

A review of endemicity and control strategies against lymphatic filariasis in Nigeria

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ABSTRACT: Lymphatic Filariasis (LF) is a neglected tropical disease (NTDs) that persists in developing countries causing disability through disfiguration with great economic repercussions. In Nigeria, LF is transmitted by female mosquitoes and caused by nematode, *Wuchereria bancrofti*. The vectors of LF, anopheles and culex mosquitoes, are widespread across rural and urban areas. This review focuses on the level of endemicity and control strategies employed against LF in Nigeria. Only reliable surveys are included in this review and criteria are applied to information identified through searches of published research in peer reviewed journals of electronic bibliographic and manual searches of local archives and libraries. Data are excluded if based on personal unpublished views. Two main strategies were employed for the control of LF as a public health problem in Nigeria, (i) interrupting transmission through annual large-scale treatment programmes, known as mass drug administration (MDA) of single doses of albendazole plus either diethylcarbamazine or ivermectin implementation to cover the entire population at risk which is not scaled up to all endemic areas and (ii) alleviating the suffering caused by LF through morbidity management and disability prevention. In Nigeria, the former has gain prominence than the latter. Despite lack of total therapeutic coverage of MDA, high success has been achieved leading to elimination of LF in some states in the country. Availability and resistance of vector species to insecticide govern transmission and sustainability of LF in Nigeria. In view to ensuring a successful control plan and eventual eradication of the disease, in addition to MDA, morbidity management and vector control to prevent human mosquitoes contact should be scale up.

Keywords: Control, endemic, lymphatic filariasis, MDA.

INTRODUCTION

The 21st century has ushered in an era when globalization of infectious diseases is occurring frequently and at an unprecedented speed (Mackey and Liang, 2012). In this “globalized” environment, pathogens do not recognize geopolitical borders because of interdependent trade, travel, migration, and international economic markets (Mackey et al., 2014). Lymphatic filariasis (LF) is a Neglected Tropical Disease (NTDs) that persists in developing countries and impoverished communities throughout sub-Saharan Africa, Asia, South and Central America (Celone, 2015). The status of LF as a neglected

disease means that health education to the populations in danger regarding symptomology, prevention and transmission does not receive the same attention as more prominently-known diseases like HIV/AIDS and tuberculosis. The disease affects more than 120 million individuals globally (Ichimori, 2014). It is estimated that around 20% (1.1 billion people) of the world population in more than 83 countries are at risk of acquiring infection (Ottensen, 2000) and at least 36 million people remain with these chronic disease manifestations (WHO, 2019) which is associated with disfigured or incapacitated with symptoms like

lymphedema (tissue swelling), elephantiasis (skin/tissue thickening), and hydrocele (fluid accumulation in the scrotum) (WHO, 2012). While LF does not typically cause mortality, the disfiguring symptoms caused by this infection can have significant implications with respect to accomplishing routine tasks and daily social interaction (Celone, 2015). Those with chronic and disfiguring conditions can alleviate discomfort and prevent secondary infection through rigorous hygiene practices such as washing the affected body parts with soap and water (Celone, 2015).

The topic of LF is important to public health due to the disability it causes in endemic areas which has economic repercussions because it debilitates healthy citizens who would otherwise contribute to economic growth (Wynd et al., 2007). In addition, the condition can be highly stigmatizing for individuals with chronic disabling symptoms that restrict social interactions due to lack of education on the disease (Gyapong et al., 2000). Visible manifestations of LF, including lymphedema of the limbs, breasts and genitalia, have profound social consequences (Evans et al., 1993). The majority of individual and communities in endemic regions have far less access to the resources necessary to address the social determinants of NTDs and may live in poor sanitary conditions, have inadequate nutrition, and lack access to necessary public health and healthcare systems for treatment, despite many of these diseases being preventable and/or treatable through specific low-cost interventions (Conteh et al., 2010).

LYMPHATIC FILARIASIS IN NIGERIA

Lymphatic filariasis vectors

Mosquitoes are unambiguously the most important vectors of infectious disease-causing agents that tremendously affect global health, with over half of the global human population at risk of exposure to mosquito-transmitted infections (Famakinde, 2018). Depending on the geographic location and biological peculiarities of each specie, wide range of arthropods (mosquitoes) transmits LF parasite (WHO, 2013). The disease is transmitted by members of *Anopheles*, *Culex*, *Aedes* and *Mansonia* genera of mosquitoes (WHO, 2013).

In Africa, lymphatic filariasis caused by *W. bancrofti* is transmitted majorly by *Anopheles gambiae* s.l., *An. funestus* s.l., *An. pharoensis*, and *Mansonia* species (WHO, 2010; 2013; Ughasi et al., 2012; Dzodzomenyo et al., 1999). *Culex* spp is known as one of the vectors of LF in urban Nigeria (Anosike et al., 2005; Nwoke et al., 2010). Larval habitats for many of these vector species are commonly standing bodies of small pools or clear and or polluted water found close to villages. In Nigeria filariasis and malaria parasites can naturally share the same vector species, in particular *Anopheles gambiae* s.l.

Causes, distribution and clinical manifestation of LF

Lymphatic filariasis is caused by 3 known species of the filarial nematode: *Wuchereria bancrofti* (*W. bancrofti*), *Brugiamalayi* (*B. malayi*) and *Brugiatimori* (*B. timori*) (Shenoy, 2008). *W. bancrofti* is the most well-documented and widespread cause of lymphatic filariasis (John and William, 2006). Lymphatic filariasis is endemic throughout Sub-Saharan Africa (John and William, 2006) and the disease is estimated to affect over 500 million people (Hotez et al., 2012).

Bancroftian filariasis also occurs sporadically in South America, India, and Southeast Asia. *Brugia* spp. associated with LF are more geographically limited and occur only in Southeast Asia. *Brugia timori* is restricted to the Lesser Sunda Islands of Indonesia. Filarial infection is usually acquired in childhood and has no gender preference. One gets infected on the bite of an infected female mosquitoes carrying an infective third stage larvae (L3) in the course of its blood meal (WHO, 2013). The lifespan of adult worms is 4 to 6 years meal (WHO, 2013). Children in endemic areas suffer from lymphedema of the limbs and hydrocele (Ramaiah and Kumar, 2000) which has also been confirmed by prevalence studies on microfilaremia and filarial antigenemia in children (Witt and Ottesen, 2001) and existence of live adult filarial worms on Doppler sonography and lymphatic dilatation by lymphoscintigraphy in children aged 3 to 15 years (Shenoy et al., 2007).

Human LF is associated with chronic disfiguring pathologies such as lymphoedema and elephantiasis (disfiguring swelling of the legs), and hydrocoele (disfiguring swelling of the scrotum) in males, and of the breasts and vulva in females (Chakraborty et al., 2013). The resulting deformities generate severe psychosocial consequences including sexual disability (Dreyer et al., 1997) and mental depressive illness (Ton et al., 2015; Obindo et al., 2017). LF is the second leading cause of long-term disabilities globally due to lymphedema, elephantiasis and hydrocele (Mshana et al., 2016). Filariasis due to *W. bancrofti*, the spp responsible for the disease in Nigeria, involves the entire affected limb, the genitals, or breasts (Shenoy, 2008). Whereas, *B. malayi* infection differs in that the lymphedema involves only the legs below the knee and upper limbs below the elbow, without genital or breast involvement (Shenoy, 2008).

Burden and control strategies of lymphatic filariasis in Nigeria

In Africa region, 39 countries are endemic and more than 394 million people are at risk of lymphatic filariasis disease (Ottesen et al., 2008). Globally, Nigeria is ranked 3rd highest with LF disease and over 114 million Nigerians are at risk of the disease burden (FMoH 2017; Anisoke et al., 2005) with the highest disease burden in the North-West

while North-Central had the lowest disease burden (Hussaini et al., 2020).

LF is prevalent in Nigeria with 574 out of 761 LGAs surveyed being endemic (FMoH, 2017). Nigeria accounted for 14.3% of the global population of people that required LF treatment (WHO, 2019). Out of over 120 million required preventive chemotherapy for LF, about 80 million people had taken at least a treatment for LF which is supposed to be taken once yearly for five years (WHO, 2019) while only 33 of the 583 endemic LGAs are yet to start mass drug administration (WHO, 2019).

Lymphatic filariasis is one of the six infectious diseases identified by the International Task Force for Disease Eradication as “eradicable” or “potentially eradicable” (CDC, 1993). In recognition of its eradicability and to achieve the goal of elimination of lymphatic filariasis as a public health problem, the Global Plan for Elimination of Lymphatic Filariasis GPELF identified two main strategies viz: (i) Interrupting transmission through annual large-scale treatment programmes, known as mass drug administration (MDA), implemented to cover the entire population at risk and (ii) Alleviating the suffering caused by lymphatic filariasis through morbidity management and Disability prevention. (WHO, 2014). Of the two strategies, the former, preventive chemotherapy delivered through mass drug administration (MDA) which aimed at reducing the density of parasites circulating in the blood of infected persons and prevalence of infection in communities to levels where transmission is no longer sustainable by the mosquito vector has gained prominence (WHO, 2010). For interruption of lymphatic filariasis transmission, microfilariae prevalence must be less than 1% or antigen prevalence less than 2% (WHO, 2011). Mass Drug Administration involve community-wide annual administration of single doses of albendazole plus either diethylcarbamazine or ivermectin implementation in endemic regions, treating the entire population at risk. MDAs are mainly conducted using community volunteers and health staff especially community health workers or community drug distributors (CDDs) (Omedo et al., 2012). Therefore, a robust health system is required to deliver effective MDA that achieves effective and high coverage over the number of treatment rounds required to ensure interruption of transmission.

Mass drug administration (MDA) coverage in Nigeria

The National Lymphatic Filariasis Elimination Programme (NLFEPE) was established in 1997 in line with the World Health Assembly Resolution (May 1997) which urged member States to eliminate lymphatic filariasis as a public health problem. Baseline survey of population-based antigen to estimate LF prevalence was carried out. Based on the survey data in Nigeria, a total of 558 LGAs were targeted for Mass Drug Administration (MDA) with Ivermectin and Albendazole tablets in 35 States and the

Federal Capital Territory. As at 2013, MDA has covered 179 LGAs of 18 States and FCT while treatment was discontinued in Plateau and Nassarawa States after the Transmission Assessment Survey (TAS) results indicated interruption of transmission.

Millions of Nigerians are no longer at risk of lymphatic filariasis as a result of wide MDA coverage and the success recorded in elimination of LF in Plateau and Nasarawa states through administration of Albendazole and Mectizan (The Carter Center 2021). In these two states alone, more than 36 million drug treatments for lymphatic filariasis were delivered to bring about this success (The Carter Center, 2021). Complimentary to MDA, insecticide-treated bed nets for mosquito control were also widely distributed. Transmission is considered to be eliminated in the two states because no new infections were found after the interventions (The Carter Center, 2021). High prevalence (31%) of LF infection still abounds in some endemic areas requiring urgent control programme (Elkanah et al., 2020).

DISCUSSION

Nigeria is an endemic country for lymphatic filariasis and ranked third globally although millions of Nigerians are no longer at risk of lymphatic filariasis as a result of wide MDA coverage. In line with data obtained from FMoH (2017), 574 out of 761 LGAs mapped are endemic for LF (Figures 1 and 2) as the status of few LGAs in the North East are unknown as a result of insecurity. MDA is the choice mode of achieving the elimination goal of the GPELF in Nigeria which has achieved a remarkable success as demonstrated by the Carter Center (2021). The goal of MDA is to reduce the density of parasites circulating in the blood of infected persons and prevalence of infection in communities to levels where transmission is no longer sustainable by the mosquito vector. The nature of LF infection necessitates that whole communities be treated and members participate to ensure that <1% microfilaria prevalence in endemic populations is attained to stop transmission (Gyapong et al., 2018). Although MDA has covered reasonable part of the country (Figures 3 and 4), some LGAs are still left uncovered due to insecurity especially in the North-East which is a danger signal that can hamper country elimination of LF. This is in line with the report of Elkanah et al. (2021) who reported high prevalence (31%) rate of LF in Northern Taraba State. While it may be perceived that achieving a proper MDA coverage might be easier in urban settings, in Nigeria where the public health system usually is stronger (in comparison to rural areas), the implementation of MDA interventions can be a challenge under certain conditions in urban settings that are characterised by overcrowded slums and intense population movements. Morbidity management and disability prevention for patients with swollen legs and scrotum is also being supported by

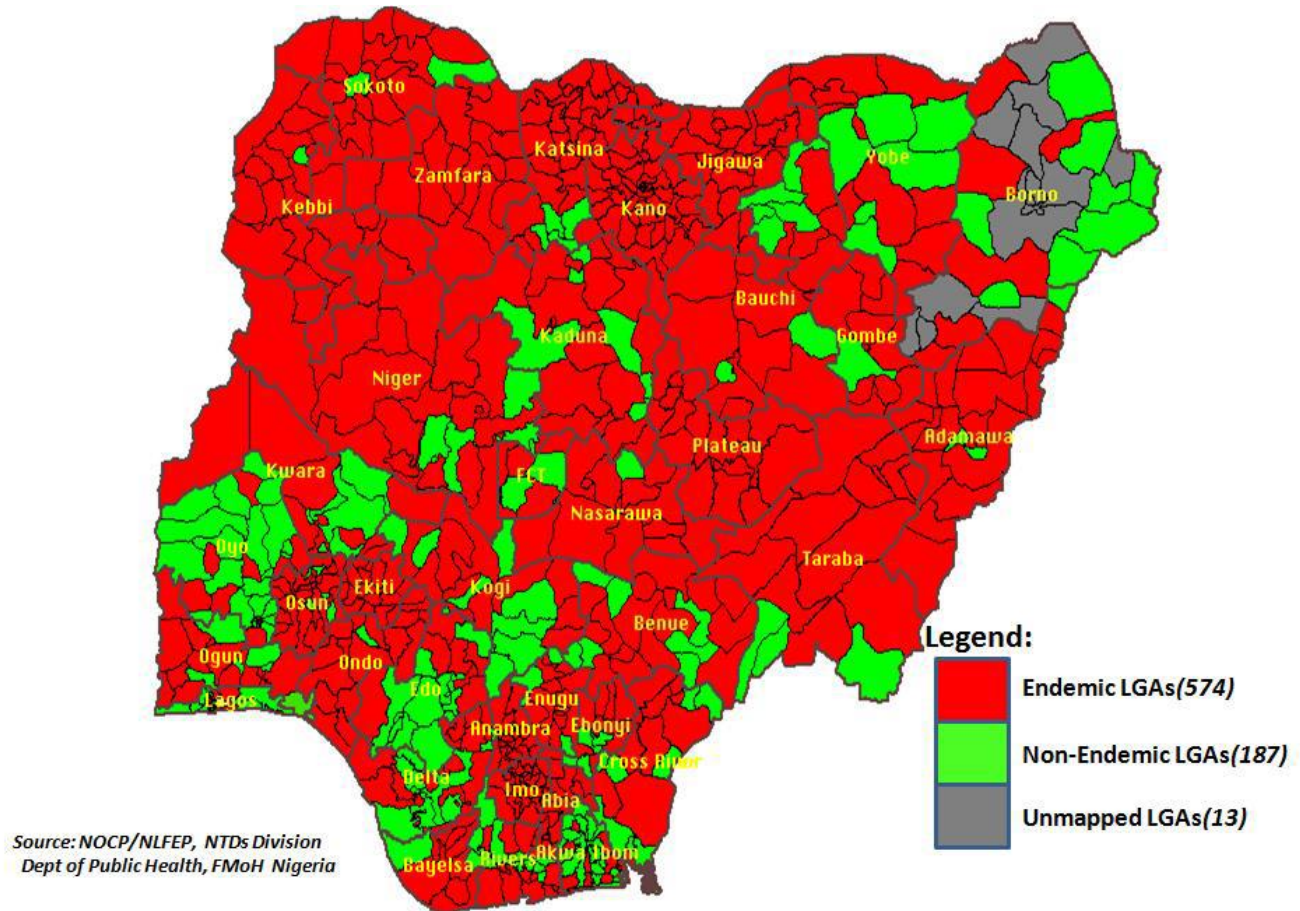


Figure 1. Endemic LGAs in Nigeria source (FMoH 2017).

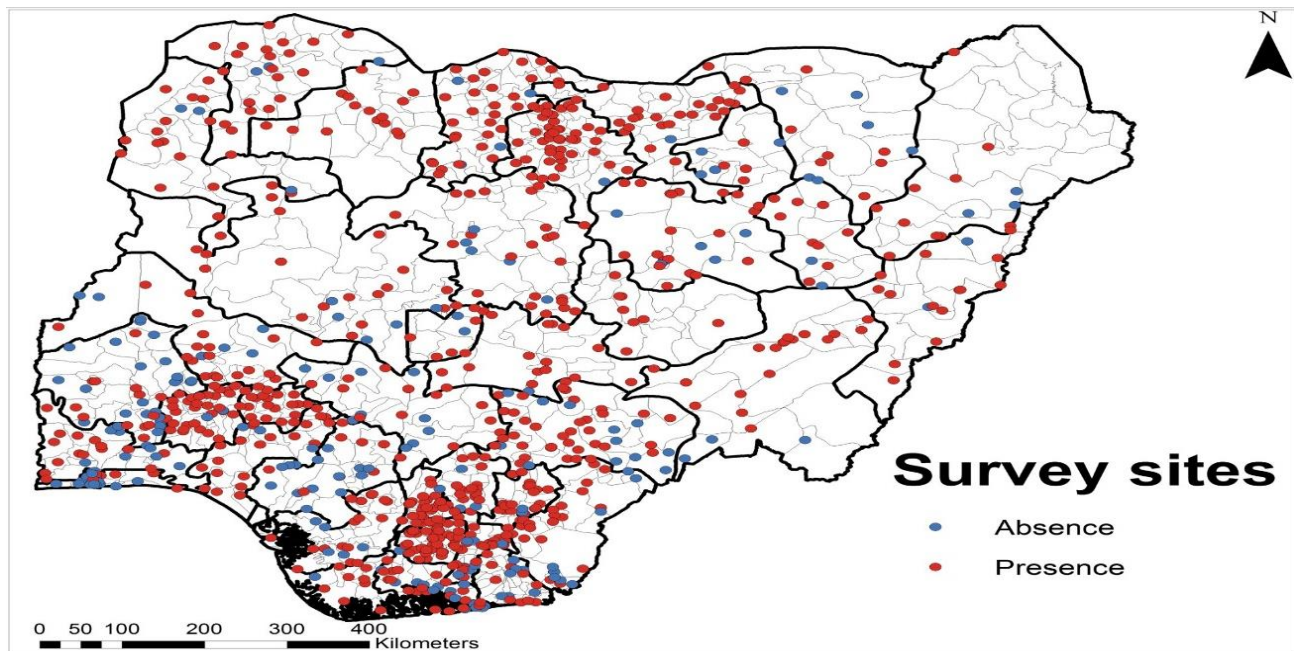


Figure 2. Nigeria map showing endemicity of LF. Red points show sites with at least one LF case and blue points show sites with no LF case source (Eneanya et al., 2018).

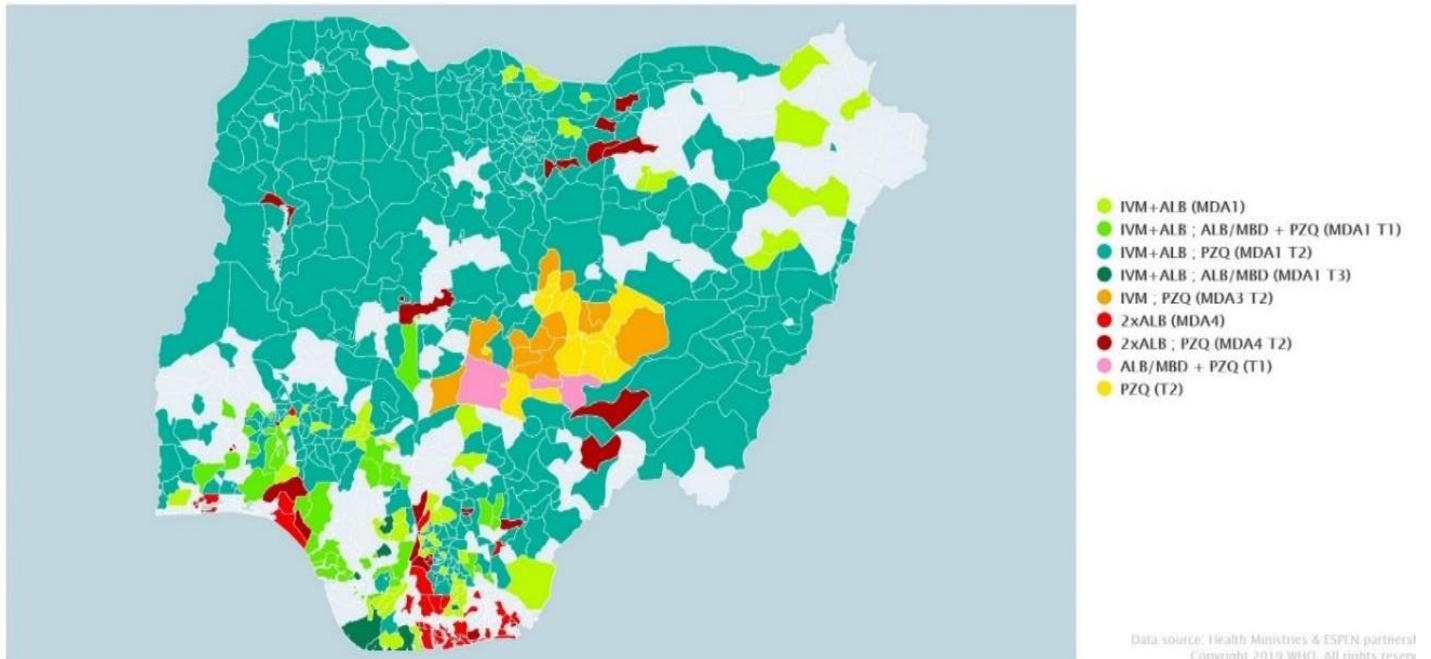


Figure 3. Mass Drug Administration Distribution in Nigeria (Source: FMoH, 2017).

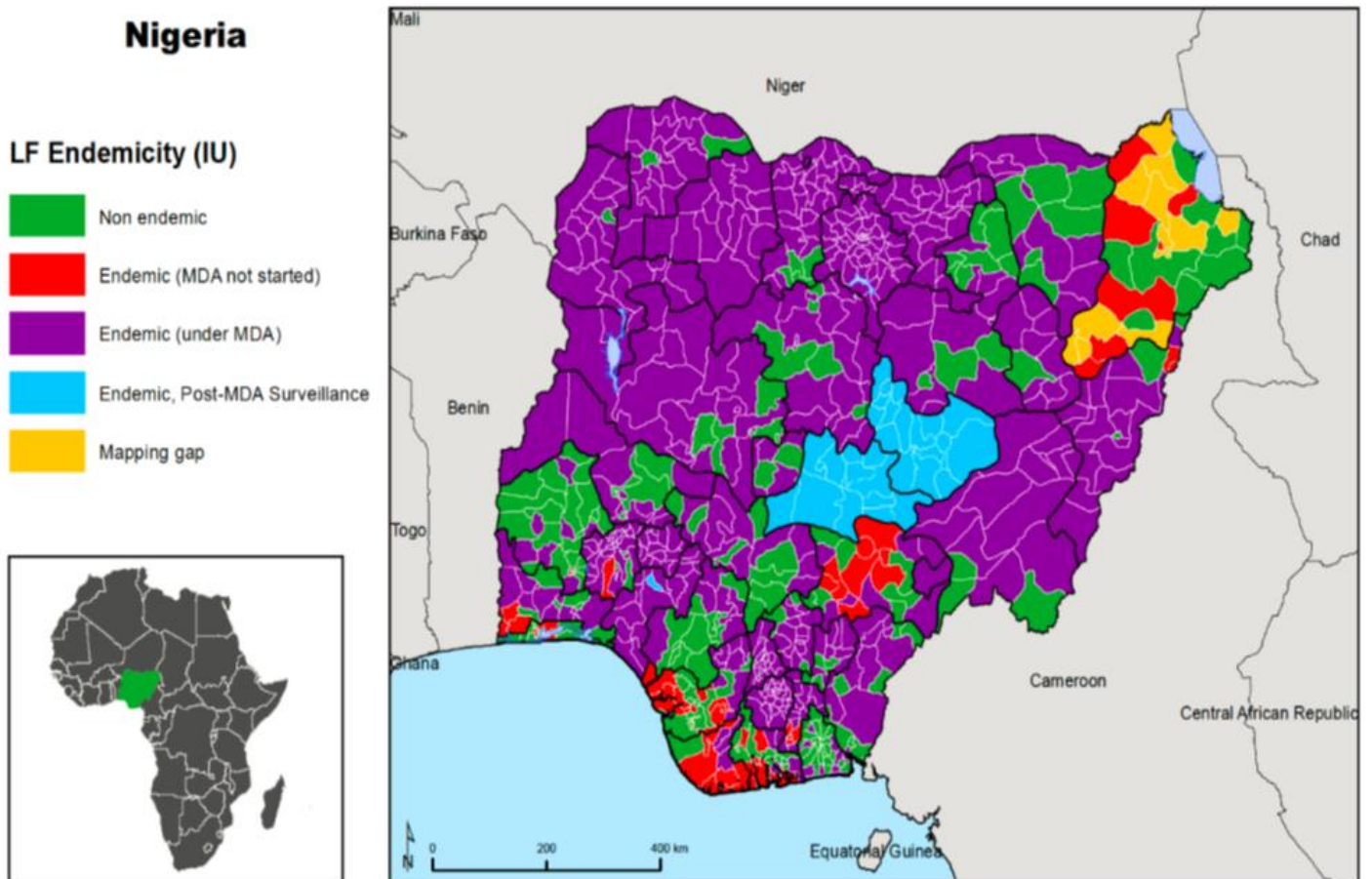


Figure 4. Status of LF endemicity and MDA coverage in Nigeria (Source: WHO, 2017).

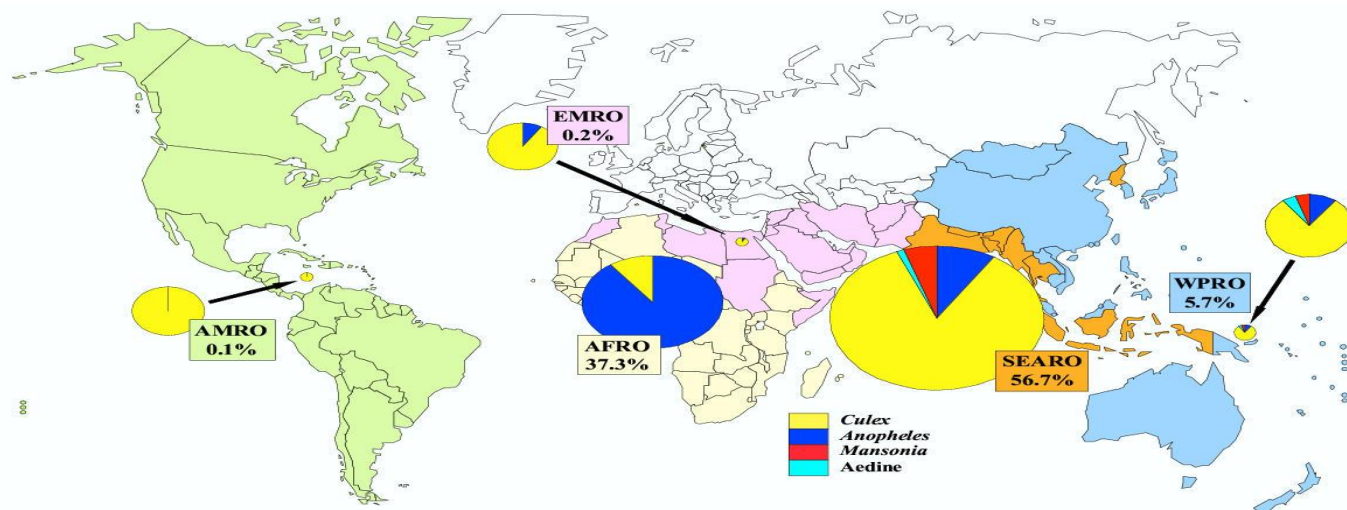


Figure 5. Distribution of vectors of LF in the World. (AMRO- Americas Region, AFRO- Africa Region, EMRO-Eastern Mediterranean region, SEARO- South –East Asia and WPRO-Western Pacific Region) (Source: Molyneux, 2003).

Table 1. Mosquitoes vector species of lymphatic filariasis feeding behaviour and periodicity in Nigeria.

Species	Target animal	Feeding	Resting	Periodicity
<i>Anopheles gambiae s.s</i>	Anthropophilic	Endophagic	Endophilic	Nocturnal
<i>Anopheles funestus</i>	Anthropophilic	Endophagic	Endophilic	Nocturnal
<i>Culex quinquefasciatus</i>	Both (Anthropo & zoo -philic)	Both (endo & exo -phagic)	Both (endo & exo -philic)	Nocturnal

WHO and implementing partners.

In Nigeria, the mosquito species *Culex quinquefasciatus* and *Anopheles gambiae sl* are the most important vector of *W. bancrofti* (Figure 5) in both rural and urban setting (Anosike et al., 2005; Nwoke et al., 2010). These mosquito species are mostly anthropophilic and endophagic and feed nocturnally (Table 1) and capable of stable transmission even at very low levels of microfilariae in the blood. In agreement with Bockarie et al. (2008) and The Carter Center (2021), in synergy with MDA, vector control is an important supplement in LF endemic areas especially where there is no complete MDA coverage. Understanding the factors that regulate the size of mosquito populations is fundamental to the ability to predict transmission rates and for vector population control. Effective control of LF through vector management requires information on the abundance of vectors in the targeted areas since there are marked seasonal variations in the mosquito abundance. In line with the findings of Sogoba et al. (2007) who reported that extensive use of agrochemicals and other chemical in public health to control mosquito populations to reduce the burden of diseases transmitted by the insects has led to widespread emergence and spread of resistance, in Nigeria, there is high resistance of insect vector of LF to insecticide which may be as a result of wide use of chemicals in agriculture to boost crop production. Development of resistance to insecticide by insect vectors

of LF can threaten control efforts in Nigeria. Insecticide resistance counters control methods by increasing vector population sizes above the critical thresholds required for disease management and could have drastic epidemiological and public health consequences.

CONCLUSION

Lymphatic filariasis is endemic in Nigeria due to wide spread and abundance of the vectors of the disease in the country. Of the two strategies identified by Global Plan for Elimination of Lymphatic Filariasis, preventive chemotherapy delivered through mass drug administration (MDA) has gained prominence and has cover over 80% of the endemic regions in the country. Elimination of lymphatic filariasis has been achieved in two states of the federation, Plateau and Nasarawa, through MDA (albendazole and Mectizan), an indication of efficacy of MDA and perhaps possible elimination of lymphatic filariasis as a public health problem in Nigeria. Morbidity management and disability prevention for patients with swollen legs and scrotum is also being supported by WHO and partners. Despite wide coverage of MDA high prospect of eliminating LF in Nigeria, a number of persons are still at risk of the disease as a result of security challenges that prevent total coverage of endemic areas.

Recommendations

1. Achieving elimination of LF transmission with MDA is critical, it is important too to scale up morbidity management programs considering the burden of the chronic clinical disease and economic burden associated with clinical LF.
2. Vector control activities during periods of high transmission should be strengthened taking into consideration vector breeding sites and distribution and encouraging extensive use Long Lasting Insecticide Treated Nets (LLITN) in addition to MDA.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

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