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ORIGINAL ARTICLE

Aedes Larval Indices and Housing Conditions in Urban Area of Ballari – A Descriptive Cross-sectional Study

Anju Mariam Jacob, K. Ramesh, Pratibharani Reddy, T. Gangadhara Goud

ABSTRACT

Background: Mosquito-borne diseases are a major public health problem. The larval indices are an important practical predictor of outbreak of vector-borne diseases. The poor quality housing and neglected peri-domestic environments are risk factors for transmission of vector-borne diseases. The artificial collection of water serves as breeding places for mosquitos. According to the WHO, 80% of the world's population is at risk of vector-borne diseases. Vector-borne disease accounts for more than 17% of all the infectious diseases, causing more than 700,000 deaths annually. **Objectives:** The objectives of the study were to find the *Aedes* larval indices in urban field practice area of VIMS, Ballari, and to study the housing conditions in relation to the mosquito breeding places in urban field practice area of VIMS, Ballari. **Methodology:** A descriptive cross-sectional study was carried out in Millerpet UPHC, Ballari, Karnataka, among houses located in the selected ward for a duration of 3 months. Simple random sampling technique was adopted to select the ward. Based on the estimated sample size, 298 houses were selected by random number method. Descriptive statistics were used to describe housing patterns, waste management, and entomological surveillance. **Results:** Out of 298 houses surveyed, a total of 2847 potential containers were inspected, and 781 of these were found positive for mosquito larvae. The house index, container index, and Breteau index were 77.85%, 27.43%, and 262.08%, respectively. About 83.9% of household were living in pucca houses and 58.1% of houses had open drains near their houses. **Conclusion:** *Aedes aegypti* is breeding in a wide range of artificial containers. To control these mosquitos, the integration of different methods should be taken into consideration and thereby to prevent outbreaks of mosquito-borne diseases.

Key words: *Aedes aegypti*, breeding sites, container index and Breteau index, house index, housing

INTRODUCTION

Housing is the basic requirement of human well-being.[1] The housing patterns differ according to the socioeconomic status. The increased influx or migration of the people from rural to urban areas along with inadequate facilities for living such as housing, poor payment scale, unemployment, lack of education, increased expenditure and increased expectation of standard of living, and lack of government support will manifest in many ways of which the most significant is the growth of urban settlements.[2]

The increase in urban population resulting in lack of available land and higher rates of rented houses forces them to live in kutcha and semi-kutcha houses.[2] A proper housing should provide adequate lighting and ventilation. The room or house should have cross-ventilation to prevent the stagnation of air resulting in the airborne infections. Adequate lighting is necessary for the preparation of food items and even to carry out day-to-day activities.

Proper waste disposal methods should be adopted and segregated waste must be collected on daily basis and should be disposed of in sanitary manner. The proper waste disposal methods are influenced by the educational status of the population.

Department of Community Medicine, VIMS, Ballari, Karnataka, India

Correspondence: Dr. K. Ramesh, Associate Professor, Department of Community Medicine, VIMS, Ballari, Karnataka, India. E-mail: ramspsm@gmail.com

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According to the WHO, 80% of the world's population is at risk of vector-borne diseases. Vector-borne disease accounts for more than 17% of all the infectious diseases, causing more than 700,000 deaths annually.[3] "Vector-Borne Diseases: Small Bite, Big Threat" was the World Health Day theme for the year 2014.[4] Vector-borne diseases have been on the rise in the last few years with epidemics reported in many countries.

Social, demographic, and environmental factors strongly influence transmission patterns of vector-borne pathogens, with major outbreaks of dengue, malaria, chikungunya, yellow fever, and Zika virus disease since 2014.[5] Any container, natural or artificial, which can hold water for about a week can support the breeding of mosquitoes.[6]

Aedes mosquito is the vector responsible for transmission of several deadly infections including dengue. Entomological surveillance has been standardized on different indices based on simple determination of the presence or absence of larvae in containers or in the premises of surveyed house. Thus, various larval indices can be calculated, namely, house index, container index, and Breteau index.[7]

At national level, National Vector Borne Disease Control Programme was implemented in India which includes disease management, integrated vector control, and supportive interventions. The program aims in reducing the mortality and morbidity associated with vector-borne diseases. Karnataka is one of the states with high prevalence of mosquito-borne diseases, namely, malaria, dengue, and chikungunya.[8] Limited studies explored the *Aedes* larval indices and housing conditions in relation to urban setting. This study aims to find out the above factors in relation to the urban population in Ballari district, Karnataka.

Objectives of the Study

The objectives of the study were as follows:

- To find the *Aedes* larval indices in urban field practice area of VIMS, Ballari
- To study the housing conditions in relation to the mosquito breeding places in urban field practice area of VIMS, Ballari.

MATERIALS AND METHODS

Study Design

This was a descriptive cross-sectional study.

Study Area

This study was carried out in Millerpet UPHC, Ballari, Karnataka.

Study Subject

Houses located in selected ward under Millerpet UPHC, Ballari.

Study Tool

A predesigned, pretested, and semi-structured questionnaire was used for this study. The questionnaire consisted of sociodemographic details, housing patterns, waste management, and entomological surveillance.

Study Duration

The study duration was 3 months from November 2019 to January 2020.

Sampling Technique

Simple random sampling technique.

1. Millerpet UPHC has a total population of 69,195. It was further subdivided into smaller administrative units called ward. There are eight wards
2. Simple random sampling technique was adopted to select the ward
3. Based on the estimated sample size, random number method was used to select the houses.

Sample Size

The formula for calculating the sample size was $n = 4pq/d^2$

Where, P is proportion, that is, 25.15

Q is (100-P), that is =74.85

d is allowable error, that is, 20% =5.03

n is sample size

So, $n = (2)^2 \times P \times Q/d^2$

$n = (2)^2 \times 25.15 \times 74.85/(5.03)^2$

$n = 298$

Hence, based on this, the sample size estimated was 298.

Inclusion Criteria

- All the houses in the selected ward were included in the study.

Exclusion Criteria

The following criteria were excluded from the study:

- Houses which were not willing to participate
- Houses which were locked at the time of the study.

Method of Collection of Data

A cross-sectional study was carried out in Millerpet UHTC, Ballari, Karnataka. The respective UHTC covers 69,195 population, which has eight wards. The study was carried out in the selected ward and the study duration was for a period of 3 months. Data were collected by house-to-house survey method in the study area. The head of the family was interviewed and necessary data were gathered. Locked houses were revisited once, and if it remained locked, such houses were not taken into consideration. The predesigned and pretested questionnaire consists of that mentioned in the study tool. Before interviewing, a written consent was to be obtained from the interviewee.

Statistical Analysis

The data were entered into Excel sheet and analyzed. The statistical test of proportions was used to find out the results.

Ethical Consideration

Written informed consent was taken from the selected households.

The study synopsis was submitted to the Institutional Ethical Committee for clearance.

RESULTS

The particulars of housing conditions and method waste disposal for the surveyed houses are given in Table 1. Out of the 298 houses surveyed, 83.9% were pucca houses followed by 13.4% of kutcha houses. About 33.2% and 25.2% of the surveyed houses had inadequate ventilation and inadequate lighting, respectively. Overcrowding was present among 23.2% of the total surveyed houses. About 82.9% of the surveyed houses had separate kitchen facilities. The majority of the houses had latrine and separate bathroom accounting for 94% and 84.9%. About 70.4% of the houses had open drains present near their houses. Vector breeding sites were present over 87.25% of the houses accounting for much increase in the transmission of vector-borne diseases in the respective area. More than half (55.7%) of the houses depends on the public source of water supply. Segregation of waste was practiced by only among 14.8% of the houses. About 60.7% and 52% of the houses disposed of the sewage and sullage through open drain. About 90.3% of the houses disposed of the garbage by means of municipality waste collection.

The distribution of artificial water containers and proportion of positive containers are shown in Table 2. The container positivity among different surveyed houses are found to be dissimilar. Some houses had much greater positivity rate than others. The main potential containers/breeding preferences were found to be discarded plastic containers (52.14%) followed by coconut shell (48.05%), discarded tires (35.85%), and water tanks (33.5%). The least container positivity was found to be in discarded or broken earthen pots (16.55%).

Table 3 shows the details of entomological surveillance. Out of 298 surveyed houses, 232 houses were found positive for

Table 1: Housing conditions and methods of waste disposal

Variables	Frequency	Percentage
Type of housing		
Kutcha	40	13.4
Pucca	250	83.9
Semi pucca	8	2.7
Inadequate ventilation	99	33.2
Inadequate lighting	75	25.2
Overcrowding present	69	23.2
Kitchen		
Separate	247	82.9
Attached	51	17.1
Latrine present	280	94.0
Separate bathroom present	253	84.9
Open drains present	210	70.4
Vector breeding sites present	260	87.25
Source of water supply		
Public	166	55.7
Private	128	43.0
Common	4	1.3
Segregation of waste done among	44	14.8
Disposal of sewage via open drain	181	60.7
Disposal of sullage through open drain	155	52.0
Garbage disposal		
Municipality	269	90.3
Open dumping	24	8.1
Kitchen garden	5	1.7

Table 2: Distribution of the artificial water containers and proportion of positive containers

Type of containers	No. of potential containers	Containers +ve for larvae	Percentage
Discarded plastic containers	257	134	52.14
Coconut shell	77	37	48.05
Tires	53	19	35.85
Water tank	406	136	33.5
Refrigerator (trays)	193	51	26.42
Broken buckets	942	226	23.99
Glass bottles	206	48	23.30
Water cooler	154	33	21.42
Ornamental ponds	118	24	20.34
Earthen pots	441	73	16.55
Total	2847	781	27.43

larva. A total of 2847 potential containers were examined out of which 781 containers had larval positivity.

Table 4 shows *Aedes* larval indices. Positive containers were present in 232 houses of 298 giving us the house index (HI) of 77.85%. Out of 2847 potential containers, 781 containers had larval positivity accounting of container index (CI) of 27.43%. The number of positive containers to the total number of houses surveyed gives the Breteau index (BI) of 262.08%.

DISCUSSION

The present study was conducted with the objective to find out the *Aedes* larval indices and the housing conditions in relation to the mosquito breeding places in urban field practice area of VIMS, Ballari.

Housing, water, and sanitation are some of the major social determinants for health. We have observed that in our study, 83.9% of the houses are pucca. Wherein kutcha and semi-pucca (13.4% and 2.7%) houses were about 16.1%. In a case–control study done by Swain *et al*., sociodemographic description of households of cases and controls was described, it was found that among case households, 34.6% had concrete roof while 65.3% had used other materials (asbestos, mixed, and thatched roof).[5] With the rampant urbanization and development, majority of people are now living in pucca houses. The socioeconomic aspects of the households were not studied in details in the present study, for which the study cannot link socioeconomic characteristics to the type of housing. In the comparative study, the outbreak is thought to have affected all houses irrespective of the structure. Another study done by Lippi *et al*. on social and spatial ecology of dengue presence and burdening during an outbreak in Guayaquil, Ecuador, 2012, shows that poor housing condition was the variable most strongly associated with dengue transmission.[9]

Table 3: Entomological surveillance

Variables	Frequency	Percentage
Total number of houses surveyed	298	100
Total number of potential containers	2847	100
Number of containers positive for larvae	781	27.43
Number of houses positive for larvae	232	77.85

Table 4: *Aedes* larval indices

Aedes larval indices	Percentage
HI	232/298 *100 = 77.85%
CI	781/2847 *100 = 27.43%
BI	781/298 *100 = 262.08%

HI: House index, CI: Container index, BI: Breteau index

In the present study, 70.4% of the houses had open drains near them and 87.25% of households had vector breeding sites around their houses. In Swain *et al*. study, case households (78.6%) had more swampy areas including gutter surrounding their home. Moreover, the results of the later study showed that 55.5% of case households had breeding sites and were found statistically significant.[5] Housing structure is proved to be linked with dengue outbreak. Studies reported that staying in sheds/old flats creates higher chances of dengue.[10] Especially, densely and nearly located houses increase the dengue spread chances because of the crowding and environmental conditions.[11]

Inadequate ventilation (33.2%) and inadequate lighting (25.2%) were present in our study households. The adult *Aedes* mosquitoes usually rest indoors on various objects, in closets, under beds, behind curtains, and other dark places. These types of households serve as a perfect hiding place for adult *Aedes* mosquitoes.[12]

In our study, 55.7% of the households depend on public water supply for their daily needs followed by 43% had private sources and 1.3% shared common water source. The municipal garbage uptake is the main mode for garbage disposal accounting for 90.3%. In the study done by Lippi *et al*. on social and spatial ecology of dengue presence and burdening during an outbreak in Guayaquil, Ecuador, 2012, logistic regression model was used for determining which socioecological factors are important to dengue presence. The results showed municipal services such as garbage collection, sewage, access to piped water, and number of houses using tap water as the predictor for dengue cases.[9] The municipal services are taking prudent measures to reduce the larval habitat, yet this study shows that there is evidence of high larval positivity and disease transmission.

Aedes mosquito breeds in natural and artificial collection of collection of water, in urban areas, *Aedes* is one of the major vectors for transmission of dengue virus. The larval surveys are the most widely used method for entomological surveillance.

In our study, we came across 2847 potential containers over 298 surveyed houses. The study shows the larval indices, HI =77.85%, CI =27.43%, and BI =262.08%, respectively. A study done by Jesha *et al.* on mosquito density in urban Kerala shows HI =25.15%, CI =10.36%, and BI =73.05%. The later study depicts a picture of high larval indices above the critical point, which made evident that the respective study area is at risk of developing an outbreak.[7] Our study also has the larval indices above critical level, where BI and HI being more than 50 and 10% show the high-risk transmission of dengue in the study area.

In addition to calculating the total container index, details of individual container type were also obtained. In our study, the most common container found positive for larvae is discarded plastic container accounting for about 52.14%. This was similar to the study done by Shaikh *et al*. Yet, another study done by Vijayakumar *et al.* on container breeding mosquitoes with special reference to *Ae. aegypti* and *Ae. albopictus* in Thiruvananthapuram also shows the most common container as plastics.[13] Irrational dumping of unused containers was the main sources found positive in our survey. In the study done by Jesha *et al.,* the most common container was found to be tins which was followed coconut shells (15%) and discarded tires (15%).[7] Our observations were similar, coconut shells being the second most common. However, the positivity among coconut shells (48.05%) and discarded tires (35.85%) were much higher than the comparative study.

This study was done during November–January post-monsoon season which also contributes to the high larval indices.

CONCLUSION

House index of more than 10% and Breteau index of more than 50 clearly say the high transmission of disease in the respective field area. *Aedes aegypti* is breeding in a wide range of artificial containers. To control these mosquitos, the integration of different methods should be taken into consideration along with health education and behavioral change communication only then the expected outcome can be obtained.

Limitations

Study did not assess the detailed sociodemographic characteristics which play a major role in vector-borne disease and its transmission.

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