IMPACT OF DIFFERENT HOUSING STRUCTURES ON FILARIAL TRANSMISSION IN RURAL AREAS OF SOUTHERN INDIA

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Abstract. The aim of the present investigation was to assess the filarial transmission levels in houses of different structure in rural areas of Andhra Pradesh, India. During this study, ecologically-similar households were selected for entomological study. The per-man-hour density (PMHD), infection and infectivity rates, were recorded in different ranges *ie*, 16.1 to 77.6, 0 -31.2% and 0 -5.6%, respectively.

INTRODUCTION

The Fiftieth World Health Assembly identified lymphatic filariasis (LF) as a most important eradicable disease (WHO, 1995). India alone contributes 40% of the global disease burden (Michael *et al*, 1996) and an annual economic loss of nearly 1.5 billion US dollars every year (Ottesen *et al*, 1997). The disease causes permanent and long-term disability and due to this disability, diseased people cannot be involved in social activities (WHO, 1995). Melrose (2002) suggested that filariasis remains an insoluble public health problem and that it is not clearly understood. According to reports of Abgelo Celli, people could be protected from malaria by screening their homes against mosquitos (Lindsay *et al*, 2002). This elucidates the importance of socioeconomic parameters, especially housing structure, in the elimination of mosquito-borne diseases. Hence, this study was undertaken to understand the role of housing structure in filariasis transmission.

MATERIALS AND METHODS

Study area

Geographical and climatic description. East and West Godavari districts lie between 16.25º-18.10º latitude North and 80.75º-82.65º longitude East on the Bay of Bengal coast of peninsular India. These two districts have abundant natural resources, such as monsoon rains, fertile soil, and perennial rivers, for systematic crop production. The two districts are separated by the Godavari River. The climate is characterized by a humid summer (46º-20ºC), winter (32º-11ºC) and monsoon (June-December). The southwest monsoon plays a major role in determining the climate of the state. The northeast monsoon is responsible for about one-third of the total rainfall in Andhra Pradesh. There was no proper wastewater disposal system in any of the study villages, often with cesspools of stagnated water. These can facilitate the favorable breeding conditions for *Culex quinquefasciatus*, the vector of Bancroftian filariasis.

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Selection of households

The study was conducted between February 2000 and January 2001, in 45 rural areas from East and West Godavari Districts, Andhra Pradesh. Previous researchers stated that the study regions endemic for filariasis (Raghavan, 1957). A total of 1,804 households was selected randomly for the entire study.

Before commencement of the filarial surveys, the study team met the relevant village heads and explained the purpose of the study and solicited their co-operation. From each selected household, socio-economic parameters, *ie* sex, age, education (illiterate, literate), average income, size of household, type of house [hut, thatched, tiled and reinforced concrete (RCC)], health, family background (permanent resident or migrant), occupation (employee, farmer, labor, and business), number of children, filariasis awareness, whether using any mosquito avoidance methods, were recorded to evaluate the relationships between the socio-economic parameters and mosquito abundance, infection and infectivity rates of mosquitos.

The majority of the people depended upon agriculture, pisciculture, and weaving, for their livelihoods. Different types of house structures were also observed in the study area, such as hut, thatched, tiled and RCC.

For the study purpose, different structured houses from ecologically similar backgrounds were selected and were given a group code, as shown in Table 1. Group A (huts) were constructed with palm tree stems and leaves, mud-plastered floors and walls, with very poor ventilation and light. Group B (thatched houses) were made using dry paddy and palm leaves, unplastered brick walls, mud floors, with poor light and ventilation. Group C (tiled houses) were constructed with concrete walls, cement floor and tiled roofs with inadequate ventilation. Group D (RCC) were well-constructed houses with concrete walls and cement roofs and floors, with well-ventilated rooms and proper lighting.

Entomological survey

Between February 2000 and January 2001, indoor-resting mosquitos were collected at fortnightly intervals with the help of mechanical aspirators (Hausherr's Machine Works, NJ, USA) between 0600 and 0900 hours. Only female *Cx. quinquefasciatus* mosquitos, the principal vectors of bancroftian filariasis (Dash *et al*, 1988), were identified using the key developed by Reuben *et al* (1994). Vector abundance was expressed as the number of female *Cx. quinquefasciatus* mosquitos collected per man per house.

Cx. quinquefasciatus females were dissected to identify the stage of the microfilaria, using the key developed by Nelson (1959) and Yen *et al* (1982). All stages were recorded, and mature infected larvae were identified on the basis of the morphology of their caudal papillae. The infection rate was calculated by the presence of any stage of microfilaria; the infectivity rate was based on the presence of third-stage microfilaria only.

Statistical methods

Analysis of variance (ANOVA) was used to study variations in the per-man-hour density of *Cx. quinquefasciatus* in different groups of houses, and the chi- square test was used for comparative analysis of the month-wise PMHDs in the different groups of houses.

RESULTS

The Month-wise Per-Man-Hour Density (PMHD), infection, and infectivity rates of *Cx. quinquefasciatus* in the different house types are summarized in Tables 2 and 3. Maximum PMHD of 70.6 (Group A), 77.6 (Group B), 48.3 (Group C), and 40.9 (Group D) were observed during December and March, while minimum of 16.1 (Group A), 18.6 (Group B), 17.8 (Group C), and 17.2 (Group D) were observed in May and June. Thus, in the summer months all types of houses showed the lowest PMHD values.

ANOVA was used to study the variations in the PMHD values of different house types. The ANOVA model yielded the F-value of 2.91 for (3, 47) degree of freedom, which was significant at a 5% level. This test confirmed that the observed differences in PMHD between households were statistically significant.

The chi-square test was used for comparative analysis of the month-wise PMHD values of the different groups. The results are presented in

Table 1
Grouping of different house structures.

Group	Type of house	Roofs	Walls	Floors
A	Hut	Palm tree leaves	Mud plaster	Mud
B	Thatched	Palm tree leaves and grass	Unplastered bricks	Mud
C	Tiled	Tiles	Concrete	Cemented
D	RCC	Cemented	Concrete	Cemented

Table 2
Month-wise PMHD variations in the different groups of houses.

Month	Hut	Thatched	Tiled	RCC
Feb 00	38.3	43.7	32.8	35.5
Mar 00	35.5	28.1	32	40.9
Apr 00	27	26.2	26.9	31
May 00	16.1	18.6	17.8	18.1
Jun 00	22.7	23.2	22.2	17.2
Jul 00	28	27.6	27.1	27.2
Aug 00	37	41.8	37	40.2
Sep 00	36.2	56.6	30.8	22.6
Oct 00	36.8	46.6	34.2	24.7
Nov 00	45.5	70	41.3	25
Dec 00	70.6	77.6	48.3	30.8
Jan 01	47.9	65.2	42	24.5

Table 3
Month-wise infection (%) and infectivity (%) variations in the different groups of houses.

Month	Hut		Thatched		Tiled		RCC	
	Infection	Infectivity	Infection	Infectivity	Infection	Infectivity	Infection	Infectivity
Feb 00	21	1.9	17.2	2.1	11.2	0	9.2	0
Mar 00	23.8	2.1	17.6	1.1	17.3	2.6	11.2	1
Apr 00	13.2	1.4	15.2	0	15.4	3	4.3	0
May00	17.1	3.2	6.8	2.3	11.2	0	0	0
Jun 00	12.5	1.8	13.7	1.3	13.6	1.3	0	0
Jul 00	25	5.5	19.5	2.2	24.3	3.4	2.3	0
Aug 00	26.2	5.6	28.2	3.4	18.2	2.2	3.5	1.1
Sep 00	31.2	5.6	31	4.6	21.3	1.9	3.1	0
Oct 00	20.5	4.3	24.2	4.3	16.5	0	5.7	1.6
Nov00	21.8	4.2	20.3	3.6	14.2	0	7.7	2.3
Dec 00	15.1	2.6	14.2	3.1	22.6	3.2	2.4	1.9
Jan 01	13.2	0	11.2	1.4	19.2	0	2.6	0

Table 4. A close inspection of Table 4 reveals that the chi-square test values for the combinations of i) Group A *vs* Group B, ii) Group A *vs* Group C, iii) Group A *vs* Group D were not significant, at a 5% level. This implies that the observed differences in the monthly PMHD values were not statistically significant, which were also observed by Baruah *et al* (2000).

The month-wise infection and infectivity rates of different housing groups are shown in Table 3; the highest infection rates were observed during the months of September for Groups A and B (31 and 31.2%), July for Group C (24.3%), and March for Group D (11.2%). Similarly, the highest infectivity rates of 5.6% (Group A), 4.6% (Group B), 3.4% (Group C), and 2.3% (Group D) were recorded during the months of August, September, July, and November, respectively.

DISCUSSION

In the present investigation, the highest PMHD ranged from 40.9 to 77.6 from all four types of houses. As discussed by Murty *et al* (2002), mosquito abundance is positively associated with the monsoon months. Similarly, the highest infection (31.2%) and infectivity (5.6%)

Table 4
Chi-square test results for PMHD by month and type of house.

Category	Chi-square (χ^2)	Degrees of freedom	Significance
1. Hut *vs* Thatched	3.2307	6	Not significant
2. Hut *vs* Tiled	0.609308	6	Not significant
3. Hut *vs* RCC	7.61812	6	Not significant

were recorded from the poorly-constructed group of houses. Housing pattern has a direct influence on the transmission dynamics of vector-borne diseases (Webb, 1985). Schofield and White (1984) stated that vector-borne diseases are transmitted in houses. Similar studies, conducted by Baruah *et al* (2000) in Varanasi, concluded the role of house design in the transmission of filariasis.

The present investigation helps to understand the impact of housing structure on vector density, and the transmission of disease. Significant differences in vector density, infection rate, infectivity rate, and microfilaria prevalence, were observed between the different housing structures. It is found that house structure with cross ventilation, white painted walls, meshed doors, windows, and with RCC roofs, etc, are most likely to reduce mosquito-resting places and highest transmission, as a large reduction of indoor biting could have a significant effect on reducing morbidity. Kolstrup *et al* (1981) successfully demonstrated modifications of houses that could reduce man-mosquito contact. This indicates that there is a need to modify housing structures, to reduce the man-mosquito contact, which has a direct impact on the vector density and transmission dynamics of disease.

ACKNOWLEDGEMENTS

The authors are grateful to the Director of the Indian Institute of Chemical Technology, Hyderabad, for his encouragement and support. Thanks are due to the Ministry of Information Technology, New Delhi, for sponsoring this study.

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