TRANSMISSION DYNAMICS OF FILARIASIS IN KHURDHA DISTRICT OF ORISSA, INDIA

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Abstract. A three year longitudinal study was carried out to quantify the different parameters of filarial transmission in an endemic area of Orissa State, India. Parasitological surveys revealed mean microfilaria rate, microfilaria density and median microfilaria density (MFD-50) to be 9.41, 19.23 and 7.33, respectively. The per man hour density of the vector, *Culex quinquefasciatus* varied from 24.2 to 66.0 with a peak in January. Infection rate varied from 0.9 to 27.5%, while infectivity rate ranged between 0.0 and 15.2%. Infectivity rate showed high correlation with microfilaria rate and per man hour density of adult mosquito. The highest numbers of first stage larvae (L_1), second stage larvae (L_2) and third stage larvae (L_3) per mosquito were found to be 25, 22 and 11, respectively. Average L_3 load per infective mosquito ranged from 1.0 to 7.2. L_3 load showed high correlation with microfilaria rate ($r = 0.845$, $p < 0.01$) while no correlation was seen with microfilaria density.

INTRODUCTION

Filariasis is a major public health problem in India. According to the latest estimate 72.8 million people are infected with *Wuchereria bancrofti* in the world (WHO, 1992). India contributes 38% of the global bancroftian filariasis (Biswas *et al*, 1996). Though Orissa state is an endemic home for lymphatic filariasis due to *W. bancrofti* and *Brugia malayi* (Dash *et al*, 1988), no information is available on transmission parameters of this disease in the state. There are also no reports on vectors of filariasis in Orissa except the recent ones by Dash (1984, 1985) and Dash *et al* (1988). The present investigation attempts to quantify the different parameters of filarial transmission in an endemic locality of Orissa, India.

MATERIALS AND METHODS

Study area

Entomological and parasitological studies were conducted in Kholadwar and Badatota area (with around 10,000 population), an endemic locality for bancroftian filariasis in Khurdha district of Orissa, India for three years from January 1989 to December 1991.

Parasitological studies

For detection of microfilaria in blood, peripheral night blood surveys were carried out between 20.00-23.00 hours for detection of microfilariae once in a year in three years. For reliable estimation a minimum of 15% of the population was sampled taking thick blood smears (25 µl). The survey covered all age groups of both the sexes. The microfilaria rate, microfilarial density were calculated. Median microfilarial density (MFD 50) was also calculated following the procedure of Sasa (1969).

Entomological studies

Indoor resting mosquitos were collected with the help of a mechanical aspirator during 06.00 to 09.00 hours. *Culex quinquefasciatus*, the only vector of bancroftian filariasis (Dash *et al*, 1988) were separated and dissected in Hayes Saline (Hayes, 1953) and examined for the presence of different laval stages of the filarial parasite. L_3 larvae were examined under phase contrast microscope and identified following the key developed by Nelson, (1959) and Yen *et al*, (1982). Infection (% of mosquitos positive for any developmental stages of the parasite) and infectivity (% of mosquitos positive only for infective larvae) rates were determined for assessing vectorial capacity. Number of L_3 per mosquito was calculated to determine the L_3 load in the particular locality. Tests of significance were done using Student's *t*-test. Pearson's correlation analyses were carried out for comparison between the different parameters.

RESULTS AND DISCUSSION

Parasitological survey

The year wise microfilaria (mf) rate and microfilaria density are depicted in Fig 1. The filarial species was *W. bancrofti*. Microfilaria (mf) rates were found to be 8.82, 8.95 and 10.5% with a mean of 9.41 ± 0.94% and mf densities were 18, 18.2 and 21.5 with a mean of 19.23 ± 1.96 in the three consecutive years from 1989 to 1991 respectively. Sasa (1967) stated that the median microfilaria density (MFD50) indicated the degree of endemi-city in an area and that it is more reliable than the arithmetic mean of the average microfilaria density. This value was determined to be 6.4, 6.6 and 9.0 with a mean of 7.33 ± 1.44 during 1989, 1990 and 1991 respectively in the locality. Studies in Lucknow and Pondicherry revealed the MFD50 to be 6.0 and 9.0 respectively (Srivastava *et al*, 1969; Rajagopalan *et al*, 1977).

Seasonal prevalence

The month wise densities of the vector *Cx. quinquefasciatus* along with temperature and humidity are presented in Fig 2. The per man hour density (PMHD) of *Cx. quinquefasciatus* varied from 24.2 to 66.0, highest in January and lowest in May/June during the study. Similar observations

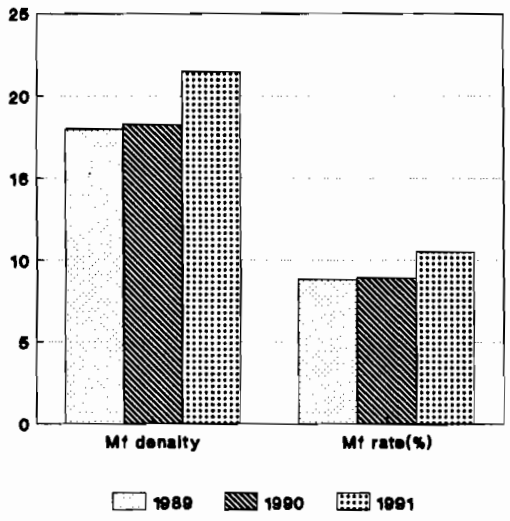

Fig 1–Mean mf density and mf rate of human population in the study area during 1989 to 1991.

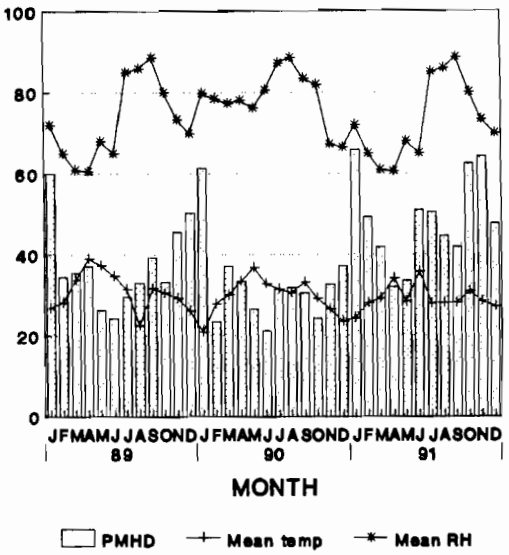

Fig 2–Per man hour density of *Cx. quinquefasciatus* in relation to temperature (degree C) and relative humidity (%) during 1989-1991.

were found by Dash *et al* (1988), in Puri district of Orissa. Dhar *et al* (1968) found that the density of this species was highest in December and lowest in June in Rajahmundry while Kaul and Watta (1968b) observed its peak density in April which was lowest in January in the Delhi population. Rajagopalan *et al* (1977) found the peak density in March, when optimum temperature was 29.9°C and lowest density in May, when the temperature was 36.8°C. In the present investigation the monthly variation in the density pattern and seasonality of the vector seems to be related to the meteorological conditions prevailing in the area. The temperature and relative humidity (RH%) within 25-35°C and 65-75% respectively are most suitable to maintain the vector density at higher level (Fig 2). Weather determines the favorable conditions that enable a vector population to increase or decrease rapidly or gradually (Kaul and Wattal, 1968a).

Vectorial capacity

Seasonal variation of filarial infection and infectivity rates in *Cx. quinquefasciatus* are shown in Fig 3. Filarial infection in mosquitos was detected in the vector throughout the year. Infection rates were highest in March and lowest in May while the infectivity rate was highest in January and lowest in April/May/June (Fig 3). The infection and infec-

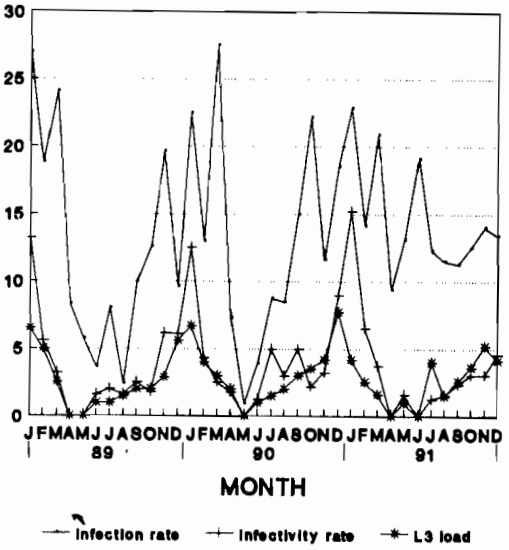

Fig 3–Month wise infection, infectivity rates and L3 load per infective *Cx. quinquefasciatus* during 1989-1991.

tivity rate varied from 0.9 to 27.5% and 0.0 to 15.2% respectively during the three years. Infection and infectivity rates were found to be high during winter, gradually decrease in summer season and during monsoon it rises again. Rajagopalan *et al* (1977) found infection rate to be highest in April and lowest in November and infectivity rate being highest in March and lowest in May in South India. The infection and infectivity rates of the Rajahmundry population varied between 10.2 to 13.2 and 2.1 to 2.4, respectively (Dhar *et al*, 1968).

No transmission was observed when the temperature was above 37°C and RH below 65%. The same observations were also recorded by Basu and Sundar Rao (1939) in Lucknow. The infectivity rate showed positive correlation with mf rates ($r = 0.4462$, $p < 0.01$) and per man hour density ($r = 0.410$, $p < 0.05$) and infection rate with per man hour density ($r = 0.411$, $p < 0.05$) only. However no correlation of infection rate with density of mosquitos was observed in Rajahmundry (Dhar *et al*, 1968), in Mangalore (Subramaniyam and Tampi, 1958), in Ernakulam (Pal *et al*, 1960), and in Rangoon (De meillon *et al*, 1967).

Load of developing larvae

The number of developing larvae (L_1, L_2 and L_3) found in wild caught mosquitos are shown in Table 1. The maximum number of L_1, L_2 and L_3 procured from a single mosquito were 25, 22 and 11, respectively. Average load of L_1 was more than L_2 and L_2 load was more than L_3 load. Bryan (1986) found the

Table 1

Mean loads of developing stages of *W. bancrofti* larvae in wild caught *Cx. quinquefasciatus.*

Month	L_1 Load			L_2 Load			L_3 Load		
	1989	1990	1991	1989	1990	1991	1989	1990	1991
January	8.4	7.1	5.3	7.5	6.5	4.4	6.5	6.2	4.2
February	5.7	5.0	3.8	5.3	4.6	3.2	5.0	4.0	2.5
March	3.5	4.0	3.3	3.2	3.2	3.0	2.5	2.0	1.6
April	4.5	4.5	4.6	3.0	3.0	0.0	0.0	2.0	0.0
May	2.5	7.0	5.3	0	2.0	3.0	0.0	0.0	1.0
June	3.0	8.0	4.6	1.0	0.0	2.7	1.0	1.0	0.0
July	7	3.0	4.3	2.5	2.0	2.0	1.0	1.5	1.0
August	3.0	4.5	4.4	2.5	3.6	2.4	1.5	2.0	1.5
September	3.5	4.4	5.8	3.0	3.8	3.4	2.0	3.0	2.6
October	6.3	5.3	5.3	3.7	4.3	4.6	2.0	3.5	3.6
November	4.0	6.6	5.7	2.9	5.8	4.5	2.0	4.2	4.2
December	7.1	8.2	7.0	5.8	7.7	5.4	5.6	7.2	5.1
Mean ± SD	4.88	5.63	4.95	3.37	3.88	3.22	2.42	2.97	2.28
	1.95	1.69	0.99	2.04	2.12	1.43	2.14	2.21	1.70

same phenomenon in a New Guinea population. The average L_3 load per mosquito ranged from 1 to 7.2; the L_3 load per mosquito showed high correlation ($r = 0.845$, $p < 0.01$) with mf rate while no significant correlation was seen with mf density. The development of *W. bancrofti* in *Cx. quinquefasciatus* in nature showed that there is a loss of 33.9% of larvae from L_1 to L_2 and 25.3% from L_2 to L_3 in the study area. Mean loads of different stages of larvae were compared. It is observed that mean L_3 load is significantly different from mean L_1 load ($t = 6.02$, $p < 0.001$). As stated by Rajagopalan *et al* (1977), what is the critical level of density, which sustains the level of transmission and whether, by reducing the density below this level, transmission could be brought down are still unknown.

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