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Wuchereria bancrofti antigenaemia among school children: A case study of four communities in the Kassena-Nankana east district of the upper east region of Ghana

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Lymphatic filariasis (LF), a parasitic disease caused by *Wuchereria bancrofti,* is of public health concern especially in the northern part of Ghana. Since 2000, several rounds of mass drug administration (MDA) against this infection have been conducted in the endemic communities. However, no studies on the prevalence of *W. bancrofti* antigenaemia have been conducted among pre-school and school-age children in these communities. This study therefore investigated the prevalence of *W. bancrofti* antigenaemia among pre-school and school-age children in the Kassena-Nankana East (KNE) district between December, 2010 and May, 2012. The study was a cross sectional analytical survey among the school children of age between 2 and 10 years old. Blood samples from two hundred (200) children each (randomly selected from Biu, Korania, Gumongo and Manyoro communities in KNE district) were screened for the presence of *W. bancrofti* antigen before and after MDA was conducted. *W. bancrofti* antigenaemia was detected among 25 (12.5%) children before MDA while 13 (6.5%) children tested positive for the antigen after MDA. The microfilaria antigen prevalence among the communities after MDA were 0% in Biuand Korania, 4.0% in Manyoro and 22% in Gumongo. This study has demonstrated that community variations exist in the prevalence of filarial antigen in KNE district. There is the need for regular surveillance that will inform treatment coverage and effectiveness.

Key words. Lymphatic filariasis, *Wuchereria bancrofti*, antigenaemia.

INTRODUCTION

Lymphatic filariasis (LF) is a parasitic disease caused by nematodes (*Wuchereria bancrofti, Brugiamalayi* and *Brugia timori).* The preferred habitats of these parasites are the lymphatic vessels and lymph nodes where they

induce the development of disfiguring and debilitating clinical symptoms (Rocha et al., 2009). LF is transmitted by a wide range of mosquitoes, depending on the geographic area (CDC, 2010). In Africa, the most common vector is the *Anopheles* species, but *Culexquinquefasciatus* which is the main vector in the Americans is also very common in transmitting LF in urban and peri urban areas in East and Central Africa (CDC, 2010). *Aedes* and *Mansonia* can transmit the infection in the Pacific and in Asia (CDC, 2010). The infection if left untreated, can develop into a chronic disease called elephantiasisand orhydrocele.

The numbers of infected persons are on the increase worldwide due to rural-urban migrations resulting in mushrooming of shanty towns often encouraging formation of favourable mosquito breeding sites (Wamae, 1994). About 120 million people are affected worldwide of whom about 40 million are incapacitated and disfigured by the disease (Wamae, 1994; WHO, 1998). Although, LF is not fatal, it has been ranked one of the world's leading causes of permanent and long-term disability and poverty (WHO, 1998), and can be devastating and crippling at both the individual and community levels (Wamae, 1994). LF is a major public health problem in the Tropics (Harnett et al., 1998; WHO, 2002). LF is endemic over wide geographic areas of Africa, Central and South America, Asia, and Oceania (WHO, 2002; WHO, 1992). *W. bancrofti* is the main species responsible for human LF, and the only known aetiologic agent in Africa (Wamae, 1994). About 751 million people are estimated of being at risk of filariasis infection (WHO, 1992). Of these, about 78 million are already afflicted, and more than 90% of the infected people are believed to harbour *W. bancrofti* (WHO, 1992; Melrose, 2002).

Studies conducted along the coast of Ghana reported 9 to 25% prevalence of *W. bancrofti* microfilaraemia (Dunyo et al., 1996; Gbakima et al., 2005). However, the prevalence of microfilaraemia in many rural communities in the middle and northern parts of the country has been reported to range between 26 to 32% (Gyapong et al., 1994; Dzodzomenyo et al., 1999). The endemic regions include Upper East, Northern, Upper West, Ashanti and Western regions. The highest prevalence rate (36%) was reported in the three Northern regions (Gyapong et al., 1994). In 1998, the World Health Organization (WHO) announced the Global Programme to Eliminate Lymphatic Filariasis (GPELF) with a goal of eliminating LF as a public health problem (Menezes et al., 2007). Lymphatic filariasis is currently subjected to renewed control and elimination programmes (Alexander et al., 2003) using annual mass drug administration (MDA) of albendazole and ivermectin among all populations that are at risk (Alexander et al., 2003). According to the world health organisation (WHO) technical advisory committee on LF report in 2005, the impact of MDA is variable, ranging from complete interruption of transmission, as in one site in Papua New Guinea where four rounds of MDA had been applied, leading to a significant reduction in transmission as pertains to Ghana and Mali where there have been three rounds of MDA (WHO, 2005).

Monitoring is a vital element in programme management that enables the success of the strategy to be assessed (GPELF, 2000). The MDA programme in Ghana has covered entire endemic population and has completed ≥ 6 rounds in many regions (WHO, 2009) including the KNE district of the Upper East region. The number of districts covered increased from 5 in 2001 to 82 in 2008 (GFELP, 2008). The goals of the Neglected Tropical Diseases Control Programme (NTDCP) of Ghana requires that LF should be reduced to less than 1% among endemic population and antigen prevalence of 0% among children by 2015.The GPELF envisages the elimination of LF globally as a public health problem by 2020.Even though there have been several rounds of MDA which aimed at interrupting transmission thereby reducing the prevalence levels and ultimately eliminating LF, current data on filarial antigen prevalence and the impact of MDA is not available.There is the need therefore, to provide information about the antigen prevalence among school children in some of the endemic communities especially in the Kassena-Nankana East (KNE) district which was one of the few districts to have started the MDA in 2001(WHO, 2004). This information would be vital for management decision making on the LF elimination programme in the KNE district. The purpose of this study is therefore, to estimate the prevalence of filariasis antigenaemia among pre- and school-age children in four communities in the KNE district of the Upper East Region of Ghana.

MATERIALS AND METHODS

Study site

The KNE District is one of the 12 districts of the Upper East Region. The district which covers an area of 1,675 km^2 along the Ghana Burkina Faso border is located within longitude 10.51N and 11.02N and latitude 0.92W and 1.55W (Figure 1). It is largely rural and lies in the dry Guinea Savanna wood land with a sub-Sahelian climate made up of a wet and a dry season. The wet season extends from April to October, with the heaviest rainfall mainly occurring between June and October while the mean annual rainfall is 1365 mm but

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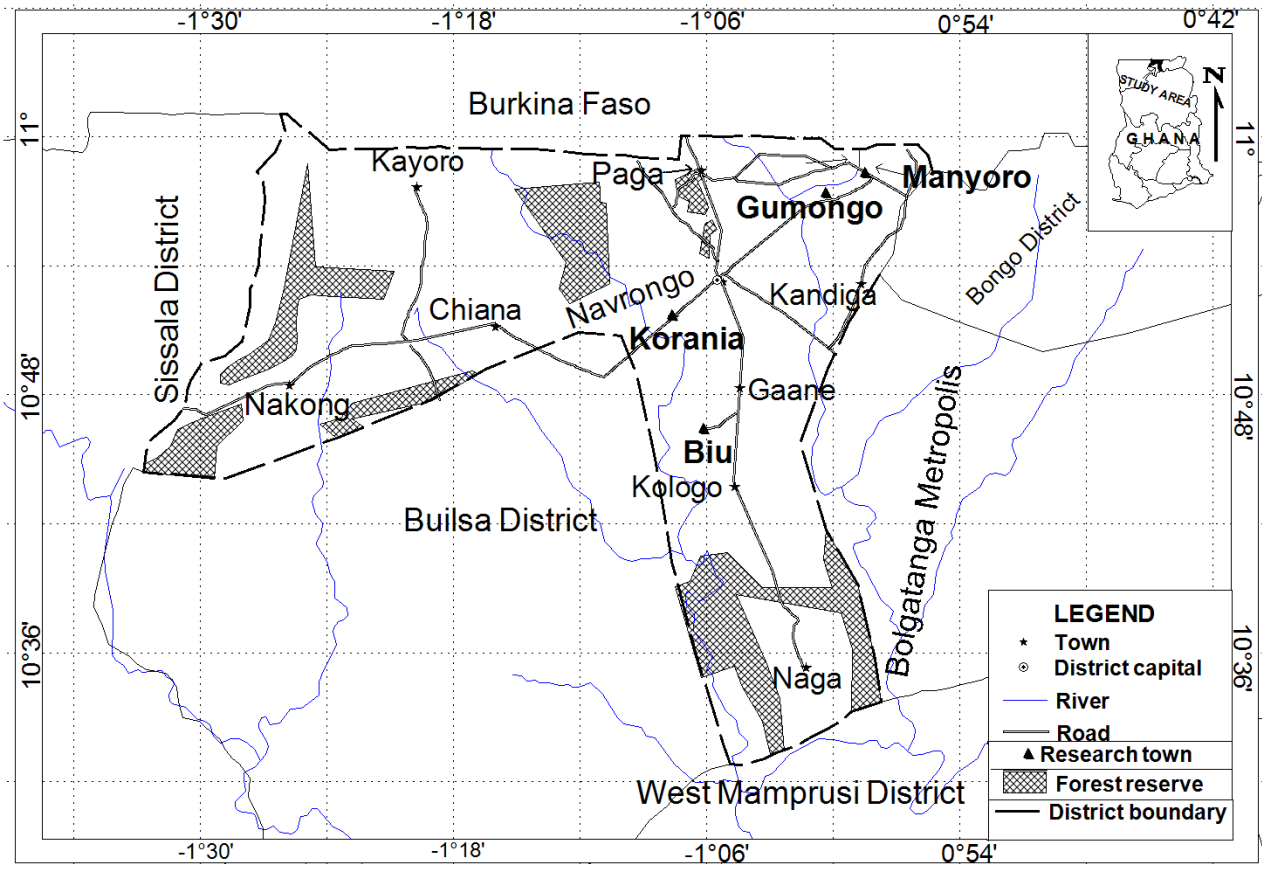

Figure 1. A map showing the study communities in the Kassenan-Nankana East District.

the highest level is recorded in August. Similarly, the dry season is subdivided into the Harmattan (November to mid-February) and the dry hot (mid-February to April) seasons. Monthly temperatures range from 20°C to 40°C (www.kassenanakana.ghanadistricts.gov.gh).

The inhabitants live in dispersed settlements or compounds, protected by outer walls and surrounded by parcels of land for subsistence farming (Gyapong et al., 1996). The district is largely rural, with only 9.5% living in urban quarters (Ngom et al., 1999). The population consists of two distinct ethno-linguistic groups: the Kassena form 49% of the district's population, while the Nankani constitute about 46% with the Builsa and migrants belonging to other ethnic groups making up the remaining 5% (Ngom et al., 1999). The main languages spoken in the area are Kassim and Nankam, with Builli being spoken by most of the minority tribe (Ngom et al., 1999). Despite the linguistic distinction, the population is, in many respects, a homogenous group with a common culture. However the district has ten traditional paramount chiefdoms, and is characterized by traditional forms of village organization, leadership and governance (Ngom et al., 1999).

The study took place in the KNE district which is endemic with *W. bancrofti* infection (Gyapong et al., 1996). In 2001, MDA started at sentinel sites in this district. The prevalence of LF microfilaria in the district before MDA started was 32.4% (Gyapong et al., 1994). However, after more than 5 rounds of MDA, microfilaria prevalence was reduced to 3.5% (Ghana Filariasis Elimination Programme, 2008).

Study population and inclusion criteria

Children born after start of MDA, aged between 2 to10 years old, residing and attending school in Biu, Korania, Gumongo and Manyoro communities in the KNE district were randomly selected for the study. The Ghana Health Service (GHS) has over the years implemented a number of interventions among the study population; this includes the annual mass deworming exercises with albendazole and ivermectin.

Exclusion criteria

Children who were born before the start of MDA, those not in school and those whose parents/guardians would not give their consent.

Study type and design

The study was a cross-sectional analytical survey conducted in the selected 4 communities in KNE district between December, 2010 and May, 2012.

Study school and participant

Participants were randomly selected from the primary schools of

Biu, Korania, Gumongo and Manyoro communities. These are known LF endemic communities and sentinel sites form as santifilarial drug administration exercises by the Ghana Health Service (GHS).

Sample size determination

A total of eleven primary schools were identified: Biu (4), Korania (2), Gumongo (2) and Manyoro (3). The total children population in the 11 primary schools was approximately 5500 pupil. The initial sample (200 pupils) before MDA as well as the final sample (also 200 pupils) after MDA, were all randomly selected from these eleven primary schools.

Sample collection

A volume of about 2 ml venous blood samples was collected from each participant into a clean labelled heparinised blood collection tubes using conventional venipuncture technique. A vein in the lower arm (cubital vein) was located and the area sterilized by cleaning with cotton wool moistened with 70% alcohol and allowed to dry. A sterile disposable syringe and needle was used to puncture the selected vein and blood was drawn and dispensed into the heparin tube from the syringe without the needle. The collected blood sample were then stored at 2° to 8°C until it was tested for *W. bancrofti*antigen.

Pre/Before MDA sampling

Blood samples of 200 school children aged 2 to 10 years old in the four communities were collected from December, 2010 to January, 2011 before MDA and tested for CFA using NOW ICT filarial antigen kit.

Post/After MDA sampling

Blood samples of 200 school children aged 2 to 10 years in the four communities who have undergone MDA were collected from November, 2011 to January, 2012 and tested for filarial antigen using the NOW ICT filarial test kit.

Laboratory investigations for both pre and post MDA

Information and communications technology (ICT) card test procedure

The NOW® Filariasis version of the card test (ICT filariasis for blood, serum or plasma, patent. no. 5,877, 028; 5,998, 220; 6, 017,767 sensitivity= 100%, specificity =96.37%, efficiency= 96.70%) was carried out according to the manufacturer's instructions. Briefly, each card was removed from the pouch, labelled and laid flat on the work bench. To ensure good blood flow and performance, the capillary tubes were filled with blood. 100 µl of blood sample was slowly added to the pad from the capillary tube. The card was closed after 30 sec to 1 min when the sample has flowed into the pink area and it is completely wet. The result was read exactly 10 min later. The test was considered positive when both lines (test and control) could be read through the visualisation window. Any line (light or dark) appearing in the test position indicates that the result of the test is positive; it is negative when only the control line can be seen.

Limitation of the filarial antigen test

This test is structured to indicate the presence or absence of *W. bancrofti* antigen in the sample. The absence of antigen does not exclude filariasis cause by other nematode species.

Ethical consideration

Signed and informed consent was obtained if the potential child´s parent demonstrated understanding of the study after the study has been explained to him/he,r and was willing to enrol his/her child. In the case of an illiterate parent, a left thumbprint was obtained on the consent forms and a separate Witness Consent form was signed by a literate witness who had observed the consent processes. The interview was done in Kassim and Nankam, the main local languages in the district. The study protocol was approved by the institutional review board of Navrongo Health Research Centre (IRB NHRC) and Committee on Human Research, Publications and Ethics (CHRPE) of Kwame Nkrumah University of Science and Technology, Kumasi.

Statistical analysis

Data analysis was done using statistical package for social science (SPSS) and MS Excel 2007 software. Data were analysed for the frequencies of filarial antigen test. The prevalence of filarial antigen among the communities, sex and age, multiple Comparisons/Analysis of measurements by community were explored using T-tests and Least Square Difference (SLD); One-Way Analysis of Variance (ANOVA). The predictions of percentages of males and females and age groups testing positive for filarial antigen test were also explored using Binary logistic regression.

RESULTS

Socio-demographic features of the study participants

About 32.5% of the study children were of pre-school level and 67.5% primary school or school-age level. Of these study children, 52.5% were males and 47.5% were females. Majority of these children were of Kassim ethnicity. Prior to the survey, the study children had been treated in the mass drug administration with albendazole and ivermectin by the Ghana Health Service.

Prevalence of filaria antigen before and after MDA

Of the 200 school children selected from the four communities before MDA, 25 tested positive for *W. bancrofti*filarial antigen. This represents 12.5% of the samples analysed (Table 1). After MDA, the overall prevalence of filarial antigen among the study children was 6.5% (13 children). The number of negative filarial antigen recorded in the study was 93.5% (187).

Prevalence of filarial antigen and sex after MDA

Among the 13 children who tested positive for filarial

Table 1. Prevalence of filarial antigensin for communities in Kassena-Nankana East District.

Test	Results Before MDA		Results After MDA	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Negative	175	87.5	187	93.5
Positive	25	12.5	13	6.5
Total	200	100.0	200	100.0

Table 2. Prevalence of filarial antigen after MDA and Sex of children.

Gender	Number	Filarial antigenaemia	
		Positive (%)	Negative (%)
Male	105	5 (4.8)	100 (95.2)
Female	95	8 (8.4)	87 (91.6)

Table3. Prevalence of filarial antigen after MDAand age of the children.

Age group (years)	Number	FilariaAntigenaemia	
		Positive (%)	Negative (%)
1 – 5	65	1 (1.5)	64 (98.5)
6 – 10	135	12 (8.9)	123 (91.1)

antigens after MDA, 8 (8.4%) were females (n=95) and 5 (4.8%) were males (Table 2). However, the difference between the female and the male positives was not statistically significant (p=0.297).

Prevalence of filarial antigen and age after MDA

The participating children were categorized into two age groups 1 to 5 and 6 to 10years. Majority of the participants fall within the 6 to 10 years age group (135 out of 200 children; Table 3). Only one child (1.5%) tested positive for the filarial antigens among the 1 to 5 years age group (n = 65) while twelve from the 6 to 10 years age group were positive. Even though there were more antigen-positive children in the 6 to 10 years age group than the 1 to 5 years age group, the difference was not statistically significant (p=0.052). However, binary logistic regression analysis predicts that 1.6% of the children in 1 to 5 years age group will test positive, while 64.2% of 6 to10 years age group will test posotive.

Prevalence of filarial antigen in the communities

Prevalence of filarial antigenaemia in the communities before MDA was 12.5%. After MDA, the rate reduced to 6.5% (Figure 2). However, among the individual communities, the prevalence after MDA was high in Gumongo (22.0%), followed by Manyoro (4.0%) but none was detected among the participant from Bui and Korania communities (Figure 3). There is significant difference between all the four communities (p=0.000). Manyoro and Gumongo are located in the north of the KNE district but are far apart while Biu is down south and Koraniain the central part of the district.

DISCUSSION

In spite of the many rounds of MDA in Ghana since 2000, filarial infection continues to affect the people of KNE district with its crippling effect. The success of MDA depends on the fact that children born after the start of the MDA should not be infected of the filarial worm let alone habour filarial antigens. The purpose of the study was to find out the prevalence of filarial antigen among school children in endemic communities which are sentinel sites for GHS and have undergone several rounds of MDA of single dose albendazole and ivermectin. This is a current report on the prevalence of filarial antigen among school in endemic community in

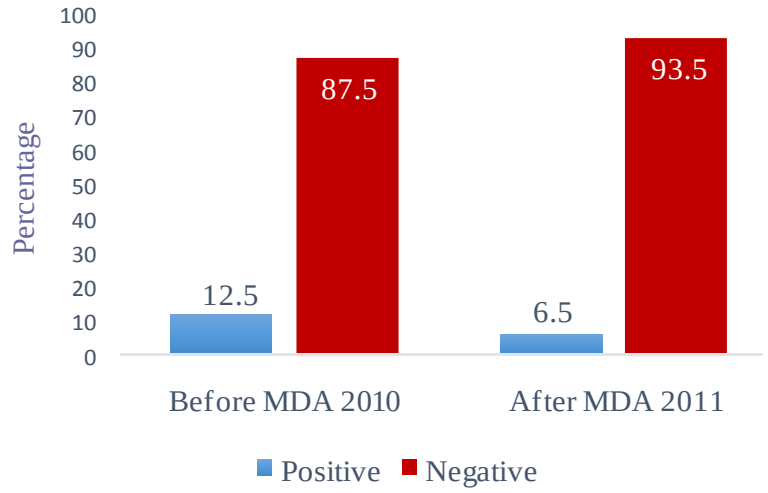

Figure 2. Comparison of prevalence of filarial antigen before and after MDA.

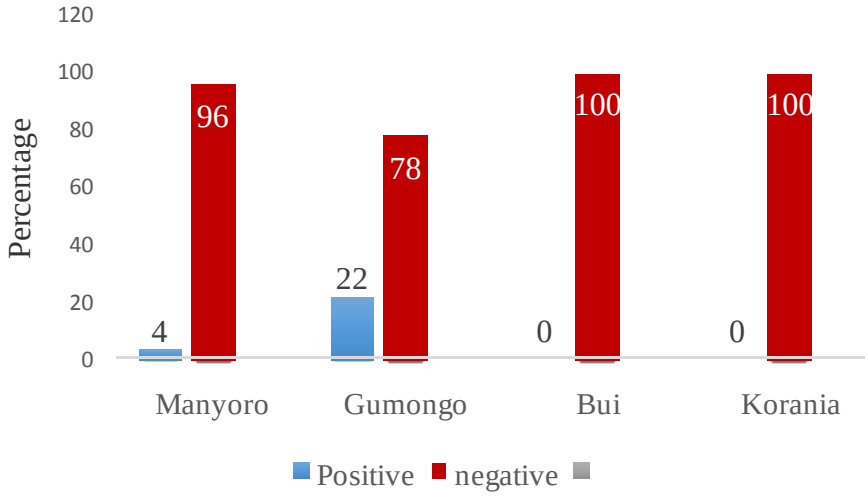

Figure 3. Prevalence of filarial antigen in the communities after MDA.

KNE district.

A study conducted by Gyapong et al. (2002) on the geographical distribution of human infection of *W. bancrofti* in Ghana, Benin, Togo and Burkina Faso revealed over 70% prevalence rates of filarial antigen among adults (age ≥ 15 years) in some communities in Ghana and Burkina Faso. In 2007 however, the Neglected Tropical Disease Control Programme reported 20 to 40% and 10 to 20% LFantigen prevalent rates in northern and southern Ghana, respectively. Our current study, has therefore shown that filarial antigenaemia prevalence in the north hasdrastically reduced to about 12.5% in 2010 (that is, at the start of our study). After a round of MDA, the rate further decreased to 6.5% among our studied population.

This reduction in LF antigen prevalence after several rounds of MDA is consistent with the report of Swaminathan et al. (2012) where after eight rounds of MDA, antigen prevalence fell to a range of 0.7 to 0.9% among children aged between 2 to 10 years old. It also compares with another report by Tisch et al. (2008) where after a MDA there was a sharp decline in the presence of *W. bancrofti* microfilaria in individuals who participated in a five year mass drug administration trial in Papua New Guinea. Bui and Korania were among the sentinel sites in the KNE district to have started the MDA and therefore the zero filarial antigen prevalence among children born after the start of MDA in these two

communities is comparable with the observation in Kenya where after several rounds of MDA, (although the annual MDA was not administered in some of the years) the filarial antigenaemia declined from 34.6 to 10.8% with absence of filarial antigen in children born after the start of the programme (Njenga et al., 2011).

The results obtained from this study in Bui and Korania follows a similar result obtained by the Ghana Filariasis Elimination Programmen (GFEP) where after an impact assessment carried out for the LF programme demonstrated marked reduction in microfilaria prevalence from 23 to 0.0% (GFEP, 2008). The results of our current study could mean that transmission of *W. bancrofti* infection in Bui and Korania communities have been interrupted, and that these communities have reached the end point in the programme for elimination of lymphatic filariasis. Manyoro and Gumongo had relatively high prevalence 4.0 and 22.0%, respectively. Geographically, these communities are faraway from Bui and Korania, with very bad terrains (that is, bad road network) which sometimes get cut off from the other communities especially in the rainy seasons. This therefore, leads to a situation where not all children in these two communities are able to assess the chemotherapeutic agents during the MDA. Moreover, some members of these communities according to Gyapong et al. (1996), do not believe in the scientific cause and interpretation of filariasis, and therefore do not accept the fact that drugs could help treat or prevent them from getting filarasis. They rather perceived and attributed the disease to spiritual causes and hence do not patronize the MDA programmes. In their opinion also, people get hydrocele fromordinary fevers and not through mosquito bites. This also impedes on vector control measures in the communities (Gyapong et al., 1996).

The high level of filarial antigen in children born after the start and repeated rounds of MDA in these two communities is consistent with the finding of Weil et al. (2008) where although infection rates decreased in children after MDA, many young children tested positive for circulating filarial antigen even after three rounds of MDA. This is because MDA did not start in the communities at the same time as with Bui and Korania. Most children in Manyoro and Gumongo started accessing the MDA drug quite late, and hence, many might have long been exposed to the parasite before the start of MDA in their community.

An important finding of the study is that gender does not play any significant role in susceptibility to filarial infection, which is in contrast with a report in Brazil by Medeiro et al. (1999) where men were said to be more susceptible to LF than women. The extent of exposure to the mosquito vectors may rather play a role in the rate of susceptibility to the infection as suggested by the report of Gyapong (2000) where in the southern part of the Ghana, women who were engaged in fishing and trapping of shrimps in the mangrove swamps were more exposed to the filariasis mosquito which probably resulted in higher prevalence of lymphoedema in women than in men in the region.

CONCLUSION

This study has demonstrated the absence of filarial antigen among children born after the start of MDA in Biu and Korania but not in Manyoro and Gumongo communities. Community variations in prevalence of *W. bancrofti* infection exist in the KNE district. Many other communities in the district must also be monitored to appropriately estimate the prevalence of filarial antigen in the district. Education and other good implementation strategies of controlling LF transmission must be adopted in communities such as Manyoro and Gumongo. Long term follow-up studies must also be conducted to ensure that *W. Bancrofti* transmission is controlled.

LIMITATIONS

The study was limited by not too large sample size due to unwillingness of some parents to release their wards to participate in this study because some parents do not believe in the scientific basis of filariasis.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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