SEASONAL PREVALENCE OF DENGUE VECTOR *AEDES AEGYPTI* IN SOME ENDEMIC AREAS OF MONYWA TOWNSHIP

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Abstract

Aedes aegypti is recognized as dengue fever mosquito that transmits chikungunya, zika and yellow fever. Vector surveillance is a significant tool to determine factors of related dengue transmission. Entomological survey was carried out in three different endemic areas of Monywa Township, from August 2018 to July 2019. The monthly mosquito larval survey was carried out by examining all containers present in houses of both urban and rural areas. A total of 50 houses in each locality were visited on the basis of systematic sampling method during every month. The potential breeding habitats were screened for the prevalence of *Ae. aegypti* larval population. A total of 1800 houses and 10405 containers were examined for breeding sites of *Ae. aegypti* in all seasons in the whole year. Out of these, 893 houses and 1818 containers were positive. The overall house index (HI), container index (CI) and breteau index (BI) were 49.61%, 17.47% and 101% respectively. Entomological indicators (HI, CI, BI) of *Ae. aegypti* larval population were above the critical level and a dynamic population of *Ae. Aegypti* correlated with rainfall in the study. Regular water supply system and dumping sites should be supported to all study areas. Public health education, community intervention for prevention of vector breeding, information from mass media and regular entomological survey are required to create public awareness and to control mosquito transmitted diseases.

Keywords: Seasonal prevalence, Dengue, *Aedes aegypti*, larval indices, Monywa Township

Introduction

Aedes aegypti is recognized as dengue fever mosquito that transmits chikungunya, zika and yellow fever (Subahar, Lubis, & Winita, 2019). Dengue is the most important vector-borne viral disease for humans, both in terms of morbidity and mortality(Da Cruz Ferreira *et al*., 2017). The incidence of dengue extremely increases worldwide in recent decades. Many dengue cases are underreported and misclassified (Subahar *et al*., 2019). South-East Asia, the Pacific, East and West Africa, the Caribbean and the Americas are dengue endemic areas(Singh *et al*., 2015). Almost half of the world's population are at risk of infection, with major social and economic consequences. According to World Health Organisation(WHO) report, 50–100 million dengue infections occur annually, while a recent study calculated that dengue cases may be closer to 400 million (Bowman, Runge-Ranzinger, & McCall, 2014).

Dengue is classified as notifiable disease since 1964 in Myanmar. In 1970, first dengue outbreak with 1,654 cases and 91 deaths occurred in Yangon. Then, dengue spread to other States and Regions. In 2015, the highest number of dengue cases (42,913) was recorded according to all States and Regions dengue reports. In 2016, the prevalence of dengue in Myanmar was found as 10,770 dengue cases and 58 deaths. The dengue cases and deaths declined by 75% and 59%, respectively in 2016 compared to 2015. Obviously, dengue endemic has increased year by year up from 1970 to 2015 (1,654 in 1970 to 42,913 in 2015). Fortunately, the Case Fatality Rate (CFR) dramatically decreased from 5.50% in 1970 to 0.33% in 2015(Sokunna *et al*., 2017).

Chikungunya fever, an arboviral infection caused by chikungunya virus (CHIKV), is Alphavirus (family Togaviridae) disease, with *Ae. aegypti*. This virus was first isolated in Tanzania

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in 1953 during a large outbreak. There is rapid increasing of number of countries (over 60) reporting CHIKV outbreak since 1953 (Simo *et al*., 2019). Chikungunya is a vector-borne disease of considerable significance and prevalence in South-East Asia (SEA) Region. The disease has been reported from countries of South and East Africa, South Asia and South-East Asia. In the WHO South-East Asia Region, outbreaks have been reported from India, Indonesia, Myanmar, Sri Lanka, Thailand and Maldives (WHO, 2009).

Vector surveillance is a significant tool to determine factors of related dengue transmission. Entomology indicators are used in vector surveillance to predict the risk of a dengue outbreak. The most used indicators are house index (HI), container index (CI) and breteau index (BI) (Subahar *et, al.*, 2019). *Ae. aegypti* also would prefer to oviposit in a less lighting area or shaded where in that particular area the temperatures are lower compared to the area that exposed to direct sunlight. The types of containers, water quality, and conditions of water containers are necessary for breeding. The condition that would lead to mosquito infestation is such as stored water in the container for an extended period, extensive rainfall during the rainy season, and ambient relative humidity and temperature. Infestation of vectors to new geographical areas, warm and humid climate, increased population density, water storage pattern in houses, and storage of trash, for instance, recyclable materials can serve as risk factors for dengue virus infections (Madzlan *et al.*, 2016). The reproduction of *Ae. aegypti* from tropical to subtropical zones occurs all the year-round, and their abundance is associated with rainfall (Ahmed *et al*., 2007).

Therefore, the current study was investigated to examine the seasonal prevalence of dengue vector *Ae. aegypti* in some endemic areas of Monywa Township with the specific objectives; to evaluate the monthly prevalence of indices (HI, CI, BI) of *Ae. aegypti* larvae and to observe the relationship between *Ae. aegypti* larvae population (BI, HI and CI) and rainfall in different periods.

Material and Methods

Study area

Monywa Township is one of the 37 Townships of Sagaing Region. The region was severely hit by dengue in 2015 and the numbers of cases and death tolls, respectively, took their positions at the first and second places in the list of reported dengue cases. Monywa Township is situated on the eastern bank of the Chindwin River, 136 kilometres west of Mandalay and located in the central dry zone of Myanmar. The township has a population of 372,095 and is divided into 26 wards (Myanmar Government, 2015). According to the recommendation of Vector Borne Disease Control unit (VBDC) of Sagaing Region, three localities, including one urban and two rural areas were selected based on the last year dengue fever cases reported for Monywa Township. Among the localities, Myawaddy quarter, which is a part of Monywa City is an urban area and other two villages, Kamma and Kyauksitpon villages, are rural areas.

Study design and study period

The present study was performed mostly based on fieldwork and investigations were carried out from August 2018 to July 2019.

Sampling methods

The monthly survey of mosquito larvae was conducted by examining all containers present in houses of three selected localities. A total of fifty houses per locality were paid a visit every month on the basis of a systematic sampling method (Depkes, 2003). The potential breeding habitats in the selected areas, such as cement tanks, metal containers, plastic containers, iron drums, earthen pots, flower vases, discarded tires and other water-filled items were carefully examined for the presence of immature stages of *Ae. aegypti*. The presence of larvae in small breeding habitats around the dwellings was carefully searched by using flashlight and pipette. The search for bigger water containers was accomplished by dipping the net into the containers (WHO, 2003). The type of habitats, in which mosquito larvae were present and their location were recorded. The sample larvae were collected and brought to the insectary room of Medical Entomology Research Division (Pyin Oo Lwin Branch), where the larvae were reared until they become adults. The adult mosquitoes were identified according to the keys of Leopoldo M Rueda (Rueda, 2004).

Data analysis

Field data was recorded in appropriate forms, and statistical analysis was conducted using Microsoft Excel.

Larval prevalence indices

The collection of larval examination method of WHO (Depkes, 2003) was used to confirm the presence of larvae in the containers. Three larval indices such as house index (HI), container index (CI) and Breteau index (BI) were calculated as follows:

1. HI = (No. of houses positive for *Aedes* larvae) / (No. of houses inspected) × 100
2. CI = (No. of positive containers) / (No. of containers inspected) × 100, and
3. BI = (No. of positive containers) / (No. of houses inspected) × 100

Weather parameters

Monthly weather parameters, including rainfall were obtained from the Meteorological and Hydrology Department, Monywa**,** Sagaing Region.

Results

The prevalence of larval population in three different dengue endemic areas of Monywa Township was computed as house, container and breteau indices in Table 1. A total of 1800 houses and 10405 containers were examined for breeding sites of *Ae. aegypti* in all seasons in the whole year. Out of these, 893 houses and 1818 containers were positive. *Ae. aegypti* larvae were detected in 49.61 % house index (HI), 17.47 % container index (CI) and 101% breteau index (BI) as the number of indices in three study areas.

Myawaddy quarter

A total of 600 houses were visited during house to house larval survey for *Ae. aegypti* breeding in all kinds of temporary and permanent water bodies of Myawaddy quarter. Among them, 265 houses were found as the breeding sites of *Ae. aegypti*. A total of 2901 water containers were searched for *Ae. aegypti* breeding, out of which 527 were found as positive containers. The overall house index (HI), container index (CI) and breteau index (BI) were 44.17 %, 18.17 % and 87.83 % respectively. The highest number of HI, CI, BI was found in October, and the lowest number of indices was found in March (Table 2). The relationship of increasing level of indices (HI, CI and BI) with the meteorological condition, especially rainfall is shown in Figure.2. The heaviest rainfall occurring June, September and October resulted in higher HI, CI and BI in those months. The highest monthly total rainfall (172.97 mm) was recorded during October followed by June (169.16 mm) and September (137.92 mm). There was no rain in February and March which months were recorded as the lowest level of indices. The population summit (BI-224 %) in October correlated to the heaviest rainfall, followed by September (BI- 178 %) and June (BI-176 %) (Figure 1).

Table 1 Prevalence of indices of *Ae. aegypti* larvae in different localities of Monywa Township

Localities searched	Houses visited	Houses positive	Containers searched	Containers positive	HI (%)	CI (%)	BI (%)
Myawaddy quarter	600	265	2901	527	44.17	18.17	87.83
Kamma village	600	318	3322	588	53.00	17.70	98.00
Kyauksitpon village	600	310	4182	703	51.67	16.81	117.17
Total	1800	893	10405	1818	49.61	17.47	101.00

HI= house index, CI= container index, BI= breteau index

Table 2 Monthly prevalence indices of *Ae. aegypti* larvae in Myawaddy quarter, Monywa Township

Months	Houses visited	Houses positive	Containers searched	Containers positive	HI (%)	CI (%)	BI (%)
August	50	21	220	25	42	11.36	50
September	50	32	351	89	64	25.36	178
October	50	36	436	112	72	25.69	224
November	50	17	194	27	34	13.92	54
December	50	15	171	24	30	14.04	48
January	50	15	184	24	30	13.04	48
February	50	14	166	21	28	12.65	42
March	50	13	203	18	26	8.87	36
April	50	18	172	25	36	14.53	50
May	50	28	194	46	56	23.71	92
June	50	35	345	88	70	25.51	176
July	50	21	265	28	42	10.57	56
Total	600	265	2901	527	44.17	18.17	87.83

HI= house index, CI= container index, BI= breteau index

Kamma village

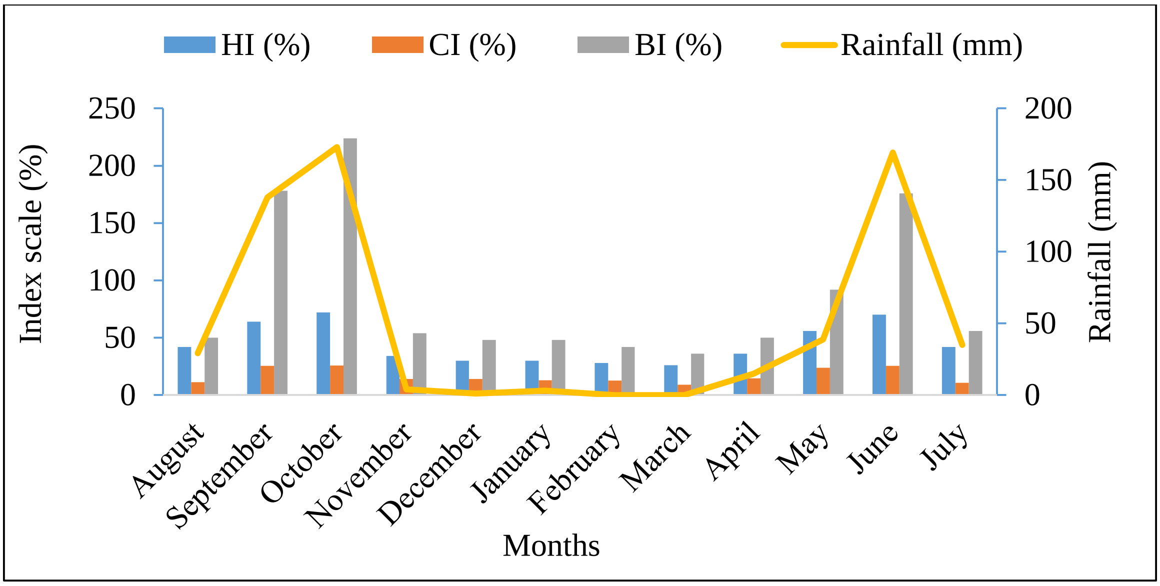
In Kamma village, 600 houses were searched for *Ae. aegypti* breeding, out of which 318 houses were found positive. A total of 588 containers was positive (containing *Ae. aegypti* larvae) out of 3322 wets (water filled) containers in the visited houses. The overall indices of *Ae. aegypti* larvae with house index (HI) 53%, container index (CI) 17.70 % and breteau index (BI) 98 % were found in the study area. In October, the highest numbers of HI, CI, and BI were 76 %, 26.53 % and 208 % respectively and the lowest numbers of indices were found in March with HI 24 %, CI 5.58 % and BI 26 % respectively (Table 3). The effectiveness of rainfall on *Ae. aegypti* population increasing was found in Kamma village. The highest of HI, CI and BI were found in October which month occurred the heaviest rainfall and followed by June and September with correlation larval indices and rainfall. The lowest of HI, CI and BI were recorded in March which month was no rain. The peak of *Ae. aegypti* larval population (BI-208 %) was found in

October with relation to the heaviest rainfall and followed by June (BI-174 %) and September (BI-156 %) (Figure 2).

Table 3 Monthly prevalence indices of *Ae. aegypti* larvae in Kamma village, Monywa Township

Months	Houses visited	Houses positive	Containers searched	Containers positive	HI (%)	CI (%)	BI (%)
August	50	30	316	55	60	17.41	110
September	50	36	432	78	72	18.06	156
October	50	38	392	104	76	26.53	208
November	50	23	231	34	46	14.72	68
December	50	16	201	26	32	12.94	52
January	50	20	217	26	40	11.98	52
February	50	13	209	17	26	8.13	34
March	50	12	233	13	24	5.58	26
April	50	25	238	42	50	17.65	84
May	50	34	264	47	68	17.80	94
June	50	37	330	87	74	26.36	174
July	50	34	259	59	68	22.78	118
Total	600	318	3322	588	53	17.70	98

HI= house index, CI= container index, BI= breteau index



HI= house index, CI= container index, BI= breteau index

Figure 1 Relationship of *Ae. aegypti* larvae population (BI, HI and CI) with rainfall in different periods of Myawaddy quarter, Monywa Township

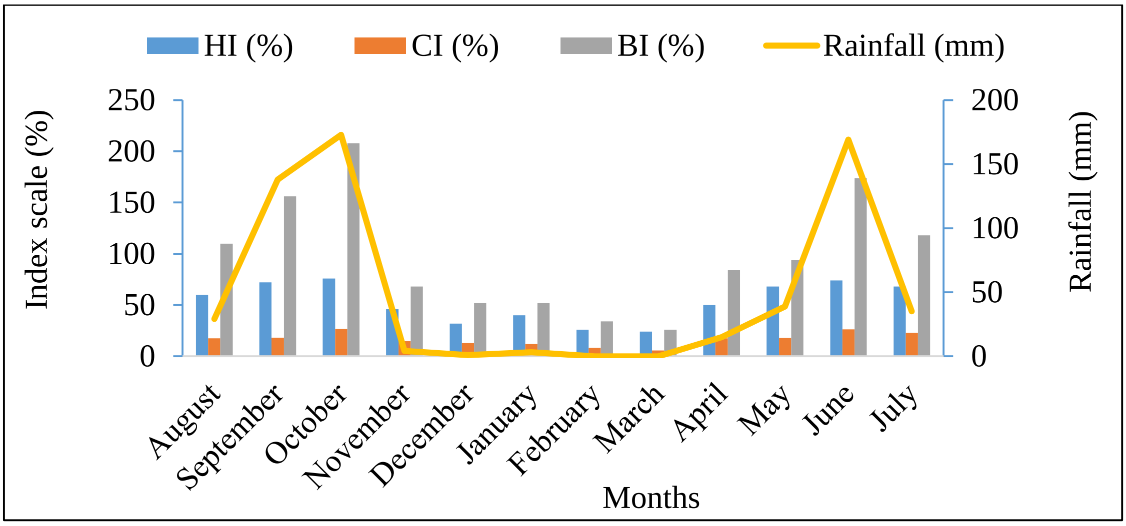
Kyauksitpon village

In total, 600 houses and 4182 water containers were inspected in Kyauksitpon village. Out of these, 310 houses were positive for *Ae. aegypti* breeding sites and 703 containers were positive for larval infection. The overall indices were 51.67 % house index (HI), 16.81 % container index (CI) and 117.17 % breteau index (BI) respectively. In monthly indices, the month of October was the highest with HI 82 %, CI 23.60 %, BI 226 % and the month of March was the lowest with HI 30 %, CI 7.77 %, and BI 48 % (Table 4). Indices of *Ae. aegypti* larval population were examined in relation to monthly rainfall, where the seasonal pattern of *Ae. aegypti* was fairly close to variations in rainfall. The maximum of breteau index (BI-226 %) was recorded in October corresponding to the heaviest rainfall and followed by June (214 %) and September (202 %) (Figure 3).

Table 4 Monthly prevalence indices of *Ae. aegypti* larvae in Kyauksitpon village, Monywa Township

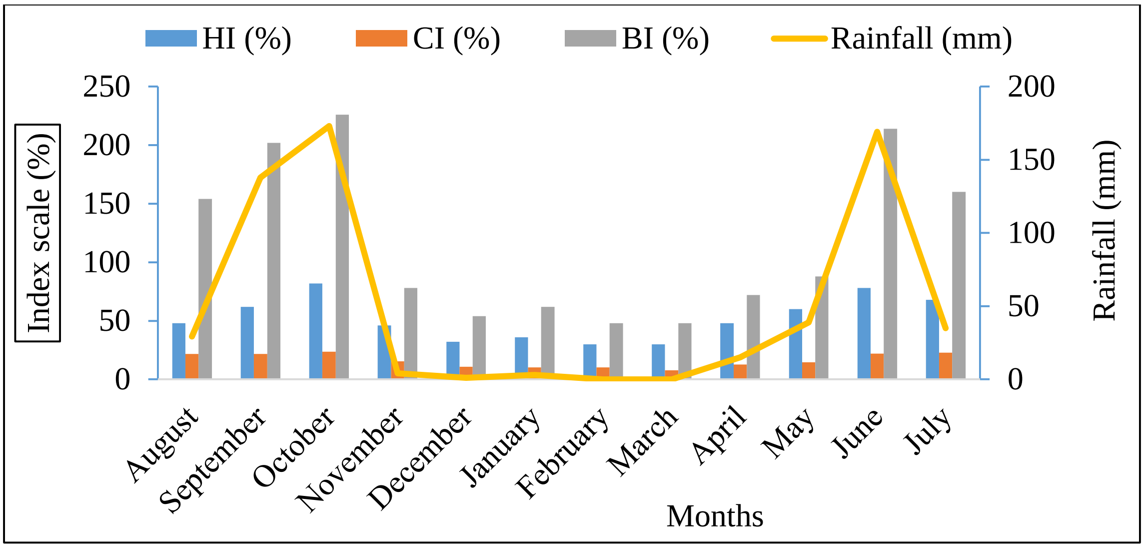
Months	Houses visited	Houses positive	Containers searched	Containers positive	HI (%)	CI (%)	BI (%)
August	50	24	355	77	48	21.70	154
September	50	31	467	101	62	21.63	202
October	50	41	580	113	82	23.60	226
November	50	23	252	39	46	15.48	78
December	50	16	251	27	32	10.76	54
January	50	18	313	31	36	10.10	62
February	50	15	235	24	30	10.21	48
March	50	15	309	24	30	7.77	48
April	50	24	283	36	48	12.72	72
May	50	30	300	44	60	14.67	88
June	50	39	485	107	78	22.06	214
July	50	34	352	80	68	22.73	160
Total	600	310	4182	703	51.67	16.81	117.17

HI= house index, CI= container index, BI= breteau index



HI= house index, CI= container index, BI= breteau index

Figure 2 Relationship of *Ae. aegypti* larvae population (BI, HI and CI) with rainfall in different periods of Kamma village, Monywa Township



HI= house index, CI= container index, BI= breteau index

Figure 3 Relationship of *Ae. aegypti* larvae population (BI, HI and CI) with rainfall in different periods of Kyauksitpon village, Monywa Township

Discussion

In Myanmar, vector borne diseases are a major public health problem. The rapid growth of population and industrial installation in urban and semi-urban areas has resulted in an alarming increase in mosquito's density. Water storage practices in the household for multipurpose use in city and rural areas provide year-round breeding opportunities for the vector. Untreated water in containers originated from pipe supply, tube wells, surface wells, ponds, and rainwater also encourage mosquito density(Maung Maung Mya *et al*., 2016).

In the present study, two types of study areas which are urban and rural were examined for *Ae. aegypti* larvae population indices. The housing index (HI) of Kamma village was the highest and followed by Kyauksitpon village and Myawaddy quarter. In the prevalence of index (CI), Myawaddy quarter was the highest and followed by Kamma village and Kyauksitpon village. However, the highest number of breteau index was found in Kyauksitpon village and followed by Kamma village and Myawaddy quarter. In all study areas, piped water supply system was not found, and the water taken from tube wells and bore wells is used for the requirement of households. Moreover, the less number of the well was found in rural areas and no coverage on the numbers of resident and house. In Kamma village, water from two houses was distributed to all houses in the village by the monthly fee.

In Myanmar, Maung Maung Mya *et al*., 2016 reported that entomology surveys in periurban areas of Mingalarywarthit and Taungnar villages, Hpa-an Township Kayin State which areas had high Dengue Haemorrhagic Fever (DHF) prevalence within the last five years. In Mingalarywarthit village, HI, CI, BI were 86.28%, 59.86 % and 172.50% respectively, whereas in Taungnar villages, HI, CI, BI were 80%, 22.06% and 206% respectively. Similarly, another study described entomological indicators with HI was 25.7%, CI was 15.5%, and BI was 48% (Thae Zar Chi Bo *et al*., 2016).

In Indonesia, the author reported 28% HI, 20.7% CI and 28.0% BI in dengue vector surveillance in Sujung village, Banten (Subahar *et al*., 2019). In India, researcher detected *Aedes* mosquitoes indices; HI, CI and BI were 43.3%, 16.4% and 146.8% respectively in 2014(Singh *et al*., 2015). The indices of *Ae. aegypti* were reported that HI, CI and BI were 14.29 %, 4.83% and 34.29% respectively in Thailand (Wongkoon *et al*., 2007). When compare the indices, the present study's entomological indicators were found higher than other research data. Differences of environmental conditions, weather conditions and times of study can effect on larval indices of *Ae. aegypti* mosquito.

World Health Organization (WHO) described that HI>5% and BI>20% for any locality are indicators of dengue- sensitive (WHO, 2003). Three levels of risk for dengue transmission: low (HI<0.1%), medium (HI 0.1%–5%), and high (HI>5%) were expressed by Pan American Health Organization(Sanchez *et al*., 2006). The National Institute of Communicable Diseases in India defined a high risk of DHF transmission when BI was ≥ 50, HI was ≥ 10, and a low risk of transmission when BI was ≤ 5, HI was ≤ 1(Wongkoon *et al*., 2007). Therefore, all larval indices of the present study are above the critical levels.

In the current study, the seasonal prevalence of *Ae. aegypti* was examined in relation to monthly rainfall. The highest indices (HI, CI, BI) were found in all study areas in October which month was the heaviest rainfall for one year. In March, rainfall was very low and the population of *Ae.aegypti*; HI, CI and BI were the lowest. The increasing of *Ae. aegypti* population was observed at above 100 mm rainfall in June, September and October. In Myawaddy quarter, seasonal prevalence and rainfall were more related than other study areas. This area had more tube wells and more vector control interventions. In Kamma village and Kyauksitpon village, the seasonal pattern of *Ae. aegypti* was moderately close to variations in rainfall. Although the less rainfall in some months, entomological indicators were to increase in these rural areas cause of water storage system. Therefore, different factors of seasonal prevalence between the urban area and rural areas were found in the present study.

In conclusion, high level indices of *Ae. aegypti* larval population were recorded in the present study and a dynamic population of *Ae. Aegypti* correlated with rainfall. The regular water supply system and dumping sites should be supported in all study areas. The elimination of discard containers and covering water storage containers should be made to reduce the vector population efficiently. Public health education, community intervention for prevention of vector breeding and information from mass media are required to create public awareness and to control mosquito transmitted diseases. A regular entomological survey is necessitated in the study areas for monitoring of *Ae. aegypti* breeding.

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