International Journal of Mosquito Research

ISSN: **2348-5906**
CODEN: **IJMRK2**
IJMR 2023; 10(3): 31-38

www.dipterajournal.com
Received: 13-02-2023
Accepted: 21-05-2023

Sajith U
Division of Environmental Science, Department of Botany, University of Calicut, Kerala, India

Jiji PV
Division of Environmental Science, Department of Botany, University of Calicut, Kerala, India

Harilal CC
Division of Environmental Science, Department of Botany, University of Calicut, Kerala, India

Corresponding Author:
Sajith U
Division of Environmental Science, Department of Botany, University of Calicut, Kerala, India

Socio-economic factors contributing to endemic filariasis in Kerala, India: Exploring xenomonitoring studies to evaluate the efficacy of therapeutic practices for disease control

Sajith U, Jiji PV and Harilal CC

DOI: https://doi.org/10.22271/23487941.2023.v10.i3a.676

Abstract
Lymphatic filariasis causes a wide spectrum of clinical and subclinical disease manifestations. The disease is prevalent in various parts of the state of Kerala, India and various factors are contributing to its endemicity in the state. The objective of the present study is to examine various socio-economic and occupational characteristics of filarial patients residing at endemic locations in 10 districts of Kerala.
The results revealed that most of the victims are males falling in the age group 61-75 years (56.55%±18). Data on the pre-infection history of patients revealed that 95.8% (±8.53) of people are residents. Details on the post-infection status revealed that most of them (77.05%±17.27) are leading a sedentary sort of life and are unemployed. 97.92% (±3.23) of the victims are suffering from clinical manifestations in the form of swelling in the legs. 58.72% (±13.64) of the patients are not following any treatment practice and 98.75% (±3.75) are not aware of the disease-causing parasite. The study as a whole concluded that a congested pattern of lifestyle, poor knowledge of disease, parasites, and vectors along with poor disease management practices are the prime reasons for the disease endemicity.
Xenomonitoring of mosquitoes for parasites during pre-MDA and post-MDA periods has also been carried out in two disease-endemic districts (Thirunellayi of Palakkad and Ponnani of Malappuram) of Kerala. The disease infection rates during the pre-MDA period were estimated to be 2.97% in Palakkad and 0.88% in Malappuram districts. No parasites were observed in mosquitoes collected from the two districts during the post-MDA period, which is an indication of the efficiency of the disease control programs undertaken in the community level.

Keywords: Lymphatic filariasis, Xenomonitoring, *Culex quinquefasciatus*, pre-MDA and post-MDA

1. Introduction
Lymphatic Filariasis (LF) is one of the major vector-borne diseases after Malaria and has been considered one of the leading causes of human deformities. The disease is prevalent in over 80 tropical and subtropical countries in the world. The disease is rampant in India, contributing to more than 40% of the global share [22], and the microfilaria (mf) is thought to infect approximately 31 million people with over 23 million having filarial symptoms. Bihar has the highest endemicity (more than 17%), followed by Kerala (15.7%) and Uttar Pradesh (14.6%). Both microfilariae (*Wuchereria bancrofti* and *Brugia malayi*) are endemic to India. *W. bancrofti* causes the predominant infection, while *B. malayi* is confined to the western coast of Kerala and in isolated geographical areas in six other states [22]. Approximately two-thirds of infected individuals show no overt evidence but in clinical trials, show some degree of parasite-associated immuno-suppression and evidence of renal dysfunction. The remaining one-third suffer from the chronic manifestations of LF such as lymphoedema, elephantiasis, and hydrocele of the legs or arms resulting in disability, social stigma, and economic consequences [14]. Patients with huge elephantoid swellings are often segregated from society. Acute attacks of filariasis frequently traumatize patients with transient episodes of disability, often confining the patients to bed [19].
Since filariasis is not a direct cause of mortality, it has been given lesser priority, compared to certain contagious epidemics.

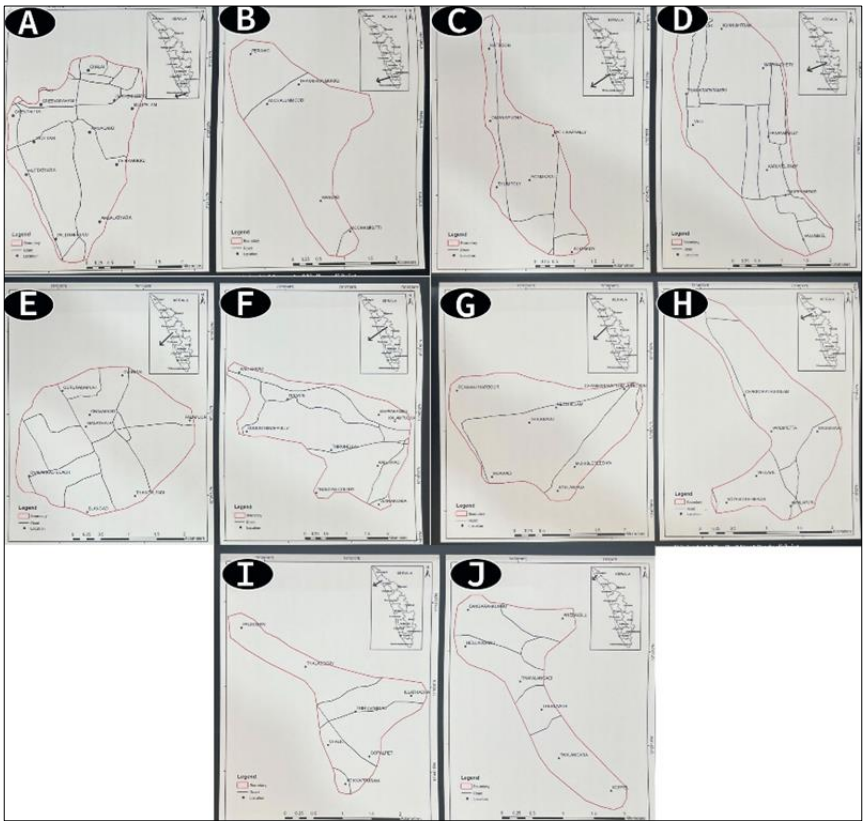
Owing to the persistence of the disease in certain geographical locations and populations, it is still a concern for health workers and policymakers. It is estimated that the annual economic loss due to the disease is very high and may affect the economic stature of many developing countries [15]. Estimation of the environmental, epidemiological, and socioeconomic reasons regarding the persistence of the disease is important to understand the extent of the burden, compliance with disease control measures, and formulation of mitigation strategies. The paucity of such data is a common feature of many of the neglected tropical diseases. Given the above reflections, an attempt is made in the present study to examine the different socio-economic and occupational characteristics of the filarial patients residing in isolated geographical locations in 10 districts of Kerala. The highest endemic locations falling within the 10 districts were Manacaud of Trivandrum, Mangad of Kollam, Kommady of Alleppey, Thoppumpady of Ernakulam, Chavakkad of Thrissur, Thirunellayi of Palakkad, Ponnani of Malappuram, Vellayil of Kozhikode, Thalassery of Kannur and Thalangara of Kasaragod. Xenomonitoring of mosquitoes for the parasites was carried out at the higher endemic regions of two districts such as Palakkad and Malappuram. Such information is likely to reveal the magnitude of disease sustenance in the selected locations and the impact of therapeutic practices on their control.

2. Materials and Methods

The objectives were accomplished through a detailed study of the victims concerning their demographic characteristics, socio-economic levels, pre and post-infection health status, healthcare measures that are undertaken, and the awareness levels of public health care and disease control. The details are furnished below.

2.1. Questionnaire survey on the demographic characteristics and social and health status of victims of filariasis

The locations with the highest filarial disease endemicity in each district were worked out from the reports of the vector control units managed by the Government of Kerala. Also, the details on the filarial victims residing in endemic areas of all 10 districts have been obtained from the respective district vector control units. All the victims were identified based on the addresses provided and the nature and purpose of the study were explained to them, for ethical reasons. The filarial victims (swelling cases) were interviewed with a structured questionnaire. Information on the demographic, social, occupational, and cultural status of the victims, their awareness levels of diseases, and the health care measures adopted by them for disease control were collected and reported, without revealing their identity. Analysis of the data was carried out and the results are expressed as percentages. The sampling sites are depicted in Figure 1.



Sampling sites-A. Manacaud of Trivandrum, B. Mangad of kollam, C. Kommady "of alleppey, d. Thoppumpady of Ernakulam, E. Chavakkad GF Thrissur, F. Thirunellayi of Palakkad, G. Ponnani of Malappuram, H. Vellatil of Kozhikode, I. Thalassery of Kannur, J. Thalangara

Fig 1: Sampling locations

2.2. Xenomonitoring of parasites in mosquito vectors

Xenomonitoring, the practice of detection of human pathogens in vectors has been in practice for decades for assessing the risk of exposure to the transmission of different vector borne diseases. In the present study, mosquitoes are collected, dissected, and examined for the presence of filarial parasites. The presence of larva in the vector indicates the presence of microfilaria carriers in the community and the

current risk of disease transmission. This passive method, without sample collection from human beings, offers greater scope for assessing the risk of filariasis within the community. The steps followed are discussed below.

2.2.1. Collection, dissection, and staining of mosquitoes

Adult vectors (*Culex quinquefasciatus*) were collected from 6 locations each, falling in Thirunellai of Palakkad district and Ponnani of Malappuram district, during the pre-MDA period and three months later (post-MDA period). Details on the distribution and administration of drugs in connection with the MDA program and their consumption pattern in each location were collected from the district vector control units. The collection of vectors was carried out before and after 3 months of implementation of a single dose of MDA. Adult *Culex quinquefasciatus* mosquitoes resting indoors were collected in the morning (6 am to 9 am) using oral aspirators. All the mosquitoes were transferred to test tubes and anesthetized with a cotton swab of ethyl acetate [23].

The anesthetized mosquitoes were brought to the laboratory and placed one by one on a glass slide. All the legs and wings were removed. Using needles, the entire body was segmented into the head, thorax, and abdomen. Each segment was placed in a drop of physiological saline and macerated using needles. The slide was then observed under the microscope to find out the presence of filarial parasites. The head, thorax, and abdominal parts of each dissected mosquito were examined separately. The slides which were positive for filarial parasites were kept separate and allowed to dry partially in the air [23]. After staining, each slide was then examined under a compound microscope to identify the stage of filarial parasites. Different life stages of parasites and infected parts of the mosquitoes (head, thorax, and abdomen) were noted. The ratio between mosquitoes that are detected positive for any of the larval stages of *W. Bancrofti* and the total number of mosquitoes dissected was noted as the infection rate. The ratio between mosquitoes that are detected positive for the larval stage, infective L3 stage of *W. Bancrofti*, and the total number of mosquitoes dissected were noted as infectivity rate.

3. Results and Discussions

Lymphatic filariasis, commonly known as elephantiasis is a painful and profoundly disfiguring disease that has a major social and economic impact in Asia, Africa, the Western Pacific, and parts of America [14]. Periodic evaluation of the epidemiological, demographic, and socio-economic reasons for the disease is important to understand the extent of compliance with the guidelines and to revise the strategies of mitigation. A questionnaire survey has been carried out among the filarial patients residing at the endemic locations of 10 districts in Kerala to have an assessment of their demographic, socioeconomic, and occupational characteristics responsible for disease confinement. A total of 72 victims were consulted to have an assessment of their demographic characteristics, and pre and post-infection health status. This was followed by a xenomonitoring on vectors for assessing the effectiveness of the mass drug administration in two districts (Palakkad and Malappuram) having the highest endemicity of filariasis.

3.1. Demographic characteristics, pre infection history, Post-infection status, health care measures, and awareness of the disease control

Assessment of the demographic characteristics was carried out as per the guidelines framed (Table 3.1), and it is noted that all age groups are susceptible to filariasis. According to earlier reports, individuals over 40 years of age have been found to have a higher prevalence of this disease [11]. In the present study, a higher prevalence of this disease was reported in age groups ranging from 61-75, followed by 46 to 60. This trend was more pronounced in Kollam (100%), Alleppey (64.64%), Palakkad (63.75%), and Malappuram (63.75%) districts. The blood group of victims' are falling in the category of A^{+ve}, B^{+ve}, AB^{+ve}, and O^{+ve} and there was no report of a negative group in any of the areas. The majority of the victims have the blood group B+ve (37.886±13.03) and the lowest with A+ve (12.667±15.89). All of the victims are married and part of a family system. Most of the family members of the victims are males (53.119±8.9) and the majority of them are in the age range of 21 to 60 years (43.927±5.87). The majority of patients (93.307±8.57) do not have a history of filariasis in their families.

Table 3.1: Demographic characteristics of filarial victims in all the districts under study

I	General information		Mean with SD
1	Age	30-45 years	2.159±3.38
		46-60 years	37.394±18.86
		61-75 years	56.547±18.00
		76-90 years	3±6.40
2	Gender characteristics of victims	Male	58.622±8.83
		Female	41.378±8.83
3	Blood group	A+ve	12.667±15.89
		B+ve	37.886±13.03
		AB+ve	29.395±20.24
		O+ve	20.053±17.56
4	Marital status	Yes	100±0
		No	0
5	Family members	Below 5 Years	17.651±5.84
		6-20 Years	18.143±2.21
		21-60 Years	43.927±5.87
6	Gender characteristics of family members	61 Years above	20.28±4.09
		Male	53.119±8.90
		Female	46.881±8.90
7	Family reports of filariasis	Yes	6.693±8.57
		No	93.307±8.57

Numerous reports are available on the gender specificity of this disease. Brabin (1990) [2] and Das, *et al*. (1992) [5] reported a similar situation, as noticed in the present study, with a higher prevalence of this disease in males, than females. Gender-specific estimates from the Indian sub-continent and other South East Asian countries indicated a 10% higher prevalence of *W. Bancrofti* infection and clinical manifestations in males than in females [21]. The results of the present study reveal that males have a 22.22% higher disease susceptibility than females. The professional attributes of both genders are found to have a greater influence in this direction.

Data on the pre-infection period were used to evaluate the role of occupational, social, and other attributes that have an impact on the transmission of diseases. Table 3.2 (a) represents the findings of the pre-infection history of the filarial victims across all the districts under study. The results showed that the majority of victims were residents (95.883%) and only a minor percentage of victims (4.167%) have been migrated from other places. The occupational status of victims was divided into three groups, namely professionals, skilled laborers, and unemployed people. Among them, skilled laborers made up a large portion of the victims (69.072%). At every site, the Pucca and Kutcha types of housing patterns have been identified and 87.383% of the victims are found residing in Pucca houses. The Kutcha-type houses are mostly seen in the coastal stretches of Malappuram, Alleppey, Kozhikode, and Kannur districts and Thirunellai of Palakkad district. The patients include a sizable portion of those who did not regularly use mosquito nets or repellents. Particularly for those with low socioeconomic standing, the size of the family plays a significant role in determining the quality of life. It has already been reported that filariasis is more prevalent in crowded living situations, poor housing quality, and insufficient waste disposal and sanitation services [13]. The prevalence of filariasis in coastal environments can mainly be attributed to these reasons. The survey also reports that 59.663% of victims had other health issues in the pre-infection period.

Survey results on the post-infection stage of filarial victims (Table 3.2 - b) show that a major share of them are leading a sedentary lifestyle and are unemployed. This has been evidenced by the higher percentage of unemployed victims (77.045±17.27) residing in all the surveyed areas, except Kommady of Alleppey, where the prevalence of the disease does not have an impact on the occupational status. Even with the illness, 54.555% of the victims are still working in this area in a variety of skilled professions. Early-stage symptoms are reported to be temperature, chills, headache, and skin lesions, which will not affect their routine life activities. However, at a later-stage, symptoms have higher manifestations with enlargement of limbs and genitalia (a condition called hydrocele). Clinical manifestations of leg swelling (97.917%) were predominant among victims in the study area. The majority of the patients (42.553±26.29) have been dealing with their illness for 11 to 20 years. Additionally, reports of victims who have endured the disease's symptoms for over 30 years have come from places like Kommady (Alleppey), Thirunellai (Palakkad), and Ponnani. (Malappuram). The distinctive feature of filarial diseases is the sporadic incidence of fever and chills. 50.795% of patients were found to have significant secondary infections. Occupational activities are hampered by an affliction of the disease. This has been reported by many researchers [17, 6]. Typically, edema in the legs of filarial patients forces them to switch to a less demanding profession [12].

Table 3.2: Pre-infection history and Post-infection status of the filarial victims in all the districts under study

Pre infection history			**Mean with SD**
1	Resident	Native	95.833±8.54
		Migrant	4.167±8.54
2	Occupation	Professional	5.625±11.34
		Skilled laborer	69.042±23.54
		Unemployed	25.333±17.44
3	Nature of house	Kutcha	12.617±6.51
		Pucca	87.383±11.74
4	Use of mosquito repellents/nets	Yes	18.386±16.12
		No	81.614±16.12
5	Other diseases	Yes	59.663±29.88
		No	40.337±29.88
Post-infection status			
1	Occupation	Professional	0.625±1.88
		Skilled laborer	22.33±17.29
		Unemployed	77.045±17.27
2	Body part affected	Legs	97.917±3.23
		Genitalia	0
		Both	2.083±3.23
3	Years of suffering from the disease	0-10	37.068±24.02
		11-20	42.553±26.30
		21-30	14.568±10.72
		31-40	3.068±6.27
		40 above	2.742±4.21
4	Fever	Yes	58.989±21.88
		No	41.011±21.88
5	Secondary infections	Yes	50.795±24.49
		No	49.205±24.49
6	Other diseases	Yes	19.469±19.62
		No	80.531±19.62

The improvement of clinical manifestations of filariasis requires the utmost medical care and strict follow-up actions. Delicacy in seeking medical care can aggravate symptoms and cause secondary infections. Table 3.3 shows the outcomes of the healthcare measures taken by the victims in all of the study areas. The findings showed that the majority of them (58.72±13.64) are not following any treatment practices and a major share (82.273±23.78) of those undergoing treatment rely on private clinics. Also, a major share of victims (88.75%) are undergoing treatment within 5 years. However, studies from a national perspective revealed that 46% -100% of people who had filarial lymphoedema sought treatment from healthcare centers [16]. It is also reported that in conservative contexts, filarial victims avoid seeking treatment for the concern of drawing attention to their condition [18]. Also in the present study, 69.667% of patients who are seeking medical care, have not found a cure. Compliance with a prescribed, simple regime of self-care practices such as leg hygiene, exercise, and self-examination has been shown in studies to reduce the clinical manifestation of the illness [8]. Studies have also been carried out to explain the function of healthcare measures on disease management [10]. Failure to treat the disease results in recurrent acute febrile attacks and progressive injury to the lymphatic system [7]. Despite a higher healthcare system prevalent in the state, the matter of lesser filarial patients undergoing treatment has to be analyzed more seriously from a more socio-economic and clinical perspective.

Awareness of people is significant in the control of diseases of endemic nature. An assessment of the awareness of filarial disease revealed that 98.75% of patients are ignorant of the disease-causing parasites and 83.299% of them the mode of their transmission (Table 3.3). Even 67.023% of the patients do not have an idea about mosquito larvae. As far as disease management is concerned, 54.295% of the victims are noted to be completely unaware and mosquito menace was never been a concern for them. Globally, a significant share of the patients are not conscious that mosquitoes are a mode of disease transmission and many researchers have also reported such a trend in their studies [24, 1, 3]. Thus disease awareness has become critical in reducing mosquito contact and avoiding infection [9]. Earlier studies reported from Kerala have shown that most of the patients residing at Shertallai taluk are well cognizant of the cause of the disease and its control [4]. This has resulted in the control of *Brugia malayi* filariasis in this region to a greater extent. The lack of awareness among victims and the general public on filarial pathogens and the mode of their transmission are acting as setbacks in disease control. The present study warrants the need for more such initiatives in the state of Kerala in general and the disease-endemic areas in particular.

Table 3.3: Healthcare measures and disease awareness in all the districts under study

Health care measures			Mean with SD
1	Under treatment	Yes	41.28±13.65
		No	58.72±13.65
2	Period under treatment	0-5 Years	88.75±19.72
		6-10 Years	8.333±17.08
		11 above	2.917±5.91
3	Mode of treatment	Government filarial clinic	17.727±23.78
		Private clinic	82.273±23.78
4	Betterment of disease	Yes	23.666±25.69
		No	69.667±34.49
Disease awareness			
1	Reason/ disease-causing parasite	Yes	1.25±3.8
		No	98.75±3.8
2	Means of disease transmission	Yes	16.801±18.6
		No	83.299±18.6
3	Knowledge on mosquitoes larvae	Yes	32.977±16.9
		No	67.023±16.9
4	Disease management	Yes	25.469±16.6
		No	54.295±18.3
		Partial	20.234±12.8

3.2. Xenomonitoring of parasites in mosquito vectors

As part of the national mission to control Lymphatic filariasis, periodic Mass Drug Administration (MDA) with diethylcarbamazine (DEC) combined with albendazole (ABZ) is practiced at periodic intervals in the state of Kerala. Xenomonitoring of parasites in the vectors was carried out to assess the efficacy of MDA. For this, the vector mosquitoes were monitored before and after MDA from two locations (Thirunellai of Palakkad and Ponnani of Malappuram districts) of Kerala. All the specimens were dissected to find out the occurrence of filarial parasites. Results of the xenomonitoring studies undertaken at the filarial endemic locations of Palakkad and Malappuram districts during the pre-MDA period are depicted in Table 3.4.

Table 3.4: Results of the dissection studies on vector mosquitoes undertaken at Palakkad and Malappuram districts during pre MDA period

Site	No. of mosquitoes dissected	Occurrence of parasites		
		No. of specimens in which the parasites were observed	Growth stage of the parasites	The body part of the mosquito where the parasites are observed
Palakkad district				
1	20	0	-	-
2	24	1	Microfilaria	Abdomen
3	15	0	-	-
4	19	1	L2 larva	Abdomen
5	15	0	-	-
6	16	1	Microfilaria	Abdomen
Malappuram district				
1	16	0	-	-
2	21	1	Microfilaria	Abdomen
3	24	0	-	-
4	14	0	-	-
5	17	0	-	-
6	23	0	-	-

A total of 109 adult mosquitoes were collected for xenomonitoring from 6 random sites in Thirunellai of Palakkad district. Of the total mosquitoes collected 92.66% were of the filarial vector (female *Culex quinquefasciatus*) and the remaining included *Aedes aegypti* and *Armigeres subalbatus*. Similarly, 115 adult mosquitoes were collected from the Ponnani of Malappuram district, and among them, 98.26% were of female *Culex quinquefasciatus* and the remaining were of *Aedes aegypti*. Vector samples from three locations of Thirunellai (Palakkad) and one location from Ponnani (Malappuram) were found to have the presence of filarial parasites. The filarial parasites observed were in the microfilarial and L2 larval stage and were observed in the abdomen of the vectors (Plate 3.1). The presence of mature larvae in the L2 stage was noticed in the third site of Palakkad district. The disease infection rates were estimated to be 2.97% in Thirunellai (Palakkad) and 0.87% in Ponnani (Malappuram) districts. As per WHO guidelines, when the infection rate progresses beyond 1%, such locations are to be treated as endemic [24]. In the present study, the presence of parasites in the vectors are an indication of the rampancy of the disease, and its magnitude is higher in Thirunellai (Palakkad) than in Ponnani (Malappuram).

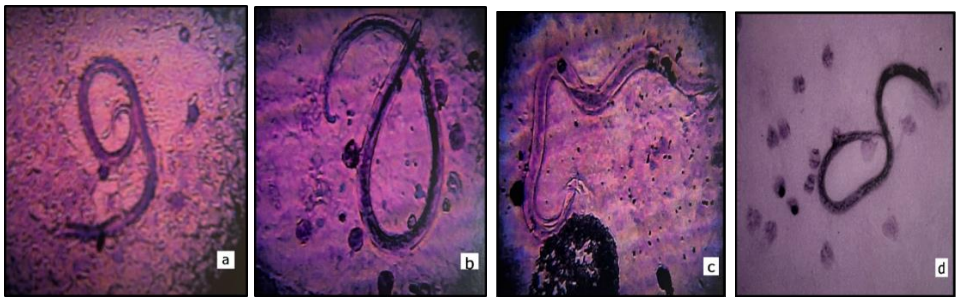


Plate 3: Filarial parasites in mosquitoes a) microfilaria, b) microfilaria, c) L3 stage larva, d) microfilaria

Xenomonitoring has been attempted in the Post MDA period, three months after the Pre MDA. The results are depicted in Table 3.5.

Table 3.5: Vector mosquito dissection studies at Palakkad and Malappuram districts during Post MDA period (December 2015 to January 2016).

Palakkad district				
Site	No. of mosquitoes collected and dissected	Occurrence of parasites		
		No. of parasites observed	Growth stage of the parasites	Body part of mosquito where in parasites observed
1	18	0	-	-
2	15	0	-	-
3	14	0	-	-
4	17	0	-	-
5	17	0	-	-
6	16	0	-	-
Malappuram district				
1	17	0	-	-
2	18	0	-	-
3	18	0	-	-
4	16	0	-	-
5	17	0	-	-
6	20	0	-	-

For post-MDA assessment, a total of 97 adult mosquitoes were subjected to experimentation from Thirunellai of Palakkad district. Of the total mosquitoes collected, 96.91% of the specimens were female *Culex quinquefasciatus* and the remaining *Aedes aegypti*. Similarly, from Ponnani of Malappuram district, a total of 106 adult mosquitoes were collected and 96.23% of the specimens were of female *Culex quinquefasciatus* and the remaining of *Aedes aegypti*. The dissection studies could not reveal the presence of filarial parasites in the vectors from both districts during the post-MDA period (Table 3.5). This can be taken as an index of the efficacy of MDA programs implemented in both the districts under study.

4. Conclusion

Lymphatic Filariasis (LF) is an important public health issue, worldwide. Various geographical, socio-economic, and cultural factors are known to be responsible for the prevalence and endemicity of this disease. Community awareness and participation are reported to be the prerequisites for the successful control of LF through integrated vector control programs. A study on the demographic characteristics, socio-economic attributes, pre and post-infection history, and disease awareness levels of patients from the disease-endemic regions of Kerala has been undertaken to assess the reasons underlying disease rampancy.

The study revealed that poor socio-economic status and inadequate awareness of disease parasites and vector control are acting as prime reasons for the disease endemicity. Xenomonitoring has been carried out to assess the efficacy of the Mass Drug Administration program undertaken at community levels in the Thitunellai (Palakkad) and Ponnani (Malappuram) regions of Kerala. Vector samples collected and monitored during the pre-MDA period from the endemic areas of Palakkad and Malappuram districts were found to harbor filarial parasites of microfilaria and L2 larva stage. All the parasites were observed in the abdominal region of the vectors. The disease infection rates are estimated to be 2.97% in Palakkad and 0.87% in Malappuram districts. The presence of parasites within the vectors is an indication of the disease rampancy in these locations. The absence of filarial parasites within the vector during the post-MDA period is an indication of the efficacy of such programs at the community levels. Lack of awareness of the disease-causing organisms and their mode of transmission and lack of people's participation in community-level programs can act as setbacks to integrated vector control programs, especially for Filariasis.

5. References

1. Ahorlu CK, Dunyo SK, Koram KA, Nkrumah FK, Aagaard-Hansen J, Simonsen PE. Lymphatic Filariasis related perceptions and practices on the coast of Ghana: Implications for prevention and control. Acta Trop. 1999;73:251-264
2. Brabin L. Sex differentials in susceptibility to lymphatic filariasis and implications for maternal child immunity. Epidemiology Infection. 1990;105:335-353.
3. Carme B, Utahia A, Tuira E, Teuru T. Filarial elephantiasis in French Polynesia: A study concerning the beliefs of 127 patients about the origin of their disease. Transaction of the Royal Society of Tropical Medicine and Hygiene. 1979;73(4):424-426.
4. Chandrasekharan A, Monto F, Tulsidas A, Rao CK. Awareness of cause and control of Brugia malayi filariasis. Journal of Communicable Diseases. 1979;11:146-147.
5. Das PK, Manoharan A, Subramanian S, Ramaiah KD, Pani SP, Rajavel AR, Rajagopalan PK. Bancroftian filariasis in Pondicherry, South India: Epidemiological impact of recovery of vector population. Epidemiological Infection. 1992;108:483-493.
6. Dash AP, Mahapatra N, Hazra RK, Acharya AS. Transmission dynamics of filariasis in Khurda district of Orissa, India. Southeast Asian Journal of Tropical Medicine and Public Health. 1998;29(1):137-140.
7. Dreyer G, Addiss D. Hope Clubs: New strategy for lymphatic filariasis-endemic areas. Newsletter of Royal Society of Tropical Medicine and Hygiene. 2000;8(1):8.
8. Dreyer G, Medeiros Z, Netto MJ, Leal NC, Gonzaga de Castro L, Piessens WF. Acute attacks in the extremities of persons living in an area endemic for Bancroftian filariasis: differentiation of two syndromes. Transactions of the Royal Society of Tropical Medicine and Hygiene. 1999;93:413-7.
9. Evans DB, Gelband H, Vlassoff C. Social and economic factors and the control of lymphatic filariasis: A review. Acta Tropica. 1993;53:l-26
10. Kanda K. The quality of life among lymphedema patients due to lymphatic filariasis in three rural towns in Haiti. Tampa, FL: University of South Florida; c2004.
11. Kazura JW, Spark R, Forsyth K, Brown G, Heywood P, Peters P *et al*. Parasitologic and clinical features of bancroftian 251 filariasis in a community in East Sepik Province, Papua New Guinea. American Journal of Tropical Medicine and Hygiene. 1984;33:1119-23.
12. Kumari AK, Harichandrakumar KT, Das LK, Krishnamoorthy K. Physical and psychological burden due to lymphatic filariasis as perceived by patients and medical experts. Tropical Medicine and International Health. 2005;10/6:567-573.
13. Mak JW. Problems in filariasis control and the need for human behavior and socio-economic research, South East Asian Journal of Tropical Medicine and Public Health. 1986;17(3):479-485.
14. Ottesen EA, Duke BOL, Karam M, Behbehani K. Strategies and tools for the control/elimination of lymphatic filariasis. Bulletin of World Health Organization. 1997;75:491-503.
15. Ramaiah KD, Das PK, Edwin M, Guyatt H. The economic burden of lymphatic filariasis in India. Parasitology Today. 2000;16;25:1- 253.
16. Ramaiah KD, Vijay Kumar KN, Ramu K. Knowledge and beliefs about transmission, prevention and control of lymphatic filariasis in rural areas of South India. Tropical Medicine and International Health. 1996;1(4):433-438.
17. Ramaiah, KD, Vijay Kumar KN, Ramu K, Pani SP, Das PK. Functional impairment caused by lymphatic filariasis in rural areas of South India. Tropical Medicine & International Health. 1997;2(9):832-838.
18. Rauyajin O, Kamthomwachara B, Yablo P. Socio-cultural and behavioral aspects of mosquito-borne lymphatic filariasis in Thailand: A qualitative analysis. Social Science & Medicine. 1995;41:1705-13.
19. Williams HA, Jones COH. A critical review of behavioral issues related to malaria control in sub-Saharan Africa: what contributions have social scientists made? Social

Science & Medicine. 2004;59:501-23.
20. World Health Organization. Lymphatic Filariasis Infection and disease control strategies; c1994. TDR/CDT/FIL/PENANG/94.1
21. World Health Organization. Guidelines for Laboratory and Field Testing of Mosquito Larvicides. 2005;13:1-41. WHO/CDS/WHOPES/GCDPP/2005.
22. World Health Organization. Report of the Expert Committee on Filariasis. Technical Report Series. 1962;233;5-38.
23. World Health Organization. Building partnerships for lymphatic filariasis - strategic plan. Geneva: World Health Organization; c1999.
24. Wynd S, Durrheim DN, Carron J, Selve B, Chaine JP. Socio-cultural insights and lymphatic filariasis control: Lessons from the Pacific. Filaria Journal. 2007;6:1-4.