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Review

Epidemiological characteristics of *Bancroftian filariasis* and the Nigerian environment

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***Bancroftian filariasis*, caused by *Wuchereria bancrofti* is widespread in Nigeria. It is a serious public health problem as well as a major cause of acute and chronic morbidity in Nigeria. *Anopheles gambiae* and *Anopheles funestus* are the main vectors in the rural Nigeria while *Culex quenquifasciatus* is the vector in the urban and semi-urban areas. Although these mosquito vectors breed and transmit bancroftian filariasis in Nigeria, human behaviour and activities, urbanization and overcrowding as well as industrialization in Nigeria have created abundant breeding sites. The availability and proximity of human settlement to these numerous breeding sites for the vectors play important role in the disease transmission and intensity in both rural and urban areas. Our quick drive and desire to develop some of the river basins into hydroelectric dams and irrigation schemes in the country has, in some cases led to increased threat to public health including aggravation of bancroftian filariasis. Together with other careless engineering practices, these projects have either aggravated the prevalence of bancroftian filariasis or directly introduced it into new areas by providing new and permanent habitat for the vector species. The epidemiological significance of these is discussed.**

Key words: *Bancroftian filariasis*, *Anopheles gambiae*, *Culex quenquifasciatus*, public health, human behavior, urbanization.

INTRODUCTION

Filariasis is a group of human and animal infectious diseases caused by nematode parasites commonly called “filariae”. The thread-like (filarial) adult parasites live in vessels, tissues or body cavities of the vertebrate hosts. The female worms are viviparous and produce microscopic embryos called microfilariae. The microfilaria (mf) circulates in the blood or migrates through the skin (depending on the parasite) from where they are ingested by vectors during blood meal. When picked up the vector, the microfilariae increase in size moult and finally develop into infective filariform larvae (L3).

Of the more than 500 filarial parasites known to infect mammals, birds, reptiles and amphibians, only eight are common parasites of man: *Wuchereria bancrofti, Brugia malayi*, *Onchocerca volvulus*, *Loa loa*, *Mansonella perstans*, *Mansonella streptocerca*, *Mansonella ozzardi and Brugia timori*. Of all these, the adults of *B. Malayi, B. timori, and W. bancrofti* inhabit the lymphatic system, hence the disease they cause is termed lymphatic filariasis. Only *Bancroftian filariasis* is endemic in Nigeria.

The female parasites of *W. bancrofti* produce, during their 4 - 6 years of life span, millions of microfilariae which circulate in the peripheral blood. The microfilaria of *W. bancrofti* has local forms or physiological races which adopt by means of remarkable phenomenon of microfilarial periodicity. That is, spatial distribution of microfilarial periodicity in the blood which synchronizes with the biting pattern or behaviour of the local mosquito vectors. In Nigeria, the microfilaria of *W. bancrofti* exhibit nocturnal periodicity. That is, the microfilaria has clear, distinct nocturnal periodicity, appearing between 12 midnight and 4 am before receding from peripheral circulation almost completely during the day.

In endemic communities an overwhelming majority of infected individuals have few overt clinical manifestations, despite the presence of large number of circulating microfilariae in their peripheral blood. These individuals may be clinically asymptomatic but virtually all persons with

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W. bancrofti microfilariae have some degree of sub-clinical disease. About 40% of these microfilariaemic individual have haematuria and/or proteinuria that reflect renal damage. The haematuria is most often microscopic and accidentally discovered during routine urine examination (Nwoke, 2009). Haematuria and proteinuria resulting from renal abnormalities are associated with the presence of microfilariae, rather than the adult worms, because clearing the microfilariae from the blood results in the complete reversal of these abnormalities. Clinical manifestation of *B. filariasis* is grouped into acute filarial adenolymphangitis and chronic manifestations which include: Lymphoedema and elephantiasis of the extremities urinogenital complications, lymph scrotum and hydrocoele, chyluria and adenopathy.

THE DISEASE BURDEN

B. filariasis is a widespread and serious public health problem; and a major cause of acute and chronic morbidity of humans in the tropics and subtropical areas of Africa, Asia, India, Southeast Asia, the Pacific Islands, and South and Central America (WHO, 1992). In endemic communities, *L. Filariasis* is most prevalent in the rural and slum areas, predominantly affecting the poorest of the poor “at the end of the road” (Udoidung et al., 2008, Okon et al., 2010). In Nigeria, *L. filariasis* has been reported in rural communities in the lower Cross River Basin (Udoidung et al., 2008, Okon et al., 2010), Ezza in Ebonyi State (Anosike et al., 2005), Igwun basin of Rivers State and parts of the Niger Delta (Udonsi, 1988, Agi and Ebenezer, 2009) as well as parts of Central Nigeria including rural communities in Plateau and Nassarawa States (Eigege et al., 2003).

B. filariasis does not directly cause death but it is recognised as the second leading cause of permanent and long term disability worldwide (Ottesen et al., 1997). The Global Burden of Disease (GBD) study by World Bank (1993) showed an estimated lymphatic filariasis (LF) prevalence rate of 3.4%. It is estimated that there are about 1.2 billions people who are at risk of the disease in the 83 countries (20% of the world population); and over 128 million people are infected or diseased (McCarthy, 2000). About 76 million people in the world are estimated to be suffering from the hidden disease or subclinical renal, respiratory, lymphatic and genital complications associated with LF (Bockarie, 2002). Of the 128 million people infected globally by LF, 91% of them are due to *W. bancrofti* while *B. malayi* and *B. timori* account for the other 9% burden (Addis, 1998). The highest LF problem in the world is in India, Indonesia and Nigeria. In other words, Nigeria is the third most endemic country in the world with 22.1% of the population thought to be infected (Michael et al., 1996). The most common debilitating disease of LF is hydrocoele.

The socioeconomic impact of *B. filariasis* on endemic areas is very serious. It leads to loss of labour or work caused by both acute episode of acute adenolymphangitis and chronic diseases thereby affecting dramatically the productivity of affected individuals, households and communities. These disease problems hamper the most important daily activities of the affected individuals and impose transient (in acute disease) or life-long (in chronic disease) limitations on their inputs (Ramaiah et al., 2000).

The impact of lymphatic filariasis on marriage and sexual life is a serious problem in endemic areas. Women, more than men, depend on their physical presentation for their self-esteem (World Bank, 1993); and the destruction of the skin and beauty of the physical appearance of adolescent girls and women by lymphedema and elephantiasis seriously affect women, including hindering marriage prospects/opportunities.

In addition to economic impact, bancroftian filariasis afflicts heavy psychosocial consequences and stigmatization on the affected individuals. For instance, skin destruction (by lymphoedema and elephantiasis) of women by bancroftian filariasis primarily imposes psychological problems on the affected women long before it hampers their marriage and sexual life. This situation creates feeling of remorse, recrimination, apathy, and resignation, resulting in the desire to conceal the lesions (Lucas and Gilles, 1973). Also stigmatization of men with hydrocoele is also observed in some of the endemic countries. Villagers in some parts of Nigeria expressed fear and insecurity towards people with filarial skin lesions and towards men with genital complications and elephantiasis of the extremities (Nwoke et al., 2000).

Of the 128 million people estimated to be globally infected by LF (McCarthy, 2000), 22 million of them (17.2%) are children below the age of 15 years-school-aged children (Michael et al., 1996; Michael and Bundy, 1997)). LF is the second leading cause of permanent as well as long term disability (Ottesen et al., 1997). It also is associated with serious impairment of mobility, day-to-day activities (including attending school) (Ramaiah et al., 1997), and these school-aged children affected by LF are also debilitated.This no doubt affects their education and future career prospects.

The acute episodic attacks of bancroftian filariasis on education of school children leads to absenteeism from school ranging from 2 - 3 days per episode (Ramaiah et al., 2000) to the tune of about 4 - 36 days per year. Again, when parents or guardians are incapacitated, this will affect their agricultural and economic activities thereby exacerbating hunger and poverty in the household. To stop this trend, the children in school are withdrawn to fill the gap in the farm. This group of children no longer has time for their education or to improve their situation. In addition to the impact of the LF incapacitation, social stigma, in form of shame, embarrassment and ridicule associated with hydrocoele among the infected boys affects their commitmen to stay and study in school

(Muhondwa, 1983; Lu et al., 1988). The affected children are frustrated to the point that they abandoned their education and future career. Absenteeism from school due to this disease affects children's academic which in turn affects performance in school, and the number of years taken to complete school as well as the overall child's performance in national examinations (Edungbola, 1983). This is a continuous circle of ignorance and illiteracy affecting the educational advancement and development of the endemic communities.

Management and treatment of Lymphatic Filariasis involves the following:

1. Treatment - using antimicrobial therapy, ivermectin, Albendazole, doxycycline as well as combination therapy.
2. Surgery.
3. Treatment of chyluria.
4. Supportive care.

In Nigeria, Mass Drug Administration (MDA) using Ivermectin indirectly has been done in parts of Central Nigeria (Richards et al., 2005). Direct efforts at lymphatic filariasis control in Nigeria has been efforts set at controlling the mosquito vectors with the free distribution of insecticide treated bed-nets in parts of Ebonyi State (Emuka personal communication).

BANCROFTIAN FILARIASIS AND NIGERIAN ENVIRONMENT

Mosquito species

The geographical distribution of *B. filariasis* is largely determined by complex array of environmental factors and availability of vector breeding sites. In Africa, the principal vectors of bancroftian filariasis are *Anopheles gambiae* (formerly called Species A of the *gambiae* complex), *Culex quenquifasciatus,* and *Anopheles funestus, Anopheles arabiensis* (formerly called Species B of the *gambiae* complex). *Anopheles melas* (a West African salt-water breeding species of the *gambiae* complex) and *Anopheles merus* (the East African salt water species, an equivalent of *An. melas*.) It breeds in salt-water lagoons and swamps). Except *C. quenquifasciatus,* the other mosquitoes are also principal vector of malaria (Sasa, 1976).

In Nigeria and other African countries, *Anopheles gambiae*, which breeds mainly in temporary habitats such as pools, puddles, hoof point, burrow pits, but also in rice fields and *A. funestus,* which breed in numerous shallow, shaded, grassy streams and river and ditches in the country are the natural vectors in the rural area (Brengus, 1975).

Another principal vector of bancroftian filariasis in the country is *C. quenquifasciatus* which is a very hardy species, breeding mainly in man-made containers and polluted waters such as septic tanks, pits, polluted drains as well as in ditches, pots and water-storage jars, especially those having organic pollution (Service, 1980). *C. quenquifasciatus* has increased in many towns due to increasing urbanization and resultant proliferation of unsanitary collections of water (Service, 1989). It is principally a night biter and rests indoors after blood meal.

In the country, the availability and proximity of human settlement to the numerous natural breeding sites of these peridomestic anopheles mosquito vectors (*A. gambiae* and *A. funestus*) of bancroftian filariasis play very important role in the disease distribution and transmission. Again, the habit of most Nigerians to litter the environment with discarded containers and the storage of water in homes create additional and permanent breeding sites for these mosquito vectors around human dwellings. This attitude consequently stabilizes and perpetuates the disease transmission (Nwoke and Ebo, 1993; Nwoke et al., 1993).

Impact of man-made lakes and irrigation projects

To meet the demands of the ever rising human populations of Nigeria, most of the major river systems, especially in the savanna and semi-arid regions, have in recent times been modified into man-made lakes and irrigation projects. The construction of man-made lakes resulting from river impoundment and the extension of irrigation projects in Nigeria can be justified from point of view of economic and social necessities such as hydroelectric power, supply flood control, improved transportation, improved agriculture and development of inland fisheries as well as recreational facilities.

In some areas, Jordan and Webbe (1986) noted that well designed and constructed irrigation system with efficient drainage, correctly prepared land, sound water – management, adequate maintenance and good agricultural practices have prevented many major ecological and public health problem. Unfortunately, in our quick drive and desire to develop some of the River Basins and the irrigation and hydro-electric dams in the country, adequate scientific knowledge and considerations have not been applied. This shortcoming has been observed to lead to increased threat to public health, sometimes to epidemic of parasitic diseases (Anya, 1987). By this, these schemes have either aggravated the prevalence of parasitic diseases or directly introduced them into new areas by providing new and permanent habitat for the disease pathogens and their vector species. WHO (1994) noted that bancroftian filariasis can also be aggravated by other man-made environmental modifications such as in road and house construction as well as river basin development.

In irrigated areas, infected as well as uninfected persons are brought together to work and live. Water-

contact activities whether for farming, domestic or recreational needs usually make use of irrigation canal waters. Wright (1968) observed that the economic exploitation and opportunities offered by the irrigation schemes and impoundment have brought about growth and great mobility of human populations to those areas. These have increased contact between infected humans, mosquito vectors and apparently healthy people, thus, increasing the disease transmission and dissemination.

Effect of careless engineering practices

In addition to dams and irrigation schemes, other careless engineering practices/constructions in the country, which have been known to create favorable breeding sites for the mosquito vectors as well as perpetuation of bancroftian filariasis transmission, include ditches, burrow-pits, quarries, and pools. This is because they are usually not properly graded and cleaned. And the habit of indiscriminate discharging of waste into these open drains pollutes the drain often to a very high level, and furthermore prevents the normal flow, thus providing excellent conditions for the larval development of the vector species.

Impact of population and urbanization

As regards *C. quenquifasciatus*, this mosquito vector as pointed out earlier naturally breeds in open drains, tree holes, crab burrows, rock pools etc, especially when these breeding sites are polluted by rich organic matter that the larvae need for nourishment. Under this natural condition, this mosquito species does not constitute a serious pest because of the restriction of its breeding site, limited far away from human settlement. In Nigerian and other West African countries, the spread of *C. quenquifasciatus* started after the Second World War as the breeding places for this urban mosquito vector increased with the growth of towns and poor sanitation as well as industrialization (Subra, 1983).

In Nigeria and other African countries and Asia, the rural population nearly doubled between 1950 and 1985 with a corresponding decline in rural infrastructure and food (DIESA, 1986). The consequent unplanned rural-urban drift has led to increased population by about seven folds of most African cities and towns (including Nigeria) between 1950 and 1980 (Hardoy and Satterthwaite, 1981). In most towns in Nigeria, therefore, the enormous pressure on shelter and services due to this unplanned urban growth had frayed the urban fabric (Nwoke et al., 1993). The consequent establishment of many illegal settlements for the urban poor in over crowded condition in cheap unhygienic squatter-houses with inadequate or no provision of infrastructure and services is now a common occurrence. The provision of clean and safe water, adequate waste disposal and sanitation, housing and other social services in most communities in the country are beyond the technical and financial resources available (Nwoke, 1992). The great mobility and over crowding of human population observed in the country is associated with serious environmental modifications and high human activity (Ukoli, 1992). The resultant interactions between the teeming human population and the environment may provide micro-breeding sites for vector species and parasitic disease dissemination such as bancroftian filariasis.

As result of the urban overcrowding, the sanitation services in most of our urban areas, especially at the urban-periphery or squatter settlements are unable to cope adequately with the influx of people. The consequent water pollution in the area creates favourable breeding sites for *C. quenquifasciatus.* In such areas, constructions of some septic tanks and pit latrines are poorly planned, sometimes improperly installed and badly maintained. And these often offer an ideal habitat for the breeding of bancroftian filariasis vectors.

Again, urbanization in Nigeria has dramatically resulted in the abandonment of traditional ways of life in favour of habits and the amenities provided by the Western society. Thus, detergents are now used on large scale by numerous homes in Nigeria. Such products and waste from industries in wastewaters play vital role in eliminating species in competition with *C. quenquifasciatus*, which itself tolerates high-level pollution. In addition to this, Iwuala (1979) reported that pots and drums commonly used for cassava fermentation in most homes in the rural Nigeria support abundant breeding of *C. quenquifasciatus*, thereby increasing bancroftian filariasis transmission in and around our homes.

In conclusion, ignorance, poverty, human activities such as uncompleted governmental as well as personal engineering projects, poor irrigation practices, urbanization with the subsequent overcrowding, poor sanitary as well as poor maintenance of public infrastructures, poor governance are factors implicated in the increasing rate of bancroftian filariasis transmission in Nigeria. If these factors remain unchecked, an outbreak of bancroftian filariasis which is saddled with many health problems is imminent.

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