brugiamalayi and the animal parasite Brugiapahangi. Proceedings of the National Academy of Sciences 83(3): 797-801.
Mathew CGet al., 2020. The health and economic burdens of lymphatic filariasis prior to mass drug administration programs. Clinical Infectious Diseases 70(12): 2561-2567.
Melendez et al., 2022. Pre-clinical development of a vaccine for human lymphatic filariasis. Frontiers in Tropical Diseases 3:998353.
Newman TE and Juergens AL, 2023. Filariasis. StatPearls. PMID:32310472
Nutman et al., 2011.Toward molecular parasitologic diagnosis: enhanced diagnostic sensitivity for filarial infections in mobile populations. *Journal of Clinical Microbiology*, *49*(1), 42-47.
Otsuji Y, 2011. History, epidemiology and control of filariasis. Tropical Medicine andHealth 39(1): 3.
Ottesen et al.,1984.Immunological aspects of lymphatic filariasis and onchocerciasis in man. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *78*, 9-18.
Paniker CJ, 2007. Textbook of medical parasitology, JaypeeBrothers Medical Publishers (P) Ltd.
Rebollo et al., 2017. Can lymphatic filariasis be eliminated by 2020? Trends in Parasitology 33(2): 83-92.
Shukla SK et al., 2019. Filariasis presents as a solitary testicular mass. Tropical Parasitology 9(2): 124.
Simón F et al., 2017. The complexity of zoonotic filariasis ecosystem and its consequences: a multidisciplinary view. BioMed Research International 2017.
Samykutty Aet al., 2010. Multivalent vaccine for lymphatic filariasis. Procedia inVaccinology 3: 12-18.
Sawers L and Stillwaggon E, 2020. Economic costs and benefits of community-based lymphedema-management programs for lymphatic filariasis in India. The American Journal of Tropical Medicine and Hygiene 103(1): 295.
Taylor et al., 2010. Lymphatic filariasis and onchocerciasis. The Lancet 376(9747):1175-1185.
Turner HC et al., 2016. The health and economic benefits of the global programme to eliminate lymphatic filariasis (2000-2014). Infectious Diseases of Poverty 5(4): 26-44.
Wharton RH, 1963. Adaptation of Wuchereria and Brugia to mosquitoes and vertebrate hosts in relation to the distribution of filarial parasites. Zoonoses Research 2(1).
Wijers et al.,1977. Bancroftian filariasis in Kenya: II. Clinical and parasitological investigations are in Mambrui, a small coastal town, and Jaribuni, a rural area that is more inland (Coast Province). Annals of Tropical Medicine &Parasitology 71(3): 333-345.
World Health Organization. Lymphatic filariasis, 2019. Fact sheet. https://www.who.int/news-room/fact-sheets/detail/lymphatic-filariasis. Accessed 2 Mar 2020
World Health Organization. Global programme to eliminate lymphatic filariasis: progress report, 2013. *Wkly Epidemiol Rec* 2019;94:457–72.
Wynd et al., 2007. Understanding the community impact of lymphatic filariasis: a review of the sociocultural literature. Bulletin of the World Health Organization 85: 493-498.
Zeldenryk et al., 2011. The emerging story of disability associated with lymphatic filariasis: a critical review. PLoS Neglected Tropical Diseases 5(12): e1366.