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Precontrol observations on lymphatic filariasis & geo-helminthiases in two coastal districts of rural Orrisa

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***Background & objectives*: Lymphatic filariasis (LF) is a major public health problem in India, accounting for 40 per cent of the global burden. The World Health Organization has launched a global programme to eliminate LF by 2020 and India is a signatory to it. Orissa, an eastern Indian State has long been known to be endemic for LF. Prior to implementation of mass drug administration programme it is important to collect baseline data on filariasis and geo-helminthiases in the State. The present cross-sectional survey was therefore carried out between February and December 2001 to obtain baseline information on both LF and geo-helminthiases before application of the control measures.**

***Methods*: The study was carried out in rural areas of Puri and Ganjam districts in two phases. In phase I, the distribution of microfilaraemia in two district was mapped out in randomly selected primary health centres (PHCs), and 12 microfilaraemic villages were identified in each district by cluster analysis for the phase II study. In phase II, detailed clinical and parasitological survey for LF and geo-helminthiases was carried out following the standard procedures.**

***Results*: *Wuchereria bancrofti* was found to be widely prevalent in Puri district with certain pockets of *Brugia malayi* while *W. bancrofti* was the only species in Ganjam district. The microfilaraemia (Mf) rate was found to be 9.5 and 11.1 per cent; and circulating filarial antigenaemia (CFA) was 16.8 and 17.8 per cent in Puri and Ganjam respectively. The geometric mean intensity (GMI) of Mf per ml of blood among positive individuals was 387 in Puri and 454 in Ganjam. The overall disease rate in Puri was 7.9 and 8.9 per cent in Ganjam. The prevalence of chronic manifestations was found to be significantly higher ($P<0.001$) than the acute manifestations in both the districts. The prevalence of geo-helminthiases was 31.8 per cent in Puri and 42.1 per cent in Ganjam; and the heavy infection was found to be significantly higher ($P<0.001$) in Ganjam compared to Puri district.**

***Interpretation & conclusion*: The present study identified LF and geo-helminthiases as widely distributed health problem in rural areas of coastal Orissa which warrants intervention measures along the lines recommended by the global programme for elimination of LF and geo-helminthiases to reduce the disease burden.**

Key words Antigenaemia - *Brugia malayi* - geo-helminthiases - lymphatic filariasis - microfilaraemia - *Wuchereria bancrofti*

Lymphatic filariasis (LF), caused by the nematode parasites *Wuchereria bancrofti*, *Brugia malayi* and *B. timori* is a major public health problem in many developing countries[1]. More than 1.1 billion persons (20% of the world's population) live in known endemic areas and one fourth of them may be infected[2]. The broad spectrum of clinical manifestations ranging from acute attacks of filarial fever to chronic manifestations of hydrocele, limb lymphoedema and elephantiasis has severe consequences for the affected individuals both physically, socially and economically[3], and makes the infection one of the important causes of disability[4]. However, with the advent of cost-effective control strategies, the disease seems to be eradicable. Hence, the World Health Organization (WHO) has launched a global programme to eliminate lymphatic filariasis by the year 2020 in accordance with resolution WHA 50.29 of 50th World Health Assembly[5]. India being a signatory to it has set its target for national elimination by the year 2015[6].

Eighteen states/union territories in India are known to be endemic for lymphatic filariasis and 429 million people are at risk of infection with 29 million parasite carriers and 22 million with chronic diseases accounting for 40 per cent of the global burden[7]. Orissa, an eastern Indian state has long been known to be endemic for lymphatic filariasis[8-11]. However, no systematic surveys have been carried out to document the extent of the problem particularly in rural Orissa. The present study was therefore carried out between February and December 2001 in two coastal districts of Orissa to obtain a baseline information on infection and disease due to LF and prevalence of geo-helminthiases prior to the implementation of pilot scale mass drug administration (MDA) programme in the State.

Material & Methods

Study design: Of the 11 coastal districts of the State known to be endemic for LF, two coastal districts, Puri and Ganjam, were selected for the study, since the pilot scale MDA programme was to be implemented in these districts. The study was conducted in two phases using two stage sampling design. Apart from generating information on lymphatic filariasis, the phase I was used as a tool for identifying the locations for more detailed examination in the phase II. The study was conducted as per the common protocol developed for the Council's task force multicentric study.

Phase I: Nine of the 18 primary health centres (PHCs) from Ganjam and six of the 11 from Puri district were selected randomly for the phase I study. Atleast 5-10 villages (depending on the population) from each PHC were identified by cyclic systematic sampling procedure for a cross-sectional survey for microfilaraemia amongst individuals between 15-30 yr of age by drawing 20 µl of finger prick blood between 20:00-23:00 h. A village having atleast one microfilaraemic individual was considered to be positive village for lymphatic filariasis. A list of 50 such villages in each district was identified and 12 villages were selected for the phase II study giving weightage to the population size and microfilariae (Mf) rate by cluster analysis.

Phase II: Detailed clinical and parasitological survey for lymphatic filariasis was conducted in the selected villages. To eliminate sampling error, the selected villages were mapped and trained field workers visited all the houses to motivate all the family members to come for medical examination.

Microfilaraemia prevalence and density: Microfilaraemia was detected by collecting two thick blood smears of 20 µl each on a clean glass slide through finger prick between 20:00-23:00 h. The smears were stained with Leishman stain to detect the microfilariae and identify the species. A second blood sample (100 µl) was taken from individuals with Mf to measure the density by counting chamber technique[12].

Antigenaemia: The circulating *W. bancrofti* filarial antigen was assessed by using commercially available ICT test kit (Amrad, Australia). The test utilizes monoclonal antibody specific for *W. bancrofti* to detect the circulating antigen. Briefly, 100 µl of whole blood, collected by finger prick was applied to the card and the sample was declared to be positive (only after 30 min) if a coloured band developed.

Filarial morbidity survey: Lymphatic filariasis was classified as acute or chronic disease as suggested by the WHO[13]. Acute disease was defined as one or more fever episodes (whether or not followed by headache, nausea and vomiting) of localized disease (pain, heat, lymphangitis or adenolymphangitis of arms and legs, male genitalia or breast) for at least 3 days. Chronic disease was identified as lymphoedema, elephantiasis and hydrocele.

Table I. Microfilaraemia in rural areas of Puri and Ganjam district based on Phase I study

District	PHCs	No. of villages	Population examined	No. (%) villages +ve	Mf rate	*W. bancrofti*/ *B. malayi*
Puri	Mangalpur	12	645	12 (100)	7.1	100/0.0
	Alagum	14	1259	14 (100)	10.3	97.4/2.6
	Chandanpur	9	1010	9 (100)	10.9	98.5/1.5
	Bangurigaon	5	308	5 (100)	6.2	100/0.0
	Astarang	2	102	2 (100)	6.2	100/0.0
	Rebananuagaon	6	388	6 (100)	11.6	100/0.0
Total	6	48	3712	48 (100)	9.7	98.1/1.9
Ganjam	Keluapalli	8	442	6 (75.0)	12.4	100/0.0
	Sumandal	9	451	7 (77.8)	14.6	100/0.0
	Khandadeuli	6	326	4 (66.7)	10.4	100/0.0
	Muncipentha	8	488	6 (75.0)	12.7	100/0.0
	Belagaon	7	351	5 (71.4)	14.5	100/0.0
	Dharakote	5	306	5 (100.0)	3.9	100/0.0
	Sheragada	6	345	6 (100.0)	6.7	100/0.0
	Bhatakumurda	7	478	7 (100.0)	7.1	100/0.0
	Khallikote	6	405	6 (100.0)	9.1	100/0.0
Total	9	62	3592	52 (83.8)	10.4	100/0.0

PHC, Primary health centre; Mf rate, microfilaraemia rate

Geo-helminthiases survey: Stool samples were collected in plastic cups provided to the children aged 6-15 yr (school going) in each village and examined for geo-helminthiases within 2-3 h of collection by direct faecal microscopic examination. A quantitative Kato-katz[14] egg count was carried out in positive samples according to the WHO guidelines and kits supplied by WHO.

Data analysis: The Mf geometric mean intensity (GMI) was calculated as antilog (Σ log (x + 1) / n) -1 with x being the number of Mf/ml blood and n the number of Mf positive individuals examined[15]. Prevalence was statistically compared by χ^2 or Mantel-Haenszel χ^2 test. The sex-wise prevalence of Mf and disease were analysed by using Z- test of significance.

Results

Phase I: A total of 3712 (2085 males, 627 females) persons from 48 villages of Puri district and 3592 (2613 males, 1429 females) from 62 villages of Ganjam district were screened for microfilariae. The overall Mf rate was found to be 9.7 per cent (range 6.2 to 11.6%) in Puri district and 10.4 per cent (range 3.9 to 14.6%) in Ganjam district. Night blood smears for identification of microfilarial species revealed that 98.1 per cent (n=353) of these were *W. bancrofti* and 1.9 per cent (n=7) were *B. malayi* in Puri district, while all (n=374) were *W. bancrofti* in Ganjam district. Further, all villages of Puri district surveyed were found to be positive for microfilaraemia, while in Ganjam district 83.8 per cent of the villages were positive (Table I).

Phase II: Microfilaraemia - Of the13,877 people residing in 12 selected villages of Puri district, 2169 (1250 males, 919 females) were examined for Mf, circulating filarial antigenaemia (CFA) and disease. Similary, in Ganjam distrtict of the 17, 423 people residing in 12 selected villages, 2128 (1357 males, 771 females) individuals were examined. The absentees included those who had gone out temporarily, those who left the villages for other reasons and those who were not willing to participate in the study. The Mf rate was found to be 9.5 per cent in Puri and 11.1 per cent in Ganjam while the CFA rate was 16.8 per cent in Puri and 17.8 per cent in Ganjam. The GMI of Mf among Mf positive individuals was 387 and 454 in Puri and Ganjam respectively. The Mf prevalence was significantly higher in adults than in children in both Puri (13.3% vs 5%; $P< 0.05$) and Ganjam (14.3% vs 6.7%, $P<0.05$) (Table II). No statistically significant difference in prevalence rate was observed related to sex in children aged 1-14 yr in both the districts. However, the prevalence was significantly higher in males than in females after 15 yr of age [Puri: Prevalence ratio (PR)=1.47, Summarized Manel-Haenszel

Table II. Results from Phase II surveys for microfilaraemia (Mf), *W. bancrofti* circulating filarial antigen (CFA) and chronic clinical manifestation in Puri and Ganjam districts

District	Age-group (yr)	Microfilaraemia			Circulating filarial antigen (CFA)		Elephantiasis		Hydrocele[a]	
		No. Examined	No. Positive (%)	GMI (95% CI)	No. Examined	No. Positive (%)	No. Examined	No. Positive (%)	No. Examined	No. Positive (%)
Puri	1- 14	978	49 (5.0)	232 (196-324)	600	71 (11.8)	978	3 (0.3)	576	8 (1.4)
	≥ 15	1191	158 (13.3)*	457 (301-680)	600	130 (21.6)	1191	34 (2.9)	674	119 (17.7)
Ganjam	1-14	932	64 (6.7)	221 (103-398)	600	89 (14.8)	932	3 (0.3)	593	8 (1.3)
	≥ 15	1196	171 (14.3)*	572 (417-783)	600	124 (20.7)	1196	41 (3.4)	764	126 (16.4)

[a], Males only; GMI, geometric mean intensity of Mf per ml of blood
*P<0.05 compared to 1-14 yr age group in the respective district

χ^2=16.62, P<0.001; Ganjam: PR=1.62, Summarized Mantel-Haenszel χ^2=22.14, P<0.001). No significant difference in microfilaraemia was observed between the two districts. In the both the study areas the age stratified Mf prevalence increased gradually from the youngest individuals to the 21-30 yr age group and then showed gradual reduction (Fig. 1).

Clinical survey: The overall disease rate in Puri was 7.9 per cent (n=173; 159 males, 14 females) and in Ganjam was 8.9 per cent (n=194; 173 males, 21 females). The clinical manifestation of the filarial disease in both the districts revealed that the chronic disease manifestations (7.2% in Puri and 8.0% in Ganjam) were significantly higher than the acute manifestations (0.7% in Puri and 0.9% in Ganjam) (P<0.001 in Puri, P<0.001 in Ganjam) and encountered more in adult age group.

Among the acute disease manifestation, epididymo-orchitis was more commonly observed (0.6% in Puri and 0.8% in Ganjam) than the adenolymphangitis [0.3% (n=7, 4 males/3 females) in Puri and 0.4 per cent (n=8, 4 males /4 females) in Ganjam]. Among the patients with acute disease (n=34), one in Puri and three in Ganjam having epididymo-orchitis and one in Puri and two in Ganjam with adenolymphagitis were Mf +ve.

Chronic manifestations were more common in males (147 of 1250 in Puri; 11.8% and 158 of 1357 in Ganjam; 11.6%) than females (11 of 919 in Puri 1.2%, 17 of 771 in Ganjam 2.2%). Hydrocele was found to be the most common chronic manifestation in males, 10.2 per cent in Puri (127 of 1250) and 9.9 per cent in Ganjam (134 of 1357). Majority of the lymphoedema/elephantiasis cases (30 of 31 in Puri and 37 of 40 in Ganjam) of either sex had lower limb involvement. One case (female) of

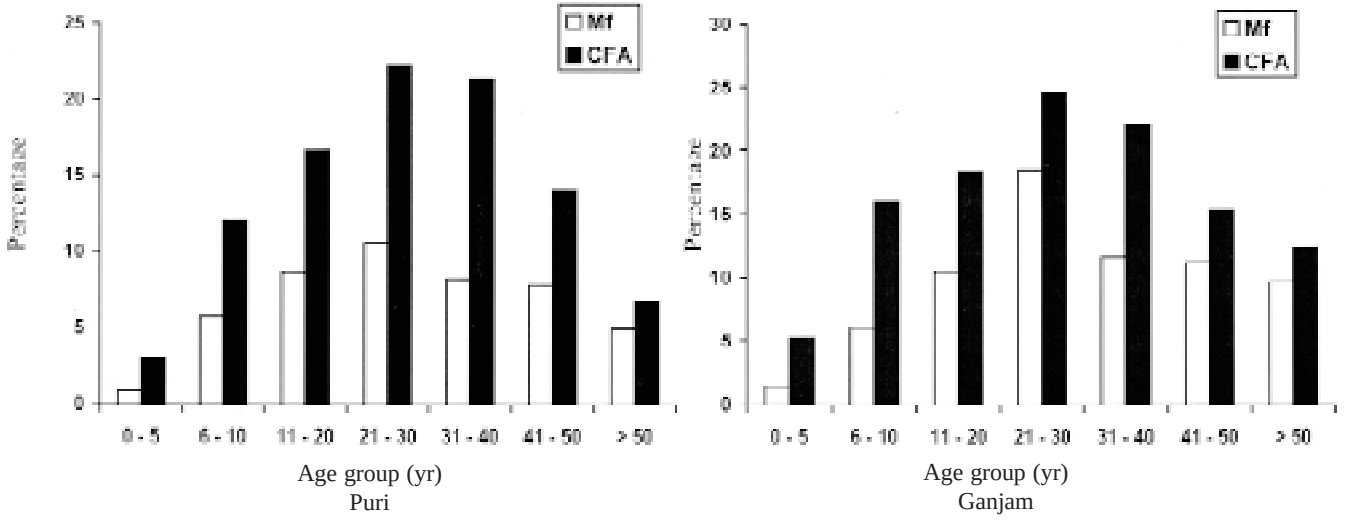

Fig. 1. Age stratified prevalence of microfilaraemia (Mf) and *W. bancrofti* specific filarial antigen (CFA) in Puri and Ganjam districts in Phase II study.

lymphoedema in Puri district and 3 cases (1 male and 2 females) in Ganjam district were found to have both leg and hand involvement. Among different grades of lymphoedema, grade II (0.96% in Puri and 1.17% in Ganjam) was observed to be predominant followed by grade I (0. 32% in Puri and 0.49% in Ganjam), grade III (0.23% in Puri and 0.14% in Ganjam) and grade IV (0.09% in each district). Mf positivity was seen in one patient each of the lymphoedema/elephantiasis in Puri, and Ganjam and two of the hydrocele cases in Puri, and one in Ganjam. Prevalence of both acute and chronic disease was statistically higher in males than in females in both the districts (P<0.001). However, no significant difference was observed in clinical symptoms between two districts.

Antigenaemia: The distribution pattern of CFA in different age groups was similar in both the districts. The peak level of antigenaemia was found to be in the age group of 21-30 yr (22.3% in Puri and 24.6% in Ganjam). The antigenaemia rate in all age groups was significantly higher than the microfilaraemia of the corresponding age group (P<0.001) (Fig. 1).

Geo-helminthiases: The overall geo-helminthiases was observed to be 31.8 per cent in Puri and 42.1 per cent in Ganjam among the school going children. In both the districts roundworm was found to be predominant (16% in Puri and 24.9% in Ganjam) followed by hookworm (8.2% in Puri and 9.1% in Ganjam) and Trichuris (4.5% in Puri and 5.1% in Ganjam). The distribution pattern of worm burden was similar in both the districts and maximum number of cases harboured the light infection. However, the heavy infection was significantly higher in Ganjam compared to Puri district (P<0.001) (Fig. 2).

Discussion

Lymphatic filariasis was recognized as a problem in the rural areas during 1962-1971 phase of the National Filariasis Control Programme (NFCP)[16]. Since then the NFCP has been carrying out delimitation surveys to find out the distribution of the filariasis. But there is a need to update this information as filariasis has made inroads into newer areas, some of the areas have been surveyed long time ago and a number of known endemic districts have not yet been surveyed[17]. The preliminary random survey (Phase I) revealed that LF was widely distributed in Puri district (all villages surveyed were positive for Mf), while in Ganjam the distribution was focal (83.8% of villages were +ve for LF). Another observation on the presence of certain pockets of *B. malayi* in Puri district, was very important because of the post drug reaction point of view after mass drug administration during elimination programme.

The age dependency of microfilaraemia prevalence in the present study was in accordance with earlier

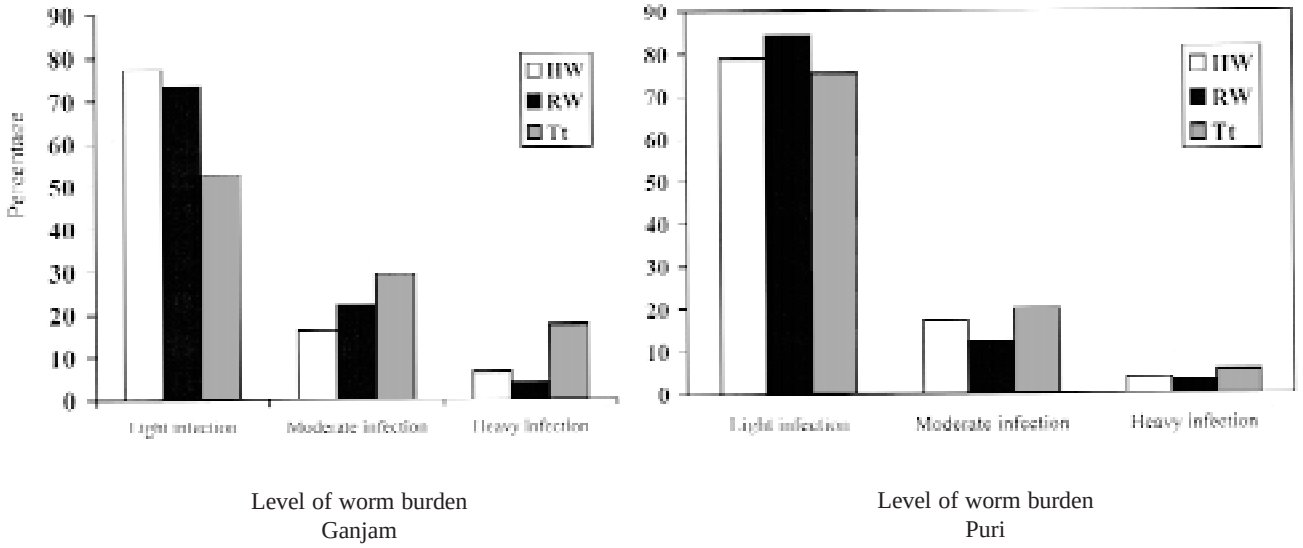

Fig. 2. Geohelminthic worm burden in Ganjam and Puri districts. HW, Hookworm; RW, round worm; Tt, Trichuris.

documented findings[18,19]. The highest prevalence of microfilaraemia in 21-30 yr age group in both sexes in Puri and Ganjam was suggestive of an intense level of transmission[20]. Similar pattern of age dependency was also observed for antigenaemia prevalence. However, the prevalence of antigenaemia was considerably higher than Mf prevalence in all age groups, similar to the observations made by Nielson *et al*[21] in Lower shrine, Southern Malawi.

Sex-specific microfilaraemia prevalence pattern revealed higher Mf rate in males than in females. Similar to that reported in south India[18]. The overall density of Mf, however, did not show any sex specific difference in the present study.

Prevalence of acute disease in the present study was observed to be significantly lower than the chronic manifestation, which correlated with the studies conducted in other parts of India[8,22]. This may be considered as a marker for level of transmission and can be used for future evaluation of filariasis control programme.

Contrary to the statistical observation made by Bundy and others[23] relatively lower disease prevalence than the Mf prevalence in the present study could have been resulted due to long-term effect of individual treatment in preventing or greatly reducing clinical disease even when it has not been possible to interrupt or reduce transmission[18]. Among the chronic disease manifestations hydrocele was encountered more frequently than the lymphoedema/elephantiasis in both the districts. This observation was in agreement with earlier reports[8,11]. The prevalence of chronic manifestations was age dependant in both sexes as observed in Pondicherry, south India[22,24] and could be due to the progressive accumulation of chronic case in a population[25].

In the present study 3.4 per cent of lymphoedema/ elephantiasis cases and 1.6 per cent of hydrocele cases in Puri district and 2.8 per cent of lymphoedema/ elephantiasis cases and 0.8 per cent of hydrocele cases in Ganjam district were found to be Mf carriers. This suggests that there could be two alternate routes leading to lymphatic pathology[26], one dependent on host response to the parasite, leading to inflammatory damage without Mf and the other secondary to the presence of adult worm inducing local immune suppressive response[27]. However, the probability of Mf association with chronic disease is variable from region to region and is related to local incidence of infection[18].

The prevalence of geo-helminthes amongst the school going children was found to be high in both the districts and was in accordance with our earlier report[28]. This may be due to the presence of source of infection in the immediate surroundings and frequent faeco-oral spread of infection among the children.

In summary, the present study identified lymphatic filariasis and geo-helminthiases as being widely distributed in rural areas of the two coastal districts of Orissa. However, it is essential to carry out investigation in other rural areas of the State so as to assess the actual magnitude of the problem which will help in implementation of effective control measures.

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References

1. Michael E, Bundy DAP, Grenfell BT. Reassessing the global prevalence and distribution of lymphatic filariasis. *Parasitology* 1996; *112* : 409-28.

2. Das PK, Ramaiah KD, Augustin DJ, Kumar A. Towards elimination of lymphatic filariasis in India. *Trends Parasitol* 2000; *10* : 457-60.

3. Evans DB, Gelband H, Vlassoff C. Social and economic factors and the control of lymphatic filariasis: a review. *Acta Trop* 1993; *53* : 1-26.

4. World Health Organization. *World Health Report 1995*: *Bridging the Gaps*, Geneva; 1995 p. 118.

5. Ottesen EA. The global programme to eliminate lymphatic filariasis. *Trop Med Int Health* 2000; *5* : 591-4.

6. Kishore J. National Health policy 2002: Future Health Development. *Employment News* 2002; *XXVII* (38) : 1-4.

7. Reddy GS, Vengatesvarlou N, Das PK, Vanamail P, Vijayan AP, Sasikala, *et al*. Tolerability and efficacy of single dose diethyal carbamazine (DEC) or ivermectin in the clearance of *Wuchereria bancrofti* microfilaraemia in Pondicherry, South India. *Trop Med Int Health* 2000; *5* : 779-85.

8. Rath RN, Das RK, Mishra G, Mohapatra BN, Rama Krishna C. Bancroftian filariasis in two selected rural communities in Puri district: Orissa - A comprehensive study of filariametric data. *J Commun Dis* 1984; *16* : 104-12.

9. Kumar A, Dash AP. Prevalence of filariasis in Ranpur tehsil of Orissa. *J Commun Dis* 1993; *25* : 195-8.

10. Kumar A, Dash AP, Mansing GD. Prevalence of filariasis in Puri rural, Orissa. *J Commun Dis* 1994; *26* : 215-20.

11. Chhotray GP, Mohapatra M, Acharya AS, Ranjit MR. A clinico epidemiological perspective of lymphatic filariasis in Satyabadi block of Puri district, Orissa. *Indian J Med Res* 2001; *114* : 65-71.

12. McMohan JE, Marshall TE, Vaughan JP, Abaru DE. Bancroftian filariasis: a comparison of microfilariae counting techniques using counting chamber, standard slide and membrane (nucleopore) filtration. *Ann Trop Med Parasitol* 1979; *73* : 457-64.

13. World Health Organization. Fourth report of the WHO expert committee on filariasis. Lymphatic filariasis: *WHO Tech Rep Ser no.702*; 1984 p. 3-110.

14. Katz N, Coelho PM, Pellegrino J. Evaluation of Kato's quantitative method through the recovery of *Schistosoma mansoni* eggs added to human feces. *J Parasitol* 1970; *56* : 1032-3.

15. Meyrowitsch DW, Simonsen PE, Makunde WH. Bancroftian filariasis: analysis of infection and disease in five endemic communities in north-eastern Tanzania. *Ann Trop Med Parasitol* 1995; *89* : 653-63.

16. Ramaiah KD, Pani SP, Balakrishnan N, Sadanandane C, Das LK, Mariappan T, *et al*. Prevalence of bancroftian filariasis and its control by single dose course of diethyl carbamazine in a rural area in Tamil Nadu. *Indian J Med Res* 1989; *89* : 184-91.

17. Dhanda V, Das PK, Lal R, Srinivasan R, Ramaiah KD. Spread of lymphatic filariasis, reemergence of leishmaniasis and threat of babesiosis in India. *Indian J Med Res* 1996; *103* : 46-54.

18. Rajagopalan PK, Das PK, Subramanian S, Vanamail P, Ramaiah KD. Bancroftian filariasis in Pondicherry, South India 1. Pre-control epidemiology observations. *Epidemiol Infect* 1989; *103* : 685-92.

19. Onapa AW, Simonsen PE, Pedersen EM, Okello DO. Lymphatic filariasis in Uganda: Baseline investigations in Lira, Soroto and Katakwi district. *Trans R Soc Trop Med Hyg* 2001; *95* : 161-7.

20. Albuquerque MFM, Marzochi MC, Sabroza PC, Braga MC, Padilha T, Silva MCM, *et al*. Bancroftian filariasis in two urban areas of Recife, Brazil: Precontrol observations on infection and disease. *Trans R Soc Trop Med Hyg* 1995; *89* : 373-7.

21. Nielsen NO, Makaule P, Nayakuipa D, Block P, Nyasula Y, Simonson PE. Lymphatic filariasis in Lower Shrine, Southern Malawi. *Trans R Soc Trop Med Hyg* 2002; *96* : 133-8.

22. Pani SP, Das LK, Balakrishnan N, Sadanandane C, Rajavel AR, Subramanian S, *et al*. A study on the clinical manifestations of bancroftian filariasis in Pondicherry, South India. *Indian Med Gaz* 1989; *123* : 111-5.

23. Bundy DAP, Grenfell BT, Rajagopalan PK. Immunoepidemiology of lymphatic filariasis: the relationship between infection and disease. In: Ash C, Gallagher RB, editors. *Immunoparasitology today (special joint issue of immunology today and parasitology today)*. Cambridge: Elsevier Trends Journals; 1991 p. A71-A 75.

24. Pani SP, Balakrishnan N, Srividya A, Bundy DAP, Grenfell BT. Clinical epidemiology of bancroftian filariasis: effect of age and gender. *Trans R Soc Trop Med Hyg* 1991; *85* : 260-4.

25. Srividya A, Pani SP, Rajagopalan PK, Bundy DAP, Grenfell BT. The dynamics of infection and disease in bancroftian filariasis. *Trans R Soc Trop Med Hyg* 1991; *85* : 225-59.

26. Ottesen EA. Infection and disease in lymphatic filariasis: an immunological perspective. *Parasitology* 1992; *104* : 571-9.

27. Amaral F, Dreyer G, Figueredo-Silva J, Noroes J, Caralcanti A, Samico SC, *et al*. A live adult worms detected by ultrasonography in human bancroftian filariasis. *Am J Trop Med Hyg* 1994; *50* : 753-7.

28. Chhotray GP, Ranjit MR. Effect of drug treatment on the prevalence of intestinal parasites amongst school children in a sub-urban community. *Indian J Med Res* 1990; *91* : 266-9.

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