International Journal of Research in Medical Sciences
Uddin MH et al. Int J Res Med Sci. 2023 May;11(5):1417-1424
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20231025

Original Research Article

Identification of density and breeding places of *Aedes* mosquito and prevalence of dengue in Rajshahi city corporation of Bangladesh

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Received: 14 March 2023
Revised: 23 March 2023
Accepted: 29 March 2023

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ABSTRACT

Background: There are various varieties of habitats that have specific characteristics of water for the breeding of mosquito. A house-to-house cross-sectional entomological survey used to be carried out at per domestic area to become aware of larval breeding sites. *Aedes aegypti* used to be primary vector and *Aedes albopictus* used to be predominant species in container-breeding habitats. Most breeding habitats have been category into excessive stage of larval density. Turbidity, pH, TOC, magnesium, calcium and sodium is amongst the characteristics that indicates a significant difference with larval density and species composition respectively. This study personal based entomological research and funding carried out by corresponding author. Students of zoology department of Rajshahi university involved in this research. Students were working as a research assistant for this study. Aim of this study was to assess determination of prevalence, density and breeding place of *Aedes* mosquito in Rajshahi city corporation.
Methods: This observational study carried out 30 wards in Rajshahi city corporation areas have been surveyed in department of communicable diseases control, director general of health services, Dhaka, Bangladesh. Duration of study 3 years. Total 3 surveys were conducted in each year; pre monsoon, monsoon and post monsoon total 9 surveys conducted by this 3 years survey period. Data entered in MS excel and statistical analysis done by SPSS trial version.
Results: This study shows that according to breeding area of 2020-2022. Here, total surveyed household were 8100. Total positive Wet container were 474 and positive place were 473 in these three years survey.
Conclusions: *Aedes aegypti* and *Aedes albopictus* are properly established inside urban places. Meteorological variables additionally affected mosquito populations. Characteristics of mosquito breeding area can affect larval density and give impact quality of life.

Keywords: Entomological, *Aedes aegypti*, *Aedes albopictus*, Container-breeding, Larval density

INTRODUCTION

Worldwide, *Aedes* mosquito is the important vector of the virus that motives dengue, a disease that stays a serious public health trouble in many tropical and subtropical countries. Rajshahi is city in Northwestern region of Bangladesh. City has warm or hot, humid climate influenced by pre-monsoon seasonal variations. It is located just north side of Padma River. Climatic situation is very warm. Most rain occurs in May to September.

Rajshahi city is closely attached to the border of India which had many dengue cases in the past few years. In this regard, Rajshahi city is threatened to face an epidemic outbreak in any times. However, to analyze the current scenario and to forecast the future of Rajshahi city, the data of breeding sources for the dengue vectors (*Aedes aegypti* and *Aedes albopictus*) was essential. In 2019, Bangladesh encountered its biggest dengue outbreak, where a big part of the patients dwelled in Dhaka. In the same year a nationwide dengue epidemic outbreak occurred. In Rajshahi division, dengue cases with deaths and severity were found in considerable number. As Rajshahi is an important city of Northwestern part of Bangladesh, vector density and risk factor analysis for dengue disease outbreak is crucially needed. The seasonal prevalence of vector is important to forecast the dengue situation. Two types of *Aedes* mosquitoes, *Aedes aegypti* and *Aedes albopictus* go about as the vector for Dengue. *Aedes aegypti* and Aedes albopictus are the primary vectors of dengue viruses in Southeast Asia, a region that historically represents the epicenter of transmission and disease occurrence.[1] Human to human transmission happens through the nibble of an infected mosquito. A few factors, for example, precipitation, temperature, moistness give fitting circumstances to its endurance, propagation, reproducing, egg incubating and infection contagiousness. *Aedes aegypti*, a major vector of dengue transmission, mainly breeds in domestic environments.[2] *Aedes* mosquito species have adjusted well to human residence, reproducing around family water compartments, for example, those utilized for water capacity or for indoor plants and in the arranged water holding vessels like disposed of jars, utilized tires and so on. These mosquitoes are daytime feeders and can't fly over significant distances (<110 yards). All alone, they can't arrive at past two stories, however, can be conveyed physically (like lifts or lifts) to any levels. They cause a harmless nibble, ordinarily on the rear of the neck and the lower legs. To complete one blood feed, they can move starting with one then onto the next person. Hence generally, whole families foster disease inside a 24-to 36-hour time frame, probably from the nibbles of a solitary contaminated mosquito. After brooding for 4-10 days, a tainted mosquito is equipped for communicating the infection until the end of its life. The effective transmission of dengue virus from a human host to a mosquito vector requires a complex set of factors to align. It is becoming gradually important to recover our understanding of the parameters that shape the human to mosquito component of the transmission cycle so that vaccines and therapeutic antivirals can be fully estimated, and epidemiological models refined.[3] Trans-ovarian transmission of dengue infection in the mosquitoes is deeply grounded and subsequently the infection can continue in the nature. This outcome in the infection to endure for longer periods and cause rehashed episodes. The duration of this study was 03 years, 2020, 2021 and 2022. Total 03 surveys were conducted in each year; pre monsoon, monsoon and post monsoon. Total 09 surveys were conducted by this three years survey period. In February was conducted the pre monsoon survey, in July was conducted the monsoon survey and in December was conducted the post monsoon survey per year in Rajshahi city (in the 30 wards of the city corporation). To determine the density frequency and abundance of *Aedes* spp. as well as to map the *Aedes* prevalent areas a seasonal prevalence survey has been planned to carry out in Rajshahi city corporation areas. Rajshahi city has 30 wards and the pre-monsoon, monsoon and post monsoon *Aedes* surveys will be conducted accordingly to get the seasonal prevalence. An entomological team was formed to carry out this *Aedes* survey in Rajshahi city. The survey was conducted in the weekly holidays and other government holidays. All the 30 wards were surveyed and entomological data and samples were collected from the households. The aim of this study was to assess the determination of prevalence, density and breeding place of *Aedes* mosquito in Rajshahi city corporation.

Mosquitoes of *Aedes* genus are the essential vectors of dengue, yellow fever, Chikungunya and Zika viruses.[4,5] *Aedes aegypti* transmits dengue virus in the tropical and subtropical South America regions, and its transmission is influenced with the aid of a number of factors, which includes vector mosquito density, circulating virus serotypes, and human populations susceptibility.[6] In Argentina, *Aedes aegypti* is most applicable mosquito from epidemiologic factor of view. This specie is characterised via its adaptation to city environment, its ability and desire of breeding in artificial containers, resistance of its eggs to desiccation and the feeding conduct of the female which bites in a couple of activities in the course of every gonadotrophic cycle.[7,8] These characteristics, collectively with this vector wide distribution in Northern Argentina, represent indispensable elements that have an effect on circulation and transmission of dengue and different associated viruses in the place.[9]

Objectives

The objectives of the study were-to determine the prevalence of *Aedes* species, to find out the distribution pattern and density of vectors in city corporation areas, to apprehend types and frequency of probable and potential breeding sources and to assess the larval and pupal indices to get the authentic breeding rates in different types of houses.

METHODS

This is an observational study carried out 30 wards in Rajshahi city corporation areas have been surveyed in the department of communicable diseases control, director general of health services, Dhaka, Bangladesh. The duration of this study period was from 2020 to 2022. 03 surveys were conducted in each year (Pre monsoon, monsoon and post monsoon). Total 09 surveys were conducted in 03 years. Larvae have been collected through breeding area and breeding source. The research assistant was checked the household and collect the *Aedes* larvae.

Site selection

A total of 30 wards in Rajshahi city corporation areas have been surveyed. Each ward was dived into 2 sites; on each site 15 households were inspected. Class interval was 20 households in this survey.

Figure 1: Rajshahi city corporation, origin by banglapedia.org.[35]

Data collection

Survey: Total 10 teams surveyed in 30 wards. 30 households from each ward were inspected. On each ward, 2 teams worked, each team covered 15 households. The data was collected using mobile phone application GPS. The students of zoology department from Rajshahi university were work as research assistant in this survey.

Lab work: An entomological technician expert in larva and pupa identification in the laboratory was assigned to identify the larva and pupa.

Data management: Two GIS experts consistently managed the data and provided geo location maps to the groups working in their designated sites.

RESULTS

The total number of households checked, total number of positive households, total number of wet containers, total number of positive wet container, Breteau index (BI), container index (CI), house index (HI) of *Aedes* survey 2020, 2021 and 2022 in Rajshahi city corporation areas are given billow.

Comparative analysis of BI, CI, HI of *Aedes* survey of 2020, 2021 and 2022 in Rajshahi city corporation areas. Ward no 26 and 13 shows the highest BI among all of the wards. In ward no. 20 and 30 show the highest container index among all the other wards. In the above table shows highest number of wet containers found in ward no. 06, 13, 14, 17 and 18 etc. On the other site highest number of positive wet container found in ward no. 26, 11 and 13.

Table 1: Indices of *Aedes* in different ward of Rajshahi city corporation (RCC) areas during 2020, 2021 and 2022.

Ward	House checked	No. of house positive	No. of wet container	No. of +ve wet container	BI	CI	HI
1	270	9	90	10	3.33	11.11	3.33
2	270	10	36	10	3.23	27.77	3.23
3	270	18	63	18	6.67	28.6	6.67
4	270	9	63	10	3.3	15.87	3.3
5	270	11	54	9	3.3	16.66	3.3
6	270	12	108	10	3.33	9.25	3.33
7	270	9	45	9	3.3	20	3.3
8	270	7	54	8	3.3	14.81	3.3
9	270	14	45	14	3.35	31.11	3.35
10	270	19	63	19	3.41	30.15	3.41
11	270	26	81	26	9.67	32.09	9.67
12	270	11	90	11	3.33	12.22	3.33
13	270	36	126	36	13.33	28.6	13.33
14	270	21	153	21	6.67	13.72	6.67
15	270	10	90	10	3.33	11.11	3.33
16	270	11	72	12	3.33	16.66	3.33
17	270	18	207	18	6.67	8.7	6.67
18	270	13	180	13	3.33	7.20	3.33
19	270	17	144	17	6.39	11.8	6.39
20	270	11	18	11	4.07	61.11	4.07
21	270	13	90	13	3.33	14.44	3.33
22	270	16	18	16	5.92	88.9	5.92
23	270	17	90	17	6.29	18.90	6.29
24	270	13	117	13	3.33	11.11	3.33
25	270	18	99	18	6.67	18.2	6.67
26	270	36	117	36	13.33	30.76	13.33
27	270	16	54	16	5.92	29.62	5.92
28	270	19	108	19	7.03	17.59	7.03
29	270	20	90	20	7.40	22.22	7.40
30	270	23	27	23	8.33	33.3	8.33

Table 2: Distribution of the study according to positive wet container and places for *Aedes* larvae.

Year	Area (wards)	Positive	
		Positive wet container	Positive household
2020	30	157	157
2021	30	182	181
2022	30	135	135

Table 2 demonstrated the distribution of the study according to positive wet container and household. When year was 2020 positive wet container were 157 and positive household were157. When year was 2021 positive wet container were 182 and positive household were 181. When year was 2022 positive wet container were 135 and positive household 135 for *Aedes* larvae.

Table 3 demonstrated the distribution of the study according to estimated and collected *Aedes* larvae. When year was 2020 total number of estimated larvae was 18221 and total number of collected larvae was 1949.When year was 2021 total number of estimated larvae was 19049 and total number of collected larvae was 2098. When year was 2022 total number of estimated larvae was 17619 and total number of collected larvae was 1762.

Table 3: Distribution of the study according to estimated and collected *Aedes* larvae.

Year	Area (wards)	Larvae	
		No. of estimated larvae	No. of collected larvae
2020	30	18221	1949
2021	30	19049	2098
2022	30	17619	1762

Above table shows that there were five categorized types of building e.g., independent house, multi-storied building, semi-pacca house/Slum, under construction site and vacant plot. During the survey period. The Independent house was the highest number of positive houses 53.44%.

Table 4: According to house type positive house percentage in Rajshahi city corporation.

House type	Percentage of positive household
Construction	7.34
Independent	53.44
Multistoried	22.36
Semi-pacca/slum	13.76
Vacant plot	3.1

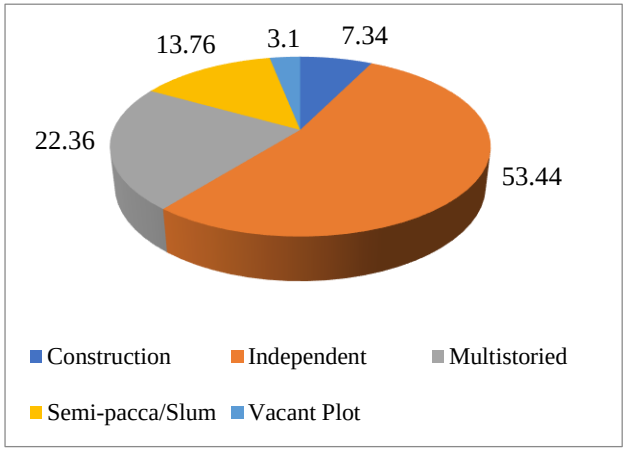

Figure 2: Percentage of positive household.

Above Figure shows that there were five categorized type of building e.g. independent house, multi-storied building, semi-pacca house/Slum, under construction site and vacant plot. During the survey period. The Independent house was the highest number of positive houses 53.44%.

Table 5 demonstrated the distribution of the study according to *Aedes aegypti* and *Aedes Albopictus*. When year was 2020 total number of *Aedes albopictus* were 1361 and *Aedes aegypti* were 588 and other species were 88. When year was 2021 total number of *Aedes albopictus* were 1466 and *Aedes aegypti* were 632 and other species were 96. When year was 2021 total number of *Aedes albopictus* were 1283 and *Aedes aegypti* were 479 and other species were 61.

In the above Figure 3 shows the dominant species diversity found during the survey period in Rajshahi city corporation *Aedes* survey. This shows the *Aedes albopictus* is more dominant than *Aedes aegypti* species.

Table 5: Distribution of the study according to *Aedes aegypti* and *Aedes albopictus.*

Year	Area (wards)	Species		
		Aedes albopictus	***Aedes aegypti***	**Other species**
2020	30	1361	588	88
2021	30	1466	632	96
2022	30	1283	479	61

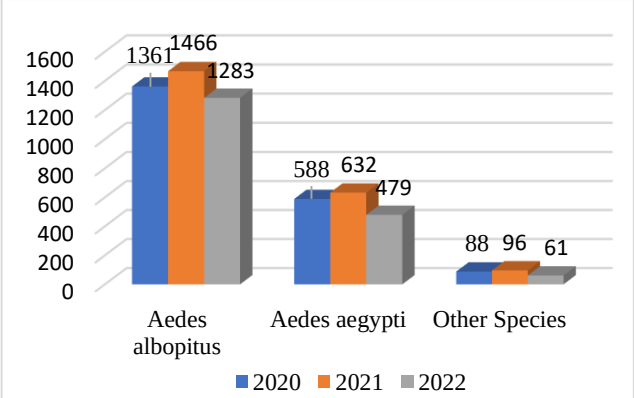

Figure 3: Distribution of the study according to *Aedes aegypti* and *Aedes albopictus*.

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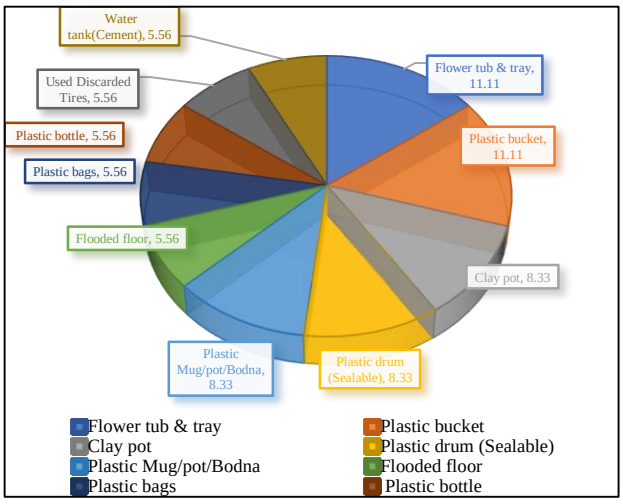

Figure 4: Percentage of positive wet container.

Figure 4 shows the percentage of the highest number of positive wet container during the survey period Rajshahi city corporation *Aedes* survey. Among the individual containers flower tub and tray and plastic bucket 11.11% showed the most productive container for the *Aedes* larval breeding source, followed by the source percentage plastic drum (Sealable), plastic mug/pot/bodna, clay pot 8.33% and flooded floor, plastic bags, used discarded tires, water tank (cement) was 5.56%.

DISCUSSION

The greater abundance of *Aedes aegypti* adult males and females in intradomiciliary premises corroborates

reviews in the scientific literature.[10] The presence of males in these surroundings is likely principally associated to the availability of shelter, due to the fact after emergence, the adult searches for sites with hiding places, the place it can continue to be at relaxation during the duration previous the onset of activities.[11]

Aedes aegypti was once as soon as greater regularly encountered than *Aedes albopictus*. According to Forattini, the city surroundings favours *Aedes aegypti*, whereas rural and suburban areas favour *Aedes albopictus*.[12] This environmental affect would possibly additionally be related to the ecology, biology, and behavior of these species, which have outstanding qualities however sharing exclusive qualities. The urban surroundings favours *Aedes aegypti*, which permits the female to feed on human blood inside houses. Additionally, these adults can oviposit and shelter themselves there. Several authors have said this behavior, which favours intra-domiciliary premises for breeding grounds and the deposit of eggs.[13,14] Our data confirm preceding findings on the bio-ecology of this species in an urban area, helping the use of groups for the surveillance and manage of adult types of the vector in houses.

Entomological surveillance makes use of various indices to measure the degrees of *Aedes aegypti* urban infestation. However, indices primarily based on genuine counts of the wide variety of adult females are greater correct.[15] In the existing study, the adult house index (AHI) confirmed *Aedes Aegypti* female presence each month of the find out about in the blocks and residences surveyed, even though distinct percentages have been found, characterizing the distribution of the species in the urban environment. One clarification can be attributed to the aggregated distribution sample of this Stegomyia, i.e., in discovering individuals of the referenced species in a particular location, it is very probable to encounter others in surrounding areas.[16,17]

The displacement of *Aedes aegypti* women appears to be related with heterogeneity in the availability of blood and containers for laying eggs. According to Harrington et al, the dispersal of these female is decreased in areas with physical or geographic boundaries that restriction their flight from 50 to 300 meters over their whole lives, which ability that they would now not frequently migrate beyond the block where they initiated their activities.[18] When females discover integral assets close to their factor of origin, they most probably do no longer migrate large distances.[19]

The woman density values in the houses surveyed (F/H) in our learn about had been shut to these determined by several authors. Chan stated 0.2 females/house as a threshold for dengue prevalence in Singapore.[20] Barata et al captured 0.4 females/house in São José do Rio Preto (SP), Brazil. Barata et al in the municipality of Ocauçu and Uchoa (SP), captured 0.4 and 0.7 females/house, respectively, with resting boxes.[21] Fávaro et al in analyzing density in two areas of Mirassol (SP), Brazil, stated that the suggest variety of females captured with aspirators ranged from 0.05 to 0.46 and from 0.08 to 0.62 at areas A and B, respectively.[22] Nguyen et al used aspirators and determined a density of 1.8 females/house in South Vietnam.

Females of this species are quickly, and insistent suckers accomplished of eating blood multiple times during at some stage in a single gonotrophic cycle, a behaviour that will increase the opportunity of infecting and transmitting DEN viruses. Dengue virus contamination occasions have been stated in areas with low densities of this mosquito.[23] Thus, performing research that think about the populace density of *Aedes aegypti* adult females transmitting dengue to exhibit the quantitative relationship between vector indices and dengue instances should define a confidence level stage that ought to be used as a warning of impending dengue transmission.

Another necessary indicator of the hazard of dengue transmission is associated to human density and the wide variety of *Aedes aegypti* females. This human-vector proximity has been mentioned with the aid of special authors. Chen et al in a study in Taiwan, confirmed a density of 0.07 females/ person. Other authors in Colombia observed 0.5 females/ character.[24] In Trinidad, Chadee discovered values of 0.6-0.7 pupae/person, however there was once curiously no dengue transmission. Barrera, in Puerto Rico, corroborates the relationship between these variables, citing a suggest of 0.99±1/3 pupae/person. Basso et al determined 0.12 pupae/person in Paraguay. More recently, in a dengue transmission place of São Paulo State, in the location of São José do Rio Preto, 0.15 pupae/person had been recorded.[25]

The variety of *Aedes aegypti* females in intradomiciliary and peridomiciliary premises used to be positively correlated with the range of residents, and the range used to be greater in intradomiciliary premises. These effects point out that this mosquito's spatial distribution was once affected through resident density/house; female of this mosquito keep a shut relationship with humans, and this proximity is favoured through locations with shelter, amongst different aspects. This information recommend that the variety of residents is a factor that attracts females to the residential environment, due to the fact the blood meal furnish is larger. Getis et al and Harrington et al suggested that people, as a substitute of mosquitoes, might also be the fundamental mechanism of dengue virus transmission inside and/or between communities.[26,27] In a study in Hawaii the usage of a spatiotemporal strategy addressing the vector habitat and dengue, the authors concluded that human population density and urbanization are danger elements for dengue propagation.[28] Lin and Wen, in analyzing the relationships amongst mosquitoes, human density, and dengue incidence, discovered that a small range of *Aedes*

aegypti females in a densely populated location may additionally be enough to motive an outbreak of the disease, due to the fact a greater human density gives excessive vector contact rates.[29]

Plan for follow up action

A dissemination program will be conducted to represent the finding of the study to the stakeholders of Rajshahi and the country as well.

Monsoon and post monsoon surveys will be conducted accordingly.

Awareness campaign, training of mosquito control personnel of RCC, advocacy meeting, direct engagement of multiple stakeholders in dengue control initiative programs will be conducted.

Special task force will be formed and they will be trained directly in the field by the entomological personnel from NME and ATDCP, DGHS.

Limitations

The present study was conducted in a very short period due to time constraints and funding limitations. The small sample size was also a limitation of the present study.

CONCLUSION

The total survey result and the knowledge on *Aedes* mosquito may help for take the right intervention. The *Aedes* mosquito is transmitting many arboviruses, it causes death to many peoples in terms of severity. To assess its seasonal prevalence in Rajshahi city corporation pre-monsoon, monsoon and post monsoon *Aedes* surveys has been done which results *Aedes albopictus* as dominant over *Aedes aegypti*. Independent household were supposed to be more preferable breeding site due to having more wet containers and also surrounded by vegetation. The Independent house was the highest number of positive houses 53.44%. Most probable productive containers were flower tub and tray, plastic bucket, plastic drum (Sealable), plastic mug/pot/bodna, clay pot etc. Among this and all other containers *Aedes* species prefers flower tub and tray, plastic drum (sealable) 11.11% for their breeding source.

ACKNOWLEDGEMENTS

Author would like to thanks to Rajshahi City Corporation of Bangladesh research also grateful to many colleagues for their thorough, helpful and usually prompt response to requests for their opinion and advice.

Recommendations

Public awareness campaign and training up the mosquito menace management team of RCC. Monsoon and post-monsoon *Aedes* survey will conduct accordingly. Involving multiple stakeholders and conducting advocacy meeting in the 30 wards of RCC. Conducting routine surveillance and survey in the 30 wards, mainly in 3 seasons pre-monsoon, monsoon and post-monsoon. Special task force could be made to monitor the households in every month. To keep Rajshahi city from the potential risk of epidemic outbreak, entomological team of NME and ATDCP, CDC, DGHS should be kept in close contact and the Khulna city corporation authority should collaborate directly with them.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Uddin MH, Islam MN, Islam SMS, Aktaruzzaman MM, Haque ME, Habiba MU, et al. Identification of density and breeding places of aedes mosquito and prevalence of dengue in Rajshahi city corporation of Bangladesh. Int J Res Med Sci 2023;11:1417-24.