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# Comparative Studies of Different Indices Related to Filarial Vector of a Rural and an Urban Area of West Bengal, India

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## Abstract

**Background:** Despite of all types of efforts, mosquito born disease like lymphatic filariasis seems to cause new disease burden in many countries. Proper information about the vector of these diseases is necessary to stop the transmission, but sometime information on vector is scanty from many areas. Present study is designed to collect comparative information about the filarial vector from rural and urban areas of West Bengal in India.

**Methods:** Regular collection of indoor-resting mosquitoes was done from the human habitations of Kolkata (urban area) and Tenya of Murshidabad district (rural area) for 2 years. Collected mosquitoes were identified and examined for different parameters following standard methods recommended by World Health Organization and pioneer workers of the field.

**Results:** In both the areas *Wuchereria bancrofti* was identified as the causative parasite of filariasis and *Culex quinquefasciatus* as the vector. In the urban area, overall man hour density, infection rate, infectivity rate and daily mortality rate of the vector was assessed as 27.56, 3.49%, 0.34% and 13% respectively, which was 11.86, 1.41%, 0.14% and 15% respectively in rural area. Average load of microfilaria, 1$^{st}$ stage, 2$^{nd}$ stage and 3$^{rd}$ stage parasite larvae in infected vectors were 8.10, 7.37, 5.38 and 2.75 respectively in urban area, which was 6.45, 5.40, 4.67 and 2.33 respectively in rural area. Among the searched shelters in urban area 4.27%, 8.85% and 1.46% were found to be invaded by 10 or more vector, infected vector and infective vector respectively, which were 1.56%, 2.08% and 0.31% respectively in rural area.

**Conclusion:** Different indices related to the vector mosquito were much higher in urban area of Kolkata than rural area of Tenya in Murshidabad, which indicates that, situation is more favourable in urban study areas for transmission of lymphatic filariasis than the rural one, though the situation in the rural area cannot be neglected. Available data will help to formulate an effective management strategy in those areas.

**Keywords:** Lymphatic filariasis; Vector; Indices; *Culex quinquefasciatus*; Rural; Urban

## Introduction

Lymphatic Filariasis (LF) is one of the leading causes of disability worldwide. More than 1307 million people live in filariasis endemic territories including 553.7 million in India and are at risk of acquiring filarial infection [1]. 20 states and union territories of India are endemic for LF with estimated 28 million microfilaria carriers and 21 million clinical cases [2].

Vector control programme in India is generally carried out by local bodies like municipalities or *panchayats*-linked with sanitation and solid waste disposal. Due to various reasons most of them unable to undertake effective vector control, which increased the vector and vector born disease problems like LF in the country largely. One of such reasons is incomplete information about vectors from many areas [3,4].

Information about filarial vector was available from different parts of West Bengal in India [5-10]. Nevertheless, information on vector related indices from many areas is scanty. Therefore, the present study has been carried out to collect information on different aspects related to the vector such as species composition of mosquitoes, Man-Hour Density (MHD) of the vector, percent of shelters with infected and infective vector, vector infection and infectivity rates, number of vectors containing different stages of parasites as well as total count of the parasites, age composition of the vector etc. from an urban and a rural area of West Bengal, India, with a comparative view.

## Materials and Methods

For the present study, 8 localities in Kolkata (Dum Dum, Park Circus, Topsia, Jadavpur, Kathgola, Ballyganj, South Sealdah and Nawpara) were selected as urban study area and another 8 localities in Tenya *gram-panchayet* of Murshidabad district (Baidyapur, Powa, Ghosh para, Subhendupur, Pallyshree, Sahapur, Kulu pukur and Gouri nagar) as rural study area. The urban study area is located at the bank of Hooghly river in the Ganges delta, at around 22.62°N and 88.42°E, monotonously plain, with elevation above sea level being about 17 feet. The rural study area is located at the bank of Bhagirathi (upper part of Hooghly) river, at around 23.84°N and 88.18°E, almost plain, with elevation above sea level being about 62 feet.

Indoor-resting mosquitoes were captured for 12 minutes from 5 human habitations fixed in each locality of each area, once in a month.

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Collection was done by one insect collector using hand collection method [11], between 0600 to 0800 hours during the year 2009-2011 (two years). So in 2 years, a total of 384 man-hours were employed (192 urban and 192 rural). The collected mosquitoes from each habitation were identified following Christophers [12] and Barraud [13], dissected to search for different developing stages of filarial larvae including microfilariae, and identified following Simonsen [14]. After staining with Leishman's stain, number of parasites detected in each infected mosquito was counted and noted separately for each human habitation.

For determination of age, ovaries were extracted by dissection of mosquitoes and then the ovarioles were isolated. After staining with Leishman's stain, the slides with ovarioles were examined under microscope for number of follicular dilatations, if any. The highest number of dilatations was noted for each mosquito. Average duration of gonotropic cycle was estimated *in vitro* by noting the time taken between artificial blood feeding and egg laying of mosquitoes [15]. Indices related to age grading were calculated following the methods of pioneer workers of the field [16-19]. One hundred vector mosquitoes per month were dissected for this study (i.e. 1200 each from rural and urban areas). Follicular dilatations, if any were also noted separately for each infected mosquito.

Available data were subjected to statistical analyses using standard normal deviate 'Z' and student's 't' test [20].

## Results

During the study, altogether 6418 and 4577 mosquitoes of 9 species each were collected from the urban study area of Kolkata and rural study area of Tenya respectively. In the urban study area, collected mosquito species were *Culex quinquefasciatus* (82.41%), *Culex vishnui* (group) (2.21%), *Anopheles annularis* (0.53%), *Anopheles barbirostris* (0.47%), *Anopheles subpictus* (3.24%), *Anopheles vagus* (2.66%), *Anopheles stephensi* (1.26%), *Aedes aegypti* (1.12%) and *Armigeres subalbatus* (6.06%); whereas in the rural study area, collected mosquito species were *Cx. quinquefasciatus* (49.77%), *Cx. vishnui* (group) (8.89%), *An. annularis* (3.17%), *An. barbirostris* (5.68%), *An. subpictus* (14.97%), *An. vagus* (10.66%), *Aedes albopictus* (0.74%) and *Ar. subalbatus* (3.91%) and *Mansonia annulifera* (2.21%) (Table 1). Of these *Cx. quinquefasciatus* was incriminated as the filarial vector in both the area and parasites obtained were different stages of *Wuchereria bancrofti*. None of the other collected species of the mosquito was found to develop any larval stages of *W. bancrofti*.

In urban area, overall MHD of *Cx. quinquefasciatus* was 27.56 which ranges from 22.88 (April) to 35.38 (August) in different months and in rural area, it ranges from 6.50 (May) to 14.88 (October) with overall value of 11.86 (Tables 2 and 3). Season wise calculation shows that, MHD was higher in Rainy season in both the area, but values were higher in urban area than in rural area in all the 3 seasons (Figure 1).

10 or more vector mosquitoes were encountered in 4.27% of the searched shelters in urban study area (ranges from 0.0% to 7.50% in different months) whereas only in 1.56% of searched shelters in rural study area (ranges from 0.0% to 3.75% in different months). In the urban area, overall 8.85% (ranges 5.0% to 13.75% in different months)

| Species | | Kolkata | | Tenya | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| 1. | *Culex quinquefasciatus* | 5291 | 82.44 | 2278 | 49.77 |
| 2. | *Culex vishnui (group)* | 142 | 2.21 | 407 | 8.89 |
| 3. | *Anopheles annularis* | 34 | 0.53 | 145 | 3.17 |
| 4. | *Anopheles barbirostris* | 30 | 0.47 | 260 | 5.68 |
| 5. | *Anopheles subpictus* | 208 | 3.24 | 685 | 14.97 |
| 6. | *Anopheles vagus* | 171 | 2.66 | 488 | 10.66 |
| 7. | *Anopheles stephensi* | 81 | 1.26 | 0 | 0.00 |
| 8. | *Aedes aegypti* | 72 | 1.12 | 0 | 0.00 |
| 9. | *Aedes albopictus* | 0 | 0.00 | 34 | 0.74 |
| 10. | *Armigeres subalbatus* | 389 | 6.06 | 179 | 3.91 |
| 11. | *Mansonia annulifera* | 0 | 0.00 | 101 | 2.21 |
| Total | | 6418 | 100.00 | 4577 | 100.00 |

**Table 1:** Species composition and percent of collected indoor-resting mosquitoes in urban area of Kolkata and rural area of Tenya (West Bengal, India).

| Month | Number collected | Percent collected | Per Man Hour Density | Percent of shelter with 10 or more Vector mosquito | Percent of shelter with infected Vectors | Percent of shelter with infective Vectors | Vector Infection rate (%) | Vector Infectivity rate (%) |
|---|---|---|---|---|---|---|---|---|
| January | 409 | 7.73 | 25.56 | 3.75 | 10.00 | 0.00 | 3.50 | 0.00 |
| February | 454 | 8.58 | 28.38 | 5.00 | 6.25 | 1.25 | 2.84 | 0.26 |
| March | 405 | 7.65 | 25.31 | 6.25 | 7.50 | 1.25 | 3.95 | 0.30 |
| April | 366 | 6.92 | 22.88 | 2.50 | 8.75 | 1.25 | 3.61 | 0.33 |
| May | 374 | 7.07 | 23.38 | 0.00 | 5.00 | 0.00 | 2.69 | 0.00 |
| June | 398 | 7.52 | 24.88 | 3.75 | 13.75 | 2.50 | 4.75 | 0.56 |
| July | 500 | 9.45 | 31.25 | 7.50 | 11.25 | 2.50 | 3.56 | 0.45 |
| August | 566 | 10.70 | 35.38 | 5.00 | 8.75 | 2.50 | 3.65 | 0.58 |
| September | 413 | 7.80 | 25.81 | 5.00 | 8.75 | 2.50 | 3.20 | 0.80 |
| October | 491 | 9.28 | 30.69 | 3.75 | 11.25 | 1.25 | 5.00 | 0.23 |
| November | 507 | 9.58 | 31.69 | 3.75 | 7.50 | 1.25 | 2.60 | 0.22 |
| December | 409 | 7.73 | 25.56 | 5.00 | 7.50 | 1.25 | 2.42 | 0.27 |
| Total*/Overall | 5292* | 100* | 27.56 | 4.27 | 8.85 | 1.46 | 3.49 | 0.34 |

**Table 2:** Month wise variation of different indices of filarial vector (*Cx. quinquefasciatus*) population collected from human habitations of urban area.

| Month | Number collected | Percent collected | Per Man Hour Density | Percent of shelter with 10 or more Vector mosquito | Percent of shelter with infected Vectors | Percent of shelter with infective Vectors | Vector Infection rate (%) | Vector Infectivity rate (%) |
|---|---|---|---|---|---|---|---|---|
| January | 174 | 7.64 | 10.88 | 2.50 | 1.25 | 0.00 | 1.20 | 0.00 |
| February | 227 | 9.96 | 14.19 | 2.50 | 1.25 | 0.00 | 0.90 | 0.00 |
| March | 219 | 9.61 | 13.69 | 2.50 | 2.50 | 0.00 | 1.43 | 0.00 |
| April | 140 | 6.15 | 8.75 | 0.00 | 2.50 | 0.00 | 1.44 | 0.00 |
| May | 104 | 4.57 | 6.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| June | 175 | 7.68 | 10.94 | 1.25 | 3.75 | 1.25 | 2.96 | 0.59 |
| July | 236 | 10.36 | 14.75 | 2.50 | 2.50 | 0.00 | 1.33 | 0.00 |
| August | 217 | 9.53 | 13.56 | 3.75 | 3.75 | 1.25 | 2.39 | 0.48 |
| September | 188 | 8.25 | 11.75 | 2.50 | 2.50 | 1.25 | 1.62 | 0.54 |
| October | 238 | 10.45 | 14.88 | 0.00 | 2.50 | 0.00 | 1.72 | 0.00 |
| November | 203 | 8.91 | 12.69 | 1.25 | 1.25 | 0.00 | 0.52 | 0.00 |
| December | 157 | 6.89 | 9.81 | 0.00 | 1.25 | 0.00 | 0.66 | 0.00 |
| Total*/Overall | 2278* | 100* | 11.86 | 1.56 | 2.08 | 0.31 | 1.41 | 0.14 |

**Table 3:** Month wise variation of different indices of filarial vector (*Cx. quinquefasciatus*) population collected from human habitations of rural area.

| Months | Number of mosquitoes containing different stages of larvae | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | mf/TC | | 1st/TC | | 2nd/TC | | 3rd/TC | | Any/TC | |
| January | 8 | 64 | 3 | 20 | 2 | 12 | 0 | 0 | 13 | 96 |
| February | 5 | 58 | 4 | 29 | 1 | 2 | 1 | 2 | 11 | 91 |
| March | 8 | 75 | 2 | 15 | 1 | 2 | 1 | 3 | 12 | 95 |
| April | 5 | 52 | 1 | 7 | 2 | 5 | 1 | 2 | 9 | 66 |
| May | 6 | 49 | 3 | 14 | 0 | 0 | 0 | 0 | 9 | 63 |
| June | 10 | 82 | 3 | 32 | 1 | 10 | 3 | 7 | 17 | 131 |
| July | 11 | 96 | 5 | 38 | 1 | 5 | 2 | 5 | 19 | 144 |
| August | 11 | 84 | 4 | 25 | 2 | 9 | 2 | 6 | 19 | 124 |
| September | 5 | 58 | 3 | 33 | 1 | 3 | 3 | 10 | 12 | 104 |
| October | 16 | 117 | 3 | 16 | 2 | 13 | 1 | 4 | 22 | 150 |
| November | 7 | 31 | 2 | 14 | 2 | 17 | 1 | 3 | 12 | 65 |
| December | 5 | 20 | 2 | 15 | 1 | 8 | 1 | 2 | 9 | 45 |
| Total | 97 | 786 | 35 | 258 | 16 | 86 | 16 | 44 | 164 | 1174 |
| Average load of parasite per mosquito | 8.10 | | 7.37 | | 5.38 | | 2.75 | | 7.16 | |

**Table 4:** Month wise number of *Cx. quinquefasciatus* containing different stages of *W. bancrofti* and the total count (TC) of each stage in urban area.

| Months | Number of mosquitoes containing different stages of larvae | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | mf/TC | | 1st/TC | | 2nd/TC | | 3rd/TC | | Any/TC | |
| January | 2 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 |
| February | 0 | 0 | 1 | 3 | 1 | 5 | 0 | 0 | 2 | 8 |
| March | 3 | 20 | 1 | 5 | 0 | 0 | 0 | 0 | 4 | 25 |
| April | 2 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 11 |
| May | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| June | 3 | 25 | 0 | 0 | 1 | 6 | 1 | 2 | 5 | 33 |
| July | 1 | 9 | 1 | 7 | 0 | 0 | 0 | 0 | 2 | 16 |
| August | 2 | 9 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 12 |
| September | 2 | 7 | 1 | 6 | 0 | 0 | 1 | 2 | 4 | 15 |
| October | 3 | 28 | 1 | 6 | 1 | 3 | 0 | 0 | 5 | 37 |
| November | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| December | 2 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 13 |
| Total | 20 | 129 | 5 | 27 | 3 | 14 | 3 | 7 | 31 | 177 |
| Average load of parasite per mosquito | 6.45 | | 5.40 | | 4.67 | | 2.33 | | 5.71 | |

**Table 5:** Month wise number of *Cx. quinquefasciatus* containing different stages of *W. bancrofti* and the total count (TC) of each stage in rural area.

and 1.46% (ranges 0.0% to 2.50% in different months) of the searched shelters was invaded by infected and infective *Cx. quinquefasciatus,* respectively. In the rural area, overall 2.08% (ranges 0.0% to 3.75% in different months) and 0.31% (ranges 0.0% to 1.25% in different months) of the searched shelters was invaded by infected and infective *Cx. quinquefasciatus*, respectively (Tables 2 and 3).

| Parity | Kolkata | | | | Tenya | | | |
|---|---|---|---|---|---|---|---|---|
| | Number of mosquitos positive for | | | | Number of mosquitos positive for | | | |
| | Microfilaria | 1st Stage | 2nd Stage | 3rd Stage | Microfilaria | 1st Stage | 2nd Stage | 3rd Stage |
| NP | 75 | 9 | 0 | 0 | 13 | 3 | 0 | 0 |
| $P_1$ | 11 | 19 | 7 | 0 | 3 | 0 | 0 | 0 |
| $P_2$ | 6 | 4 | 6 | 0 | 2 | 1 | 2 | 0 |
| $P_3$ | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 |
| $P_4$ | 1 | 0 | 1 | 9 | 1 | 0 | 0 | 1 |
| $P_5$ | 1 | 0 | 0 | 4 | 0 | 0 | 0 | 1 |
| Total | 97 | 35 | 16 | 16 | 20 | 5 | 3 | 3 |

NP=nulliparous, $P_1$=uniparous, $P_2$=biparous, $P_3$=triparous, $P_4$=quadriparous, $P_5$=pentaparous

**Table 6:** *Cx. quinquefasciatus* containing different stages of *W. bancrofti* and their parity status.

Overall vector infection and infectivity rates among the mosquitoes collected from the human habitations of the urban study area were 3.49% and 0.34%, respectively, with highest numbers of infected and infective vectors encountered in October (5.00%) and September (0.80%) respectively. In rural area, overall vector infection and infectivity rates were 1.41% and 0.14%, respectively, with highest numbers of infected and infective vectors encountered in June (2.96% and 0.59% respectively) (Tables 2 and 3). Season wise calculation shows that, vector infection and infectivity rates were higher in Rainy season in both the areas, but values were much higher in urban area than in rural area in all the 3 seasons (Figure 1).

In both the area, number of mosquitoes containing different developmental stages of *W. bancrofti*, total count of each stage larvae and average load of parasite in infected vectors shows a decrease from microfilaria (mf) to 1st stage to 2nd stage and 3rd stage. But the corresponding figures were much higher in urban area than in rural area (Tables 4 and 5).

Study on parity status of infected vectors reveals that, in urban area, 97 mosquitoes containing mf (75, 11, 6, 3, 1 and 1 were nulliparous, uniparous, biparous, triparous, quadriparous and pentaparous respectively), 35 containing 1st stage larvae (9, 19, 4 and 3 were nulliparous, uniparous, biparous and triparous respectively), 16 containing 2nd stage larvae (7, 6, 2 and 1 were uniparous, biparous, triparous and quadriparous respectively) and 16 mosquitoes positive for

| Months | Number of mosquitoes studied | Mosquitoes of different parous | | | | | | | | Proportion parous | Daily survival rate | Daily mortality rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NP | $P_1$ | $P_2$ | $P_3$ | $P_4$ | $P_5$ | $P_6$ | $P_7$ | | | |
| January | 100 | 41 | 22 | 15 | 13 | 5 | 2 | 2 | 0 | 0.59 | 0.92 | 8 |
| February | 100 | 35 | 18 | 23 | 11 | 8 | 3 | 1 | 1 | 0.65 | 0.93 | 7 |
| March | 100 | 46 | 14 | 16 | 16 | 5 | 3 | 0 | 0 | 0.54 | 0.86 | 14 |
| April | 100 | 51 | 16 | 14 | 12 | 7 | 0 | 0 | 0 | 0.49 | 0.84 | 16 |
| May | 100 | 63 | 14 | 12 | 8 | 3 | 0 | 0 | 0 | 0.37 | 0.78 | 22 |
| June | 100 | 60 | 22 | 10 | 6 | 1 | 1 | 0 | 0 | 0.4 | 0.79 | 21 |
| July | 100 | 44 | 21 | 18 | 10 | 4 | 3 | 0 | 0 | 0.56 | 0.87 | 13 |
| August | 100 | 48 | 20 | 12 | 13 | 5 | 2 | 0 | 0 | 0.52 | 0,85 | 15 |
| September | 100 | 43 | 17 | 12 | 16 | 9 | 2 | 0 | 1 | 0.57 | 0.87 | 13 |
| October | 100 | 45 | 16 | 9 | 14 | 8 | 6 | 2 | 0 | 0.55 | 0.86 | 14 |
| November | 100 | 48 | 20 | 16 | 7 | 6 | 2 | 0 | 1 | 0.52 | 0.9 | 10 |
| December | 100 | 47 | 19 | 20 | 8 | 1 | 4 | 1 | 0 | 0.53 | 0.9 | 10 |
| Total/Overall* | 1200 | 571 | 219 | 177 | 134 | 62 | 28 | 6 | 3 | 0.52* | 0.87* | 13* |
| % | 100 | 47.58 | 18.25 | 14.75 | 11.17 | 5.17 | 2.33 | 0.50 | 0.25 | | | |
| Presumptive mortality rate | | 61.64 | 9.18 | 24.29 | 52.23 | 54.84 | 78.57 | 50.0 | | | | |

NP=nulliparous, $P_1$=uniparous, $P_2$=biparous, $P_3$=triparous, $P_4$=quadriparous, $P_5$=pentaparous, $P_6$=hexaparous, $P_7$=heptaparous

**Table 7:** Proportion parous, daily survival rate, mortality rate and presumptive mortality of natural population of vectors in urban area.

| Months | Number of mosquitoes studied | Mosquitoes of different parous | | | | | | | Proportion parous | Daily survival rate | Daily mortality rate |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NP | $P_1$ | $P_2$ | $P_3$ | $P_4$ | $P_5$ | $P_6$ | | | |
| January | 100 | 36 | 20 | 16 | 21 | 5 | 2 | 0 | 0.64 | 0.93 | 7 |
| February | 100 | 47 | 16 | 12 | 15 | 8 | 1 | 1 | 0.53 | 0.9 | 10 |
| March | 100 | 53 | 15 | 13 | 10 | 7 | 2 | 1 | 0.47 | 0.83 | 17 |
| April | 100 | 57 | 13 | 10 | 12 | 6 | 1 | 1 | 0.43 | 0.81 | 19 |
| May | 100 | 72 | 10 | 9 | 6 | 2 | 1 | 0 | 0.28 | 0.73 | 27 |
| June | 100 | 66 | 21 | 6 | 7 | 0 | 0 | 0 | 0.34 | 0.76 | 14 |
| July | 100 | 52 | 18 | 16 | 8 | 4 | 2 | 0 | 0.48 | 0.83 | 17 |
| August | 100 | 48 | 17 | 20 | 11 | 3 | 1 | 0 | 0.52 | 0.85 | 15 |
| September | 100 | 48 | 21 | 8 | 14 | 7 | 1 | 1 | 0.52 | 0.85 | 15 |
| October | 100 | 51 | 13 | 11 | 18 | 5 | 1 | 1 | 0.49 | 0.84 | 16 |
| November | 100 | 48 | 18 | 21 | 7 | 4 | 2 | 0 | 0.52 | 0.9 | 10 |
| December | 100 | 44 | 16 | 19 | 13 | 6 | 2 | 0 | 0.56 | 0.91 | 9 |
| Total/Overall * | 1200 | 622 | 198 | 161 | 142 | 57 | 16 | 5 | 0.48* | 0.85* | 15* |
| % | 100 | 51.83 | 16.50 | 13.42 | 11.83 | 4.75 | 1.33 | 0.42 | | | |
| Presumptive mortality rate | | 68.11 | 18.68 | 11.80 | 59.86 | 71.92 | 68.75 | | | | |

NP=nulliparous, $P_1$=uniparous, $P_2$=biparous, $P_3$=triparous, $P_4$=quadriparous, $P_5$=pentaparous, $P_6$=hexaparous

**Table 8:** Proportion parous, daily survival rate, mortality rate and presumptive mortality of natural population of vectors in urban area.

3rd stage larvae (3, 9 and 4 were triparous, quadriparous and pentaparous respectively). Whereas in rural area, 20 mosquitoes positive for mf (13, 3, 2, 1 and 1 mosquitoes were nulliparous, uniparous, biparous, triparous and quadriparous respectively), 5 mosquitoes infected with 1st stage larvae (3, 1 and 1 were nulliparous, biparous and triparous respectively), 3 mosquitoes positive for 2nd stage larvae (2 and 1 were biparous and triparous respectively) and 3 mosquitoes were found to be infected with 3rd stage larvae (1 each triparous, quadriparous and pentaparous) (Table 6).

Study on age composition of natural population of vector *Cx. quinquefasciatus* reveals that, in urban area, 47.58%, 18.25%, 14.75%, 11.17%, 5.17%, 2.33%, 0.50% and 0.25% mosquitoes were nulliparous, uniparous, biparous, triparous, quadriparous, pentaparous, hexaparous and heptaparous respectively; which were 51.75%, 16.50%, 13.42%, 11.83%, 4.75%, 1.33%, 0.42% and 0.0% respectively in rural area. Overall proportion parous (PP), daily survival rate (DSR) and daily mortality rate (DMR) of the natural population of vectors in the urban area was calculated as 0.52, 0.87 and 13 respectively and in rural area 0.48, 0.85 and 15 respectively (Tables 7 and 8). Season wise calculation shows that, DMR was higher in summer season in both the areas (Figure 1).

Presumptive mortality of *Cx. quinquefasciatus* was 61.64% between nulliparous and uniparous, 19.18% between uniparous and biparous, 24.29% between biparous and triparous, 52.23% between triparous and quadriparous, 54.84% between quadriparous and pentaparous, 78.57% between pentaparous and hexaparous, 50.0% between hexaparous and heptaparous in urban area; which was 68.11% between nulliparous and uniparous, 18.68% between uniparous and biparous, 11.80% between biparous and triparous, 59.86% between triparous and quadriparous 71.92% between quadriparous and pentaparous 68.75% between pentaparous and hexaparous in rural area vectors (Tables 7 and 8).

## Discussion

The urban study area of Kolkata has much dense human population and closely situated habitations in comparison to the rural study area of Tenya of Murshidabad, which increased the possibility of man-vector contact in urban area. First-hand information on different aspects

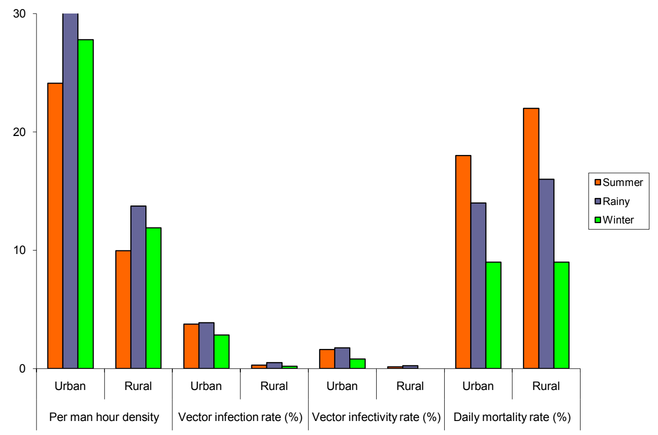


**Figure 1:** Comparison of seasonal variation of different indices of filarial vector population of urban and rural area.

related to the filarial vector was gathered during the present study from urban area of Kolkata and rural area of Tenya of Murshidabad district, West Bengal, India.

*Cx. quinquefasciatus* was the dominant species among house frequenting mosquitoes in both urban and rural areas. MHD of vectors from both the study areas was lower than some other endemic areas of West Bengal but higher than some other area also [5,6,8-10]. Comparison shows that, MHD was much higher in urban area than in rural area in all the months, seasons and overall ($p<0.05$). In both the areas MHD was higher in rainy season than those in other seasons ($p>0.05$).

Shelters with high density of vector mosquitoes and shelters with higher numbers of infected and infective vectors are of more epidemiological importance [21]. Present study shows that, percent of shelters with high density (10 or more) vectors, with infected and infective vectors were higher in urban area than in rural area ($p<0.05$), which increases the possibility of chance of parasitic transmission in urban area.

Vector infection and infectivity rates in both the area were lower than some other areas [9,10] but higher than some other endemic areas [8]. Seasonal data reveal that, in both the areas infection and infectivity rates were higher in rainy season closely followed by summer season ($p>0.05$). This tendency was also found in some other area [9] but unlike of some other area also, where higher rates were found in summer [10]. Vector infection and infectivity rates were significantly higher in urban area than in rural area under present study ($p<0.05$).

A strong fall in the average load of microfilaria to average load of infective stages in those vectors shows a natural bearing in control of filarial transmission in both urban and rural area, which was also reported in some other studies [9,10,22]. However, average load of parasites per vectors was higher in urban area than in rural area ($p>0.05$).

Analysis of the parity status of the infected *Cx. quinquefasciatus* mosquitoes in both the study areas revealed that a high proportion of the mosquitoes acquired infection during their first blood meal and most infective mosquitoes are triparous, quadriparous and pentaparous. So mosquitoes of higher parous were of more epidemiological importance [23]. Presumptive mortality between two successive age groups shows that after passing the initial age, the vectors tend to survive the age which generally harbours the infective parasites in both the study area. So the probability of filarial transmission was almost similar in urban and rural area in respect of this index. Moreover, rate of overall daily mortality of vectors and also in summer and rainy season were lower in urban area than in rural area ($p>0.05$).

From the present study it can be concluded that, in both the study areas of Kolkata (urban) and Tenya (rural) possibility of filarial transmission is higher in monsoon months followed by warm months. Study related to different indices shows that urban areas were more susceptible for transmission of filarial parasite. But vector related indices from rural study area indicate that a favourable situation for transmission of filarial parasite exists also in that area and there is a possibility to create a grave situation in near future, as some rural areas of West Bengal are already considerably become endemic [6,24-26]. So, appropriate preventive measures including vector control, developing awareness among the peoples about the disease and concerned vector should be taken immediately to stop the situation to become worse.

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