



Original Research

Status of lymphatic filariasis with progression of age and gender & eradication strategies: A survey among residents of Hardoi district of Uttar Pradesh, an endemic region of North India

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Abstract: Lymphatic filariasis (LF) is a chronic and debilitating disease that affects people in tropical and sub-tropical areas of Asia, Africa, and Western Pacific. It is one of the leading community health problems in some of the endemic districts in India including Hardoi district of Uttar Pradesh. The disease is caused by the parasites *Wuchereria bancrofti* (*W. bancrofti*), *Brugia malayi* (*B. malayi*) and *Brugia timori* (*B. timori*), transmitted by the vector *Culex*, *Anopheles* and other mosquitoes. This cross-sectional survey study was carried out in rural areas, where its inhabitants vary in socio-economic status, from low to middle-income class. 12 villages of Hardoi district, Uttar Pradesh, India were included. The aim was to see the impact of age and gender on various clinical forms of LF and in estimating its economic and social implications. 260 LF affected people in different parts of Hardoi district were surveyed. The results revealed that the Mass Drug Administration (MDA) coverage reached more than 90%. The overall Microfilaria rate had been reduced, however the prevalence of elephantiasis increased with the progression of age and was found to be highest among people of >70 years of age, regardless of their gender.

Key words: Lymphatic filariasis; *Wuchereria bancrofti*; *Brugia malayi*; *Brugia timori*.

Introduction

Lymphatic filariasis (LF) is a chronic and debilitating disease that affects people in tropical and sub-tropical areas of Asia, Africa, Western Pacific and some areas of the United States of America. The disease is caused by the parasites *Wuchereria bancrofti* (*W. bancrofti*), *Brugia malayi* (*B. malayi*) and *Brugia timori* (*B. timori*), transmitted by the vector *Culex*, *Anopheles* and other mosquitoes (1-2). Lymphatic filariasis (LF) is by far the most prevalent disease of the filarial infections (3) commonly known as “elephantiasis”. As per WHO report, till 2016, preventive chemotherapy (PC) to eradicate the spread of LF infection was considered necessary in 53 out of 72 endemic countries. More than 6.7 billion treatments have been delivered worldwide in 64 countries since the Global Programme to Eliminate Lymphatic Filariasis (GPELF) was launched in 2000. 20 countries out of 72 have reduced infection prevalence to levels at which transmission is assumed not to be sustainable and moreover, 9 countries out of 20 have now been recognized as attaining the elimination of LF as a public health problem (4). It is estimated that about, 856 million people in 52 countries worldwide are affected and require chemotherapeutic preventive measures to safe-

guard against the spread of this parasitic infection. The total population in all implementation units (IUs) in a given country with evidence of more than 1% infection prevalence is considered to require PC. Earlier in 2000, over 120 million people were infected, with about 40 million disfigured and incapacitated by the disease (4, 5). The current estimate shows that in India alone about 553 million people live in endemic areas with approximately 48 million having either circulating microfilariae (mf) or overt diseases like hydrocele, lymphoedema, and elephantiasis.

Filariasis is one of the most common causes of permanent disability among tropical diseases worldwide creating the highest disease burden regarding disability-adjusted life years (DALYs) (6). Those affected also suffer psychosocial stigmatization and economic suffering as it can lead to job loss or “inability to work.” The disease is, therefore, a major cause of poverty as it causes an economic burden for those affected, on their dependents, their communities and the country as a whole (2, 7). World Health Assembly passed in 1997, a resolution for the elimination of LF as a public health problem in the world by 2020 (2). In 1998, World Health Organization (WHO) launched a global program for the “Elimination of LF” (8-10).

The circulating mf transmit the disease via blood of patients. Therefore, to reduce transmission, the communities were kept on annual mass drug administration (MDA) for 4-6 years reaching up to 80% coverage of the entire population at-risk aiming to reduce mf loads to zero or close to zero (11). Before MDA implementation in a country, units were targeted for a rapid assessment study, and also baseline data on LF level was obtained to monitor the impact of MDA. Few countries (Cape Verde, China, Costa Rica, Solomon Islands, South Korea, Suriname, and Trinidad and Tobago) with small population density managed to eliminating the disease (12) using a combination strategies that included vector control and single annual doses of 2-drug treatments of albendazole along with ivermectin or diethylcarbamazine (11, 13). It is the currently preferred strategy for LF elimination recommended by WHO (14). The global LF elimination program has been strengthened by donation of albendazole by GlaxoSmithKline and continued donation of ivermectin by Merck & Co (15). The fear of ivermectin resistance to emerge and poor drug compliance raises the pressing need for a potential antifilarial agent possessing both microfilaricidal and adulticidal activity (16).

LF has a wide range of clinical manifestation from acute attacks of filarial fever, chronic conditions such as hydroceles, lymphoedema, elephantiasis of limbs, enlarged breasts, and kidney damage, thus causing significant morbidity and disability for those affected (17, 18). The most widely used method for diagnosis of filarial infection is a microscopic examination of blood for the presence of microfilaria (mf). This approach has limited sensitivity and is not suitable for large-scale mf screening of human populations in endemic areas because it is time-consuming and labor-intensive. In epidemiological surveys, the alternate technique used to detect and characterize filarial parasites in vectors includes the collection, dissection, and microscopy, is also not reliable because the mosquitoes may carry both animal and human filarial parasites, which cannot be identified biochemically or morphologically (19, 20).

To overcome some of these shortcomings, improved methods for diagnosis of filarial infections are needed to study the transmission, epidemiology and facilitate surveillance activities to monitor control efforts (21, 22). In addition, because the clinical manifestations of filariae vary greatly among individuals, an ideal diagnostic test which would not only detect the infected individuals or those have been exposed to infection, but would also characterize various clinical manifestations that the lymphatic-dwelling parasites, induce the infected population (23). The present study reported the observation and analysis of the data in Hardoi district as part of the elimination of Lymphatic filariasis have been obtained along with the impact of age and gender in the consequences of disease developments.

Materials and Methods

Survey of endemic area

The study was carried out in 12 villages of Hardoi district, Uttar Pradesh, India [Figure-1]. The fields were selected by prevailing environmental factors that could predispose the residents to lymphatic filariasis along

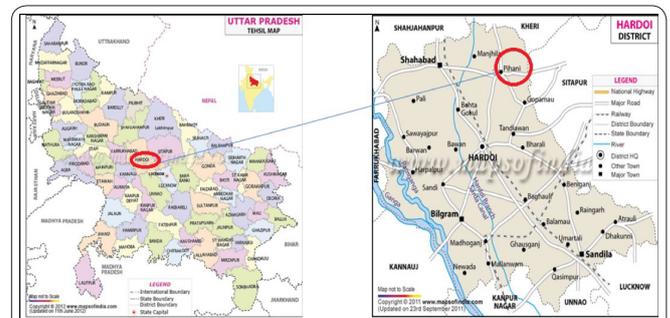


Figure 1. It shows the filariasis infected area in the Pihani region of Hardoi district of Uttar Pradesh, an endemic region of North India.

with information related to the presence of the disease in the communities. The study area is known for its endemicity for lymphatic filariasis caused by *W. bancrofti*, which is mainly transmitted by *Culex quinquefasciatus* (24, 25). It was carried out between January to March 2012. The study population included all adolescents and adults who attended the participating health clinics in the study area during the survey and agreed to participate in the survey. The clinic was community health center Pihani, Hardoi, which are the main public health facilities in the study area.

It is rural area with inhabitants vary in socio-economic status, from low to middle-income class. Participants had to have lived in the area for at least 5 years and had to be 10 years or older. A total of 260 Individuals respondents aged ≥ 10 years participated fully in the survey. The survey was carried out with the full support and cooperation of the local community leaders and medical personnel in the area. This typical rural setting lacks basic amenities such as good roads, electricity, and safe water supply. Poor structured housing made of mud and practices like storage of water in open earthen vessels with thick forest surrounding dwelling places are prominent factors predisposing the people to mosquito-related diseases. Inhabitants mainly depend on agriculture and related activities, such as agricultural labor.

Methods of data collection

A well-structured questionnaire on knowledge, awareness, and predisposing factors of lymphatic filariasis was prepared by researchers with input from a medical sociologist, social psychologist, and parasitologist using a standard WHO questionnaire format. 12 villages were covered, and door to door survey has conducted for a total of 260 respondents filled the questionnaire. Out of 260 LF affected patients, 102 were male and 158 were female. The questionnaire was validated and pretested to ensure reliability and validity before initiating the fieldwork. 10 Research assistants were recruited to administer the questionnaire using the local language to determine the extent of participants' knowledge, awareness, and attitude and perception, as well as their psychosocial behaviors about lymphatic filariasis. Every subject has been informed about the intention of the study and was carried out with the informed consent of subjects. Medical examination for signs and symptoms (acute or chronic) for lymphatic filariasis of each subject was done, i.e., lymphedema (elephantiasis), scrotal swelling (hydrocele), breast swelling and hand swelling. Local swelling and warmth in the groin with or

without associated with constitutional symptoms such as fever, nausea or vomiting. The investigators explained these terms in the local language (Hindi), which are very common in the study area.

Ethical consideration

All the subjects were well informed about the study's objectives and procedures. The participation was voluntary, and any of the subjects has the full option to withdraw from the study without any penalty. Willing participants gave the consent to the administration of the questionnaires. All the information that was collected was used according to the ethical norms.

Results and discussion

Most of the participants had a primary school education N=122 (46.92%), with farming (63.46%) being the most predominant occupation. Most of them were married N=165 (86.54%) A majority of the respondents N=172 (66.15%) had heard about elephantiasis. Most of the people (76.92%) had no sources of information about elephantiasis and only 34.62% (N=90) of the respondents were aware and used preventive measures like bed nets. But the majority of them N= 200 (76.92%) don't have any knowledge of elephantiasis (Table 1). The summary of a clinical examination of 260 individuals is represented in Table-2. The chronic condition of lymphatic filariasis, namely lymphodema (elephantiasis) and hydrocele are more prevalent in the study population. During the investigation, arm elephantiasis was recorded in seven men and 11 women. The elephantiasis is widespread in female as compared to the male in the affected region of UP. Whereas, the overall disease attributable to filariasis is more prevalent in males than in females (Table 1). When the age and gender-specific prevalence of chronic filarial conditions were studied, it was found that the incidence of elephantiasis increased with age in both males and females and it was found to be highest in people having > 70 years of age. While hydrocele was observed in 21 male in the age group of 10-70 years.

The age dependency of chronic forms exists; this may be due to the accumulation of chronic cases within the study population. The present age-dependent trends are consistent with that of the prevalences of chronic filarial conditions in south India (26) and ADLs (27), and also to that in Varanasi of North India (28). The study also indicated the differences between males and females with regard to the prevalence of various forms

Table 1. Sociodemographic characteristics, awareness, preventive measures and knowledge about elephantiasis among the study population (N= 260) is summarized in the table.

Parameters	Response	Percentage
Literacy Rate		
No Education	28	10.77%
Primary Education	122	46.92%
Secondary Education	80	30.77%
Tertiary	30	11.54%
Marital Status		
Unmarried	35	13.46%
Married	225	86.54%
Profession		
Unemployed	40	15.38%
Farming	165	63.46%
Student	10	3.85%
Other	45	17.31%
Awareness of elephantiasis in the community		
Yes	172	66.15%
No	88	33.85%
Preventative measures Against Mosquitoes (Mosquitoes Net Usage)		
Yes	90	34.62%
No	170	65.38%
knowledge of elephantiasis		
Yes	60	23.08%
No	200	76.92%

of the filarial disease. The hydrocele contributed to the higher overall disease burden (chronic forms) in males as compared to elephantiasis. The prevalence of elephantiasis was found to be more in female individuals as compared to the males. However, generally the prevalence of hydrocele was higher than that of elephantiasis in male individuals (26, 29). Never the less, the prevalence of total disease burden attributable to filariasis was significantly higher in males than in females (26). The earlier data of 17 localities from India indicated that the point prevalence of disease was generally lower in females as compared to males. Moreover, they also suggested that gender dependency and the preponderance of clinical manifestation was primarily due to the occurrence of hydrocele in males. This observation could partially be explained by the relatively higher exposure of males to mosquito bites in addition to other anatomical and hormonal differences between males

Table 2. Filariasis infected male patients in Pihani area is represented in [A], whereas female patients in the Pihani area of Hardoi district is represented in [B]. Out of 260 LF affected patients, 102 were male and 158 were female.

Age Groups	Symptoms			Age Groups	Symptoms		
	Lymphoedema in Leg	Lymphoedema in Hand	Hydrocele		Lymphoedema in Leg	Lymphoedema in Hand	Hydrocele
10-20	10	1	1	10-20	7		3
20-30	12	0	3	20-30	13		1
30-40	26	4	8	30-40	60		5
40-50	17	3	5	40-50	42		3
50-60	7	0	0	50-60	15		3
60-70	1	0	4	60-70	6		0

[A]

[B]

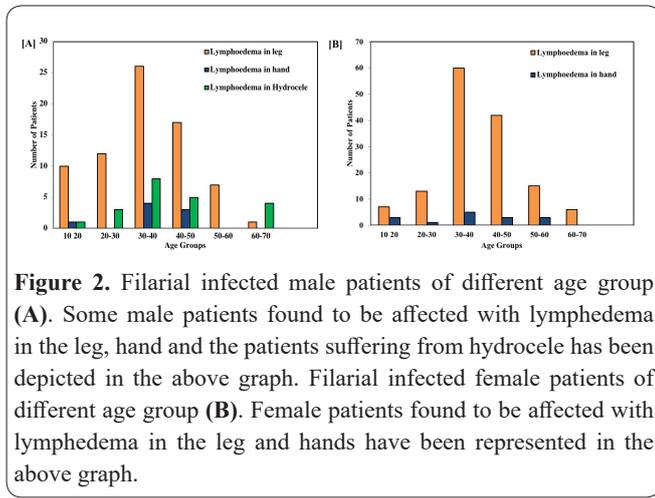


Figure 2. Filarial infected male patients of different age group (A). Some male patients found to be affected with lymphedema in the leg, hand and the patients suffering from hydrocele has been depicted in the above graph. Filarial infected female patients of different age group (B). Female patients found to be affected with lymphedema in the leg and hands have been represented in the above graph.

and females. Gender-specific physiological factors such as hormones have been speculated to influence parasite establishment in the human host as indicated by Brabin, 1990 (30). The present study also suggests that age and gender dependency of the appearance of various clinical forms should be considered in estimating the economic and social implications of filariasis.

Our results show that some filarial infected male patients with lymphedema in the leg are higher among different age groups as represented in Figure-2A. It was also observed that the number of male patients suffering from hydrocele increases with age (Mostly seen at 60-70 years old). Furthermore, we found that filarial infected female patients with lymphedema in the leg are highest in all the affected age group as compared to lymphedema in hand as represented in Figure-2B. Our result suggested that 30-40 years old female patients with lymphoedema in leg are more infected as compared to the other age groups.

Figure-3A shows a comparative for the distribution of filarial infection among the male patients with regard to different body locations (e.g., leg, hand, hydrocele). It is found that the majority of patients have lymphedema in the leg and less have lymphedema in hand. Figure-3B depicts a cross-sectional analysis graph which shows the curvature of male patients among different age with

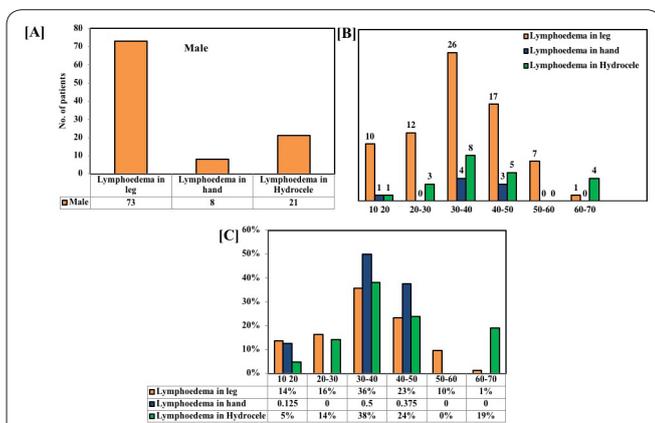


Figure 3. A comparative graph of the number of filarial infected male patients involving different locations (e.g., leg, hand, hydrocele) (A). A cross-sectional analysis graph shows the curvature of male patients among different age groups found to be affected with lymphedema in the leg, hand, and hydrocele (B). A cross-sectional analysis graph shows the percentage of male patients among different age groups affected with lymphedema in the leg, hand and hydrocele (C).

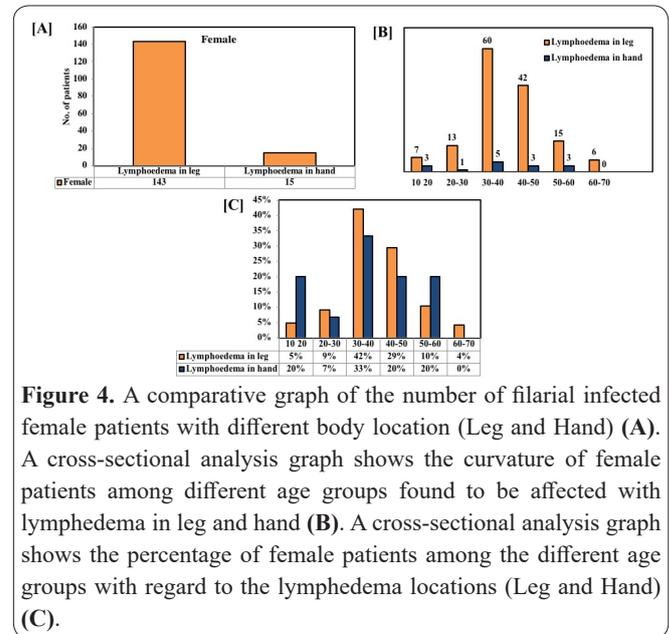


Figure 4. A comparative graph of the number of filarial infected female patients with different body location (Leg and Hand) (A). A cross-sectional analysis graph shows the curvature of female patients among different age groups found to be affected with lymphedema in leg and hand (B). A cross-sectional analysis graph shows the percentage of female patients among the different age groups with regard to the lymphedema locations (Leg and Hand) (C).

lymphedema in the leg, hand, and hydrocele. However, it is worth noticed that Pre-mid age group (30-40 years of age) showed maximum number of all type of lymphoedema. Cross-sectional analysis graph shows the percentage of male patients among the different age groups with lymphedema in the leg, hand and hydrocele (Figure-3C). Our results suggest that lymphedema in legs are most commonly seen in the male patients.

A comparative graph showing the number of filarial infected female patients with regard to affected locations (e.g., leg, hand) (Figure-4A). It was found that among the female patient, the majority of the patients have lymphedema in the leg and to lesser extent in their hands. A cross-sectional analysis graph shows the curvature of female patients among the different age groups affected with lymphedema in leg and hand [Figure-4B]. It is worth noting that at Pre-mid age group (30-40 years of age), the number of all type of lymphoedema is comparatively higher. A cross-sectional analysis graph shows the percentage of female patients among different age group affected with lymphedema in leg and hand (Figure-4C). Our results suggested that lymphedema in leg are most commonly in the females.

Finally, a comparative analysis graph for the number of filarial infected male as well as female patients and a total number of patients' among the different age groups is shown in Figure-5A. It has been noticed that the number of female patients is higher when compared

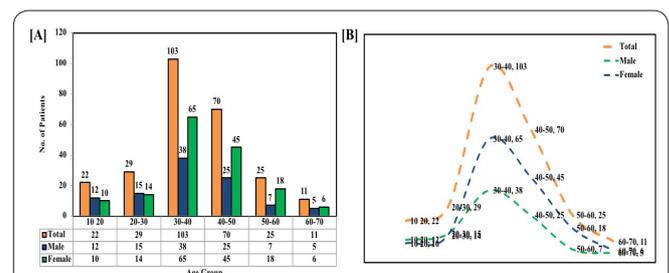


Figure 5. A comparative analysis graph of no. of filarial infected male as well as female patients concerning different age group (A). A cross-sectional analysis graph shows the curvature of male, as well as female patients concerning different age group, found to be affected with different lymphedema (B).

with the male ones in all age groups. Cross-sectional analysis graph shows the curvature of male as well as female patients in the different age groups (Figure-5B).

Conclusion

Lymphatic filariasis (LF) is by far the most prevalent disease of the filarial infections (3, 8 & 31) commonly known as “elephantiasis,” affecting around 1.4 billion people globally with about 40 million disfigured and incapacitated by the disease in 73 countries (32). It is noticed that in comparison to male patients, female patients are more in number in all age group. We also showed a cross-sectional analysis graph shows the curvature of male as well as female patients concerning different age group as shown in figure 5(b). It is found that at pre-mid age group, i.e., 30-40, number of both male and female patients is comparatively. From the public health viewpoint, the distribution and prevalence of LF are higher among the females as compared to male in various disease condition of filariasis. The data and conversation with the affected population during my survey suggested, to prevent the occurrence of new infection and disease by administration of a single annual dose of the anti-filarial drug, i.e., DEC or co-administration of DEC + Albendazole among the affected population and greater emphasis is needed among the LF⁺ females. Our finding from the above survey may recommend that we are supposed to take care of those individuals who already have the disease to provide home management (lymphoedema) as well as hospital-based control for limb hygiene and surgical correction of hydrocele respectively to eradicate LF.

Author Contributions

Conceptualized and planned the study and experiments M.S., H.M., and S.M.F. Performed the experiments: M.S., S.M.F., and I.A. & A.K. Analyzed the data: M.S., S.M.F., and M.J.A. Contributed reagents/materials/analysis tools: experiments H.M. Wrote the paper: S.M.F., M.S., and S.K. All authors reviewed the manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

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