

COMPARATIVE STUDIES ON MAN-BITING POPULATION OF FILARIAL VECTOR  
*Cx. quinquefasciatus* (Diptera: Culicidae) BETWEEN TRIBAL AND NON-TRIBAL  
AREAS OF BANKURA DISTRICT, WEST BENGAL INDIA

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**Abstract.** West Bengal, India is endemic for filariasis and the number of patients infected with bancroftian filariasis is increasing. There are no observation on the potential vector of filariasis from the tribal areas that make up considerable part in this state. This study investigate population of *Cx. quinquefasciatus* in tribal and non-tribal areas of Bankura district. Species composition of mosquitoes, per man-hour density, hourly densities of night biting *Cx. quinquefasciatus*, number of *Cx. quinquefasciatus* biting per man per day and per man per night. Preferential biting site and peak period of filarial transmission were recorded from both the study areas. Infection rate, infectivity rate of man-landing vector population and annual transmission potential were observed to be 0.31%, 0.00% and 0.00 in tribal areas and 0.73%, 0.23% and 359.71 in non-tribal areas respectively.

**Key words:** Filariasis, *Cx. quinquefasciatus*, man bait, Tribes, Non-Tribes, Transmission potential

## INTRODUCTION

Available records indicate that approximately worldwide 120 million people are infected with lymphatic filariasis. The number infected in India is approximately 45.5 million, which is 48% of the world burden <sup>(1)</sup>. The most common and predominant vector of bancroftian filariasis in India is *Cx. quinquefasciatus* <sup>(2)</sup>. Bancroftian filariasis prevails in an endemic form in West Bengal, India. Studies of filariasis vectors in West Bengal have been previously conducted in urban areas <sup>(3,4,5,6)</sup>. Only two published comparative accounts are available on man-landing *Cx. quinquefasciatus* in an urban and a rural area of West Bengal <sup>(6,7)</sup>. There have been no studies on man-biting populations of *Cx. quinquefasciatus* in Bankura district, West Bengal, India. Important parameters of disease transmission such as mosquito species composition, per man hour density, density per man day and hourly density are

unknown. Also unknown is there people are receiving infective mosquito bites that the peak season of transmission is, the infectivity rates of the mosquito the annual transmission potential (ATP).

The parameter ATP was first described by Duke <sup>(8)</sup>. It was used to characterize transmission risk of Onchocerciasis by *Simulium* sp in the Volta river basin of Africa <sup>(9)</sup>. In order to correctly assess the threat of filaria transmission in an area, the WHO <sup>(1)</sup> expert committee on filariasis recommend its calculation.

## MATERIALS AND METHODS

Bankura district of W.B., India is endemic for bancroftian filariasis <sup>(10,11)</sup> the climate is marked by high temperatures and humidity. Rainfall is moderate. The tribal study areas were located within or beside jungle areas, isolated from common villages and urban areas. The tribal area

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lack electricity. There are no schools or industries and there are no latrine or planned drainage system etc and situated at a radius of 10-15km around Sonamukhi Municipal town of Bankura district. The tribal villages are inhabited by aboriginal kolid people low income<sup>(12)</sup>. These people have a very specific culture (non-tribes). As totemistic beliefs and matriarchal influence. They live in mud houses built apart with very clean surroundings, use their own language (Santali) and practise traditional medicine.

Man-landing mosquitoes were collected from 12 tribal villages and from 12 localities selected in the town of Sonamukhi. Sonamukhi is in a non-tribal area. The buildings are made of one or two stories concrete. There are concrete roads, and the town has access to electricity, school, college, market. There are slum areas that have stagnant drains, but sanitary latrine are present also. There is a school in each study area (tribal and non-tribal), two male volunteers wearing only short laid (one indoors and one outdoors) on cot, about 45 cm above the ground with maximum exposure to mosquito bite. All the man-landing mosquitoes were captured for 24 hours from 6 a.m of a day to 6 a.m. of the following day fortnightly for one year from august 2000 to July 2001. Altogether 1152 man-hours (576 indoors and 576 outdoors) were employed in each area for collection.

Collection was done in 6 shifts (3 during day and 3 during night) employing 6 persons (3 indoors and 3 outdoors) in each shift<sup>(13)</sup>. Human volunteers of different heights (150 cm to 175 cm) and different ages (23-55) were used. Mosquitoes collected from different parts of the body were noted separately dividing the human body into 4 parts namely, head body, upper extremity (hands, arms and fingers) and

lower extremity (thigh, legs and feet). Each hour collection was kept separately in numbered test tubes. Mosquitoes were sorted and indentified in the field. *Cx. quinquefasciatus* were dissected and examined for filarial worms. Number of mosquitoes infected with microfilariae and other stages (1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup>) of filarial parasites, the numbers of different larval stages and their position in the body (head, thorax or abdomen) of each infected mosquito were noted.

An ATP was calculated using the total number of infective larvae (3<sup>rd</sup> stage) of filarial worm found in the total number of vector mosquitoes that would be expected to bite an individual who was exposed 24 hrs a day for full year<sup>(14)</sup>. It was calculated using the following formula of Walsh et al.<sup>(9)</sup>.

For statistical analysis Standard Normal Deviate (SND) 'z' test and student's 't' test were used.

## RESULTS

During 24 hrs man-bait catch, 7 species of mosquitoes were collected in TA. The species collected were following . *Cx. vishnui* group (31.0%), *Anopheles vagus* (23.1%) and *Cx. quinquefasciatus* (38.9%). Ten mosquito species were collected in NTA, *Armigeres subalbatus* (16,5%) *Cx. quinquefasciatus* (65.1%). When 12 hr night catches were considered *Cx. quinquefasciatus* figured 41.1% and 77.0% in TA and NTA respectively. *Cx. quinquefasciatus* (65.1%) was collected most often followed by *Armigeres subalbatus* (16.5%).

Average per man-hour density was highest in November in TA and in September in NTA.

$$\text{ATP} = \frac{\text{No. Of days in a year} \times \text{No. of infective larvae}}{\text{No. Of days worked}} \times \frac{\text{No. of mosquitoes caught}}{\text{No. Of mosquitoes dissected}}$$

Table 1. Results of different parameters studied

	Tribal area			Non tribal area		
	Indoors	Outdoors	Total*/ Avr	Indoors	Outdoors	Total*/ Avr
1. No.of night-biting <i>Cx. quinquefasciatus</i> collected	988	1126	2114*	5561	6178	11739*
2. Per man-hour density of night biting <i>Cx. quinquefasciatus</i>	3.4	3.9	3.67	19.3	21.45	20.38
3. Per man per night density of <i>Cx. quinquefasciatus</i>	41.2	46.9	44.0	231.7	257.4	244.56
4. Per man per day density of <i>Cx. quinquefasciatus</i>	3.46	5.25	4.30	13.7	12.8	13.2
5. No.of <i>Cx. quinquefasciatus</i> dissected	915	987	1902*	2941	3225	6166*
6. No.of infected vector	3.0	3.0	6.0*	15.0	30.0	45.0*
7. Vector infection rate (%)	0.33	0.30	0.31	0.51	0.93	0.73
8. Highest infection rate (%)	1.58 (J)	1.26 (A)	0.79(J)	1.76(Au)	2.78(Au)	2.27(Au)
9. No.of infective vector	0.0	0.0	0.0	6.0	8.0	14.0
10. Vector infectivity rate (%)	0.0	0.0	0.0	0.20	0.25	0.23
11.Highest infectivity rate (%) (in Au)	0.0	0.0	0.0	0.70	0.69	0.70
12. No.of.average annual infectivity bites.	0.0	0.0	0.0	92.34	123.12	215.46
13. Annual transmission potential.	0.0	0.0	0.0	293.5	432.0	359.71
14. Highest transmission potential (in aug)	0.0	0.0		85.56	125.2	105.4

Avr = Average ; A = April ; J = January ; Au = August.

**Table 2. Seasonal breaks up of different indices**

	Tribal area			Non-tribal area		
	Summer	Rainy	Winter	Summer	Rainy	Winter
Prevalence of <i>Cx. quinquefasciatus</i>	33.07	39.67	33.25	29.66	36.90	30.02
Vector infection rate (%)	0.25	0.41	0.38	0.15	1.51	0.26
Vector infectivity rate (%)	0.04	0.0	0.0	0.0	0.49	0.10
Annual transmission potential 14.67	14.67	0.0	0.0	0.0	288.06	56.98

The 14 parameters measured during this study are presented in Table 1. Seasonal distribution of the parameters in the tribal and non-tribal areas are presented in Table 2.

The most mosquitoes were collected (16.3% in TA and 13.4% in NTA) between 0100 and 0200 hr. In the TA 11.63%, 31.64%, 42.05% and 14.66% mosquitoes were collected in the 1<sup>st</sup> (1800 hrs–2100 hrs), 2<sup>nd</sup> (2100 hrs–00 hrs), 3<sup>rd</sup> (00 hrs–0030 hrs) and 4<sup>th</sup> (0030 hrs–0060 hrs) quadrants of night respectively (collectively from indoors and outdoors) and the corresponding figures were 12.92%, 30.49%, 38.14% and 18.43% respectively in NTA.

Out of 2323 *Cx. quinquefasciatus* from man (indoors + outdoors) in the TA 5.2%, 13.9%, 25.6% and 55.3% came to bite on the head, body, upper extremity and lower extremity of the human body respectively. In the NTA, out of 12374 mosquitoes, the corresponding figures were 6.0%, 15.0%, 20.0% and 59.1% respectively. In each location of each study area, nearly or more than 55% mosquitoes landed on the lower extremity of the body.

In the TA, among the infected vector population an average of 50.0%, 33.3% and 16.7% mosquitoes were positive for microfilariae, 1<sup>st</sup> and 2<sup>nd</sup> stage larvae respectively. Altogether 41 larvae of *W. ban-*

*crofti* including microfilariae were found in the infected mosquitoes of which 27 (65.8%), 11 (26.8%) and 3 (7.31%) were microfilariae, 1<sup>st</sup> stage and 2<sup>nd</sup> stage larvae respectively. Average load of Mf, 1<sup>st</sup> stage and 2<sup>nd</sup> stage larvae per infected mosquito was 9.0, 5.5 and 3.0 respectively. In the NTA, among the infected population, 33.3%, 25.0%, 12.5% and 29.16% mosquitoes contained Mf, 1<sup>st</sup> stage, 2<sup>nd</sup> stage and 3<sup>rd</sup> stage larvae respectively. Altogether 356 larvae including Mf were detected, of which 232 (65.17%), 75 (21.1%), 26 (7.3%) and 23 (6.46%) were Mf, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> stage larvae respectively. Average load of Mf, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> stage larvae per infected mosquito was 14.5, 6.25, 4.3 and 1.64 respectively.

## DISCUSSION

A year man-landing study revealed that more mosquitoes came to bite a man in the NTA than those in the TA. Twenty four hour catches indicated that *Cx. quinquefasciatus* was the most commonly collected species in the NTA. Among vector mosquitoes collected, 91.0% were collected at night and 9.0% were collected during the day in the TA. In the NTA 94.9% were collected at night and 5.1% were collected during the day. In the TA, paddy fields and small clean water pools

were found to have larvae *Cx. vishnui* group and *An. vagus* mosquitoes (comprising more than 50% of total mosquito population). In the NTA *Cx. quinquefasciatus* predominated due to extensive foul water breeding facilities. Lower percentage of *Cx. quinquefasciatus* population might be one of the vital causes for the lower endemicity, in the TA than the non-tribal one indicating a role of species composition of mosquitoes on the dynamics of filarial transmission as also reported by Chandra<sup>(11,15)</sup>.

The density of *Cx. quinquefasciatus* in TA was much lower than the non-tribal one, presumably due to less vector breeding facilities. Yearlong study showed that 46.1% and 53.9% of *Cx. quinquefasciatus* landed indoors and outdoors respectively in TA and 47.6% and 52.4% respectively in NTA. In both the areas, biting density of the filarial vector was higher outdoors than indoors indicating the exophagic nature of this species. This exophagic tendency was more pronounced in tribal microenvironment due to its bushy, forest-based nature. In both the areas, the biting propensity of the filarial vector was higher ( $P < 0.05$ ) in rainy season. The biting density in both the study areas was the highest between 1 a.m to 2 a.m. combining indoors and outdoors. Regarding filarial transmission, the 3<sup>rd</sup> quadrant of night was the most important as the highest biting activity was observed in this quadrant in both the areas like the findings of other workers at different places of the world<sup>(16,17,18)</sup>. The biting intensity of filarial vectors both indoors and outdoors and in both tribal and non-tribal microenvironmental conditions was higher ( $P < 0.05$ ) on the lower extremity than the other parts of human body as also reported by others<sup>(13,19,20)</sup>. Lower extremity was the preferred biting site of filarial vectors probably due to less disturbances.

Average vector infection rate was more or less equal indoors and outdoors in TA, but in NTA infection rate was higher outdoors than indoors. Infection rate was significantly lower ( $P < 0.05$ ) in TA than that in NTA. In TA, no significant seasonal difference in infection rate was noted. In NTA, both infection and infectivity rates were significantly higher ( $P < 0.05$ ) in rainy season than those in other season. The potentiality of filarial transmission in non-tribal microenvironment was considered to be more favourable than tribal one which was evidenced by the higher rate of vector infectivity in NTA (0.22%) than that in TA (0.0%). In TA, the vector population infected with *Mf* probably could not survive so long as to become infective.

As the filarial vector *Cx. quinquefasciatus* is a night biting species transmission of the disease occurred during the night. The peak period of filarial transmission was assessed on the basis of exposure of human being to infective mosquitoes as well as the infective larvae of *W. bancrofti* following the method of Chandra (1995). In the TA for not having any infective mosquito, the filarial transmission cycle was supposed to be incomplete. In the NTA, human population was exposed to the highest number of bites of infective mosquitoes and thereby the infective stage larvae in the 3<sup>rd</sup> of night this time indicating as the peak period of filarial transmission in a 24-hour period as also reported from some other places<sup>(7)</sup>.

Average biting rate of *C. quinquefasciatus* per man per night in NTA was significantly higher ( $P < 0.05$ ) than that in TA. During night the vector species was found to be exophagous in both the areas, but in daytime, though the biting activity was low, the vector species were preferably endophagous to avoid sunlight and various other daytime disturbances. Avera-

ge daily biting rate and annual biting rates were many times higher ( $P < 0.05$ ) in NTA than those in TA which indicated that mosquitogenic sites had been increasing to a larger extent in NTA probably due to improper sanitation and indiscriminate urbanization resulting into greater man vector contact.

In the TA the transmission potential was 0 as the infectivity rate was 0. It is known that mosquitoes of higher physiological age (triparous and above) are more important in terms of filarial transmission<sup>(21)</sup>. The probable causes of 0 infectivity rate of vector population in the TA, might be the unavailability of aged mosquito in nature, less density of vector and less microfilaria rate among tribal people<sup>(11)</sup>. In the present non-tribal study area average ATP was higher than those in Calcutta and Memari of West Bengal<sup>(6)</sup> but lower than some parts of Howrah<sup>(3)</sup>. As *Cx. quinquefasciatus* was slightly exophagous and annual infective biting rate was higher outdoors than indoors, ATP was also significantly higher outdoors. Transmission potential was significantly higher ( $P < 0.05$ ) in rainy season than other seasons. Significantly higher transmission potential indicated higher probability of filarial transmission in NTA than that in TA. Tribal population who were infected with *Wuchereria*<sup>(10)</sup> probably had their infections from NTA, as and when they came in stayed for considerable period of the year NTA for employment as labourer. Detailed information revealed from the present study may help to formulate an effective measure to control filariasis in the Bankura district, West Bengal India.

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