Tropical Biomedicine 27(1): 41–46 (2010)

Lymphatic filariasis in children: age dependent prevalence in an area of India endemic for *Wuchereria bancrofti* infection

Mandal, N.N., Bal, M.S., Das, M.K., Achary, K.G. and Kar, S.K.
Regional Medical Research Centre (ICMR), Bhubaneswar-751023, Orissa, India.
e-mail: mandalrmrc@yahoo.com
Received 24 November 2009; received in revised form 8 December 2009; accepted 9 December 2009

Abstract. Lymphatic filariasis has been considered as a disease of adults and most epidemiological surveys have excluded children. The prevalence of infection and clinical manifestations of the disease among children in the age group of 1-15 years was determined in a *Wuchereria bancrofti* endemic area. The 1383 children from the rural villages of a coastal district (Khurda), State of Orissa, India, were studied. The finger prick blood (50ìl) samples were collected between 20:30 and 23:30 hours for parasitological and immunological evaluation. At the same time clinical examination was also recorded. Circulating Filarial Antigen (CFA) status and antibody (IgG) to filarial antigen was also determined in the study population. The prevalence of asymptomatic microfilaraemic carriers (AS), acute disease (AC), hydrocele (Hyd) cases and cryptic infection (CFA +ve) were 9.9%, 14.6%, 3.8% and 17.1% respectively. It was observed that 45.4% of the children below 15 years of age were either infected or had clinical manifestations of the disease. IgG antibody positivity 75.4%, 84% and 95.8% were observed in 1-5 yr, 6-10 yr and 11-15 years age group respectively. The study suggested that asymptomatic infection and acute form of disease were common occurrence among the children and more than half of the children population were either infected or having clinical manifestations of the diseased by pre-adult stage (11-15 years of age) in the endemic area.

INTRODUCTION

Lymphatic filariasis caused by the nematode *Wuchereria bancrofti* is a major vector borne disease; affecting 120 million people worldwide and about 22 million children below 15 years of age are infected with the disease (Michael *et al.*, 1996). Individuals living in the endemic area can be categorized into two major groups i.e., i) infected/ diseased and ii) uninfected individuals based on their clinical and parasitological status. The infected/diseased group includes asymptomatic microfilaraemic carriers, acute disease, chronic disease (both elephantiasis and hydrocele) and cryptic infection. Asymptomatic microfilaraemic carriers were microfilaria (Mf) positive without any symptoms. Cryptic individuals were free from microfilaraemia, acute or chronic symptoms but positive for circulating filarial antigen (CFA), which is the marker of live worm. Acute filarial disease were identified as those having localized signs and symptoms of pain, lymphangitis, acute dermatolymphangio-adenitis (ADLA), chills, distal oedema of affected leg, inflammatory nodules or cord in the lymph of arms and leg (Dreyer *et al.*, 1999) with or without fever. Uninfected individuals were free from microfilaraemia, circulating filarial antigen and filarial symptoms. Previous studies revealed that clinical manifestations of filariasis in an endemic community were mostly associated with adult population and were inadequately reported among children. Hence, little is known about the spectrum of clinical manifestation or the natural history of the disease in children, which might be due to

unique natural history of disease or previously available of inadequate diagnostics tools. A number of epidemiological studies of lymphatic filariasis among children have been reported in recent years from different endemic regions (Witt *et al.*, 2001; Srividya *et al.*, 2002; Beau *et al.*, 2004; Shenoy *et al.*, 2007). Lymphatic filariasis is quite common in the state of Orissa, India, especially in the coastal districts. We have been studying the antifilarial immune response in this region for more than one decade (Das *et al.*, 1992). However, no studies on infection and disease prevalence among the children of Orissa, India have been reported. Recently we have reported high prevalence of antigenemia among children in this region (Bal *et al.*, 2007). The objective of this study was to assess the age specific prevalence of infection and disease among the children living in *Wuchereria bancrofti* endemic area of Orissa, India.

MATERIALS AND METHODS

The study was conducted, during 2005-06, involving 1383 children (1-15 years of age) living in four villages of Khurda district of Orissa, India. The study area is known to be endemic for filariasis caused by *Wuchereria bancrofti*, which is mainly transmitted by *Culex quinquefasciatus* (Dash *et al.*, 1998). These coastal villages are located approximately 40-50 kms away from the state capital Bhubaneswar and about 40 kms away from Bay of Bengal. Inhabitants of these villages depend mainly on agriculture. The study protocol has been approved by the institutional ethical committee. A door-to-door night blood survey was carried out in the villages. Informed consent was obtained from their parents of the children before performing the clinical and parasitological examination. About 90% of the total children population was investigated. The presence of microfilaria was checked from thick smear of finger prick blood (50µl) collected between 20:30 and 23:30 hours. Children suffering from acute filarial disease were identified as those having localized signs and symptoms (lymphangitis, ADLA, chills, distal oedema of affected leg, inflammatory nodules or cord in the lymph of arms and leg with or without pain and fever). Hydrocele in males was identified by physical examination. Circulating filarial antigen was detected in finger prick blood sample collected in filter paper disc using Og4C3 test kit (JCU Trop. Bio, Queensland, Australia) according to the manufacturer's instruction. The sample from each individual was tested and the mean optical density values were used to determine the antigen concentration in units from standard curve made earlier with the seven standard antigens enclosed in the kit. Individuals with an antigen unit of 128 (> titer of standard no. 3) were considered as CFA positive. Children with CFA positive, but negative for Mf and disease, were considered as cryptic infection. Uninfected individuals (endemic normal) are those who are free from Mf, CFA and clinical manifestation of disease. IgG antibody to filarial antigens (Setaria digitata antigenic extract) was determined by Enzyme Linked Immuno Sorbent Assay (ELISA) following published procedure (Das *et al.*, 1992).

RESULTS

The overall prevalence of infection and clinical manifestation of the disease among the children is shown in the Table 1. Out of the 1383 children studied, 9.9% of children harboured microfilaria without any symptoms, 14.6% of the children had the signs and symptoms of acute diseases, 3.8% developed hydrocele and 17.1% were found to have cryptic infection. No cases of elephantiasis were observed. The gender wise prevalence was also determined in the study population. More males were (49%, 387/789) infected than the females (40.5%, 241/594) in view of the overall clinical manifestation. In endemic normal group, females contributed more (59.42%, 353/594) than the males (50.95%, 402/789). The study population was also allocated into 3 age groups; 1-5 years, 6-10 years and 11-15 years. The prevalence of microfilaraemia in

Table 1. Distribution of infection and clinical manifestation of the disease among the endemic children

Group	Male Number (%)	Female Number (%)	Total number (%)
Endemic normal	402 (50.95)	353 (59.44)	755 (54.6)
Cryptic infection	121 (15.35)	115 (19.36)	236 (17.1)
Asymptomatic microfilaraemic	74 (9.37)	63 (10.60)	137 (9.9)
Acute filariasis	140 (17.74)	63 (10.60)	203 (14.6)
Hydrocele	52 (6.59)	–	52 (3.8)
Total	789	594	1383

children below 5 years of age was about 3.6% (6/169, Figure 1). It progressively increases with the increase of age and reached to 10.2% in 6-10 years and 11.3% in 11-15 years of age group. The acute filariasis was observed to be about 4.7% in children below 5 years of age, which increases rapidly to 11.6% in 6-10 years and to 20.1% in 11-15 years of age group. The children developed acute filariasis, 69% were found to be male and 31% were female. The development of hydrocele was noticed with the increase in age (i.e. none in below 5 years of age group) 2.08% in 6-10 years and 6.3% in 11-15 years of age group. The prevalence of cryptic infection was observed to be highest (21%) in children below 5 years and exhibiting decreased trend to 18.2% in 6-10 years and 14.9% in 11-15 years of age group. The prevalence of uninfected individuals in the community was highest (70.4%) in the younger age group (1-5 years) and then gradually decreased with the increase of age (Figure 2). The percentage of prevalence gradually decreases to 57.9 % in 6-10 years and to 47.3% in 11-15 years of age group. On the other hand the infected individuals (microfilaraemic, cryptic group and clinical manifestations) follow the reverse trends as compared to uninfected individuals like 29.6 % in 1-5 years, 42% in 6-10 years and 52.7% in 11-15 years of age group.

Filarial- specific IgG antibody levels were determined in children of different age group. IgG antibody seropositivity of 75.4%, 84% and 95.8% were found in 1-5 years, 6-10 years and 11-15 years of age groups respectively.

DISCUSSION

The present study demonstrated the prevalence of the disease in pre adult population in the study villages of Khurda District The prevalence of microfilaraemia in early age group was low. It gradually increased with the increases of age up to 11.3% in 11-15 years of age group. The similar type of microfilaraemia prevalence was also reported from other endemic areas (Pani *et al.*, 1991; Hightower *et al.*, 1993; Braga *et al.*, 1997). Our findings on microfilaraemia prevalence also agreed with the earlier study for boys and girls (Dreyer *et al.*, 1999). Our results indicated that the increasing microfilaraemia prevalence according to the age in an endemic area correlates with the duration of exposure to the infection. The acute filarial disease was also found to be high in the endemic children (14.6%). This high prevalence is a reflection of intense transmission of the infection and thereby indicating the hyper-endemic region for filariasis. The age related prevalence depicts the highest percentage of uninfected individuals at early age group (1-5 yr.) then gradually decreases. The prevalence of infected populations supersede (52.7%) over the uninfected population, indicating that more than half of the children are getting infection in the community during the age of 11-15 years. In an endemic area the total population will be the sum of uninfected and infected/diseased individuals (Bundy *et al.*, 1991). Our study showed that 45.4% (628/1383) of children below 15 years of age in the community were either harbouring

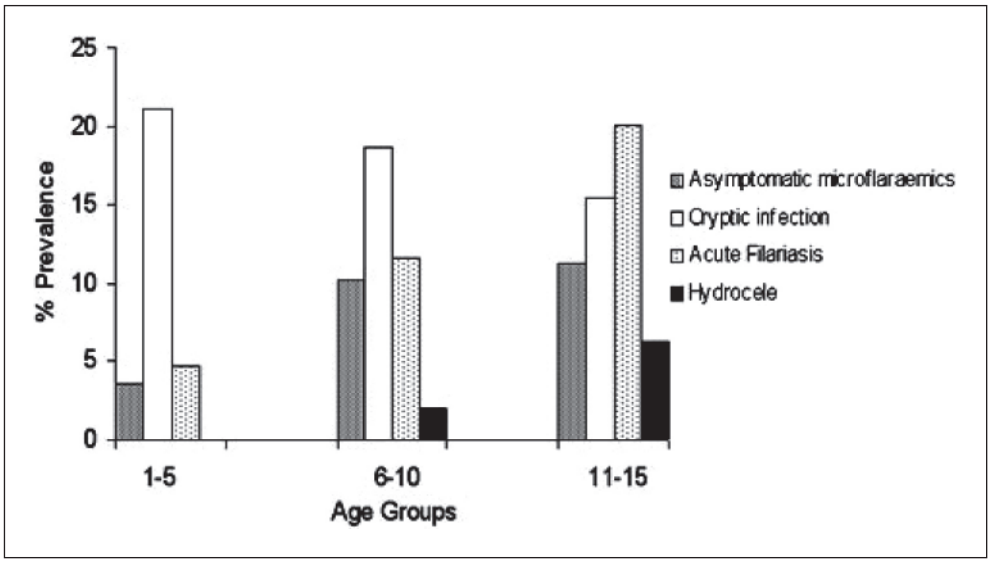

Figure 1. Age-group prevalence of the disease in children living in filaria endemic villages. The different clinical manifestations of disease shown as percentage.

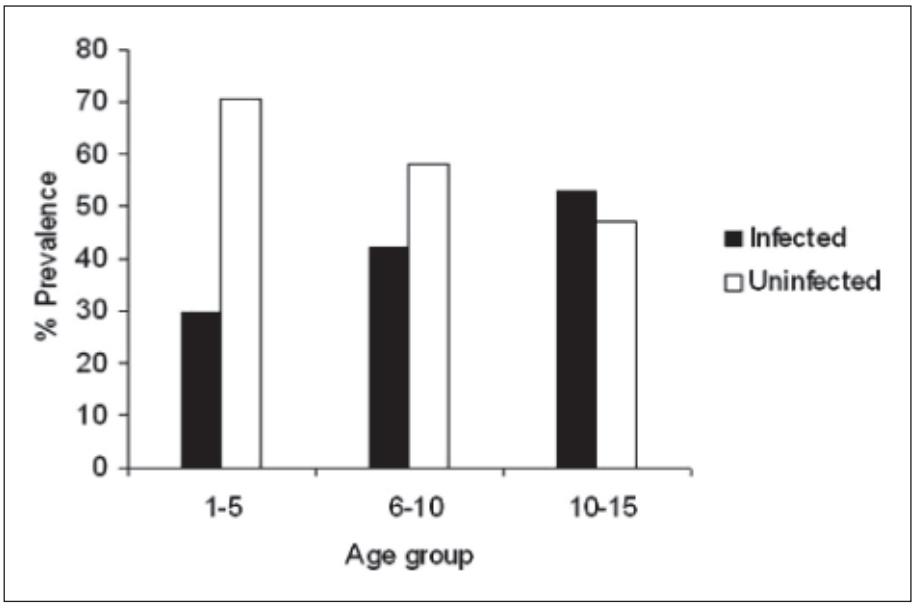

Figure 2. Overall prevalence of infected (CFA + ve and Symptomatic) and uninfected (CFA-ve and asymptomatic) children in filaria endemic villages (in percentage).

parasite or developed symptoms of the disease. This is an indicator of early-acquired infection in life and become the sources of future disease in the community.

The immunological findings in the present study indicates the high IgG seropositivity were associated with high infection status. The seropositivity at early age group was quite low. It gradually increases and reached up to 95.8% in the 11-15 years of age group. The study reported that IgG is associated with infection status

(Nielsen *et al.*, 2002). Our results are directly correlated with infection status among the pre-adult population in the community. More specifically, it is hypothesized that the correlation between immune responses and infection intensity changes with both transmission intensity and host age; the association is expected to be positive in young children because both infection and immune responses reflect exposure, but as the hosts age, the association becomes negative as the immune response gained via cumulative exposure starts to regulate worm intensities (Jaoko *et al.*, 2007). It is very much essential to know the infection/disease prevalence in the pre-adult group for understanding the future disease status. The global elimination programme is committed to protect children from lymphatic filariasis (Ottesen, 2000). This type of study will help the community to develop strategies for treatment of children for their infection and sub clinical lymphatic damages to reduce the disease burden in the adult population.

Acknowledgements. The technical assistance of Mr. H.S. Naik and Mr. K.C. Parichha in laboratory as well as in field is gratefully acknowledged. We are thankful to The Director, Regional Medical Research Centre (ICMR), Bhubaneswar, India, for intramural funding and consistent support for this study.

REFERENCES

Bal, M.S., Beuria, M.K., Mandal, N.N. & Das, M.K. (2007). Antigenemia in young children living in *Wuchereria bancrofti*-endemic areas of Orissa, India. *Transaction of the Royal Society of Tropical Medicine Hygiene* **103**: 262-265.

Beau De, Rochars, M.V.E., Milord, M.D., Jean, Y.S., Desormeaux, A.M. & Dorvil, J.J. (2004). Geographic distribution of lymphatic filariasis in Haiti. *American Journal of Tropical Medicine and Hygiene* **71**: 598-601.

Braga, C., Albuquerque, M.F.M., Scindler, H., Rezende, A., Maciel, A. & Silva, M.C.M. (1997). Epidemiological pattern of lymphatic filariasis in children living in endemic areas. *Journal of Pediatrics (Rio J)* **73**: 95-100.

Bundy, D.A.P., Greenfell, B.T. & Rajgopalan, P.K. (1991). Immunoepidemiology of lymphatic filariasis: the relationship between infection and disease. Immunoparasitol Today. Ash C. and Gallagher RB (editors). Cambridge: *Elsevier Trends Journals* ppA74-A75

Das, M.K., Beuria, M.K. & Dash, A.P. (1992). Immunoglobulin E and G4 antibodies to infective larvae in *Wuchereria bancrofti* endemic population. *International Archives of Allergy and Immunology* **99**: 118-122.

Dash, A.P., Mohapatra, N., Hazra, R.K. & Acharya, A.S. (1998). Transmission dynamics of filariasis in Khurda district of Orissa, India. *Southeast Asian Journal of Tropical Medicine and Public Health* **29**: 137-140.

Dreyer, G., Medeiros, Z., Netto, M.J., Leal, N.C., De Castro, L.G. & Piessens, W.F. (1999). 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 Hygiene* **93**(4): 413-417.

Dreyer, G., Naroes, J., Adiss, D., Santosh, A., Medeiores, Z. & Figueroa do Silva J. (1999). Bancroftian filariasis in paediatric population: an ultrasonography study. *Transactions of the Royal Society of Tropical Medicine Hygiene* **93**(6): 633-636.

Hightower, A.W., Lammie, P.J. & Eberherd, M.L. (1993). Maternal infection - a persistent risk factor for microfilaraemia in offspring. *Parasitology Today* **9:** 418-421.

Jaoko, W.G., Michael, E., Meyrowitsch, D.W., Estambale, B.B., Malecela, M.N. & Simonsen, P.E. (2007). Immuno-epidemiology of *Wuchereria bancrofti* infection: Parasite transmission intensity, filaria-specific antibodies, and host immunity in two east African communities. *Infection and Immunity* **75**(12): 5651–5662.

Michael, E., Bundy, D.A.P. & Grenfell, B.T. (1996). Re-assessing global prevalence and distribution of lymphatic filariasis. *Parasitology* **112**: 409-418.

Nielsen, N.O., Bloch, P. & Simonsen, P.E. (2002). Lymphatic filariasis-specific immune responses in relation to lymphoedema grade and infection status. II. Humoral responses. *Transactions of the Royal Society of Tropical Medicine Hygiene* **96**(4): 453-458.

Ottesen, E.A. (2000). The global programme to eliminate lymphatic filariasis. *Tropical Medicine and International Health* **5**(9): 591-594

Pani, S.P., Balkrishnan, N., Srividya, A., Bundy, D.A.P. & Grenfell, B.T. (1991). Clinical epidemiology of bancroftian filariasis: effect of age and gender. *Transactions of the Royal Society of Tropical Medicine Hygiene* **85**: 260-264.

Shenoy, R.K., Suma, T.K., Kumarswami, V., Rahmah, N., Dhananjayan, G. & Padma, S. (2007). Preliminary findings from a cross sectional study on lymphatic filariasis in children, in an area of India endemic for *Brugia malayi* infection. *Annals of Tropical Medicine and Parasitology* **101**: 205-213.

Srividya, A., Michael, E., Palaniyandi, M., Pani, S.P. & Das, P.K. (2002). A geostatistical analysis of the geographic distribution of lymphatic filariasis prevalence in southern India. *American Journal of Tropical Medicine and Hygiene* **67**: 480-489.

Witt, C. & Ottesen, E.A. (2001). Lymphatic filariasis: an infection of childhood. *Tropical Medicine and International Health* **6**: 582-606.