

# Seasonal Prevalence of *Aedes aegypti* in Semi-Urban Area of Yangon Region, Myanmar

San San Oo<sup>1\*</sup>, Tin Lay Mon<sup>1</sup>, Nyo Nyo Aung<sup>1</sup>, Thida Ei<sup>1</sup>, Toe Toe Soe<sup>1</sup>, Aye Aye Su<sup>1</sup>,  
Khin Khin Soe<sup>1</sup>, Khin Mar Lwin<sup>2</sup>, Thin Thin Soe<sup>2</sup>, Myat Lwin Htwe<sup>2</sup>

<sup>1</sup>Department of Zoology, Yangon University, Yangon, Myanmar

<sup>2</sup>Department of Zoology, Kyaing Tong University, Kyaing Tong, Myanmar

Email: \*sansanooyu@gmail.com

**How to cite this paper:** Oo, S.S., Mon, T.L., Aung, N.N., Ei, T., Soe, T.T., Su, A.A., Soe, K.K., Lwin, K.M., Soe, T.T. and Htwe, M.L. (2020) Seasonal Prevalence of *Aedes aegypti* in Semi-Urban Area of Yangon Region, Myanmar. *Advances in Entomology*, 8, 107-116.

<https://doi.org/10.4236/ae.2020.83008>

**Received:** March 23, 2020

**Accepted:** May 31, 2020

**Published:** June 3, 2020

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## Abstract

Prevalence rate of *Aedes aegypti* was conducted in 20 houses from semi-urban areas of Yangon Region. Larval surveys were done at indoors and outdoors water containers of five types. Prevalence rate of larval density larvae was investigated monthly by standard indices. The highest infestation rate of the container index (CI) was in June 2018 (56.52%), the second highest was in July 2017 (48.36%) and the lowest rate was in April 2017 (5.07%); those of the Jar index (JI) was highest (36.49%) in June and second highest rate (23.8%) was in October 2017. Reasoning the Metal drum (MI) was highest (13.95%) in June 2018 and second highest (6.25%) was in July 2017. The larval infestation rate of Earthen pot (EI) was highest (42.1%) in July 2017. The larval incident rate in almost all indices showed that the highest rate was at the beginning of monsoon season, in June and July, while in the remaining months, the larval incident rate was found to decrease due to the application of insecticides in the study area by the Township Public Health Department. However, the application of insecticides did not cover all the breeding sites of the mosquitoes, the water puddles under their houses were left to apply the insecticides. The positive larval incident rate was assessed by Household (HI), Container index (CI), Breteau index (BI). The highest and second highest positive larval incident rates were all in June 2018 and July 2017 in all indices, HI (27.3% and 23.4%), CI (56.52% and 48.36%), BI (17.56% and 16.79%) and SI (28.49% and 24.38%) respectively. The lowest rate in all indices was 2.56% (HI), 5.07% (IC), 2.67% (BI) and 1.91% (SI) in April. In this study, the fluctuation of indices of infestation rates and positive larval index value was positively correlated in similar trends in the study months. The reason for difficult control measure depends on the water sources under their houses and remains stagnant throughout the year, even in the dry season. High incident and death rates of the children due to Dengue/Dengue

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Haemorrhagic fever patients in June and July could not be directly correlated with the prevalence of *Aedes aegypti*. The control measure is needed to wash out the water source under the houses and to apply the insecticides to the all breeding sites.

### Keywords

*Aedes aegypti*, Infestation Rate, Positive Larval Indices, South Dagon Township

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## 1. Introduction

Mosquito species comprises 3500 species under the family Culicidae of order Diptera globally. The family Culicidae has two subfamilies, Anophelinae and Culinae. Mosquitoes are important vectors of diseases such as Malaria, Yellow fever, Chikungunya, West Nile, Dengue fever, filariasis, Zika and other arboviruses. By transmitting diseases, the mosquito causes the deaths of more people than any other animal taxa; over 700,000 each year [1].

The female mosquito *Aedes aegypti* is the main transmitted vector of the virus (DENV) causing Dengue Haemorrhagic Fever (DHF) which is one of the serious and acute diseases that is fatal to the children at most. The mosquito species *Aedes* can breed in any sources of water in Myanmar. This disease becomes spread into the central dry zone although it was in the lowland area of southern parts of Myanmar over the times of past [1] [2]. Most of the DHF cases occurred during wet season although few cases were also observed in cool and hot season, from November to May. In Yangon Division, monsoon started in later weeks of May and tailed off in the month of January (VBDC, South Dagon Division, Annual Report, 2017) [3] [4].

DHF is the disease of children and adult. Most of the cases about 90 percent occurred in children under 10 years of age. The most vulnerable age group is from three to seven years. From the prevention and control point of view, these ages are of preschools and primary schools. Therefore preschools and primary schools may be important sites of dissemination of dengue virus because *Aedes aegypti* has a short flight range and usually bites during the daytime [5] [6]. The dengue virus moves with the people, particularly children.

*Aedes aegypti* is the domestic habitants and in most instances is only in the semi-urban areas and in the country. After biting a person whose blood contains the virus, the female *Aedes aegypti*, mosquito can transmit dengue virus either immediately, by a change of host when its blood meal is interrupted, or after an incubation period 8 - 10 days, during which time the virus multiplies in the salivary glands of the vector. Therefore, a survey should be made to establish the presence of population density and seasonal prevalence of *Aedes* vectors and their resistance to insecticides. Thus vector should be the main target of surveillance and control activities (Mosquito Borne Diseases Bulletin Vol: 2. No.1,

2010) [7] [8]. Hence, this study was carried out the possibility of breeding sites and actual breeding sites of the study area. The study area is satellite area of Greater Yangon Area, and the area of the cases of Dengue fever. The community is importance for the disease control of mosquito of *Aedes*, Malayaria and others [9] [10].

## 2. Materials and Methods

### Site Selection and Study Period

The study area was chosen five wards, South Dagon Township of Yangon Region, Myanmar, situated about 45 kilometers, south of Yangon city was the survey area of the present research. Most of the houses in the ward were built of wood, bamboo and that, the remaining few were built of bricks and corrugated iron sheet houses. Water supply system was wells, and tube wells, the latter was few in numbers. There are also some ponds which collect rain water during raining season. Water storage is mainly by metal drums, ceramic jars, cement tanks, Plastic Tanks and earthen pots and is secondary by their under house.

### Selection of Houses

A total of 100 houses from five wards (20 houses from each ward) were chosen for larval collection. From those twenty houses, 20 houses belong to high categories people, 40 houses of middle categories people and the remaining 40 from low categories people.

### Resting Collection of Adult Mosquito

A total of 100 houses were selected to examine the breeding sites and adult collection from five wards. The mosquito nets (the size of 45 cm × 15 cm × 25 cm) were applied inside and outside of the houses to collect the adult mosquitoes using sucking tube during 8:00 am and 12:00 am.

### Adult Survey: Biting and Landing Collection

Biting and landing collection of adult mosquitoes was observed inside houses. A total of 100 houses were chosen for adult landing and biting collections. In a house at a place where there is diffuse light an insect collector sat quietly and with the help of a torch light and a sucking tube collects all the mosquitoes collected into the test tubes or Barraud's cage and then label it properly. The same procedure was repeated in the next houses. During the operation, two insect collectors were utilized and 20 - 30 minutes were spent in each hour. After the end of the operation of the day all the mosquitoes collected were taken for identification.

### Larval Survey

From these 100 houses, premises of indoor and outdoor were thoroughly surveyed for all the potential breeding source of *Aedes aegypti*. The survey was done in the same houses for throughout the year. Water containers were observed to be such as metal drums, ceramic jars, cement tanks, earthen pots, and miscellaneous.

### Data Analysis

The larval surveillance was followed by Dengue guideline of World Health

Organization (2010). Formulae of four indices: House Index, Containers Index, Breteau Index and Stegomyia Index and Landing/Biting rate, and resting rate to assess the incident rate of *Aedes aegypti* larvae and adults were as followed:

$$\text{House Index} = \frac{\text{No. of houses that are positive for } Aedes aegypti \text{ larvae}}{\text{No. of houses examined}} \times 100$$

$$\text{Container Index} = \frac{\text{No. of water holding containers that are positive for } Aedes aegypti \text{ larvae}}{\text{No. of water holding containers examined}} \times 100$$

Breteau Index = No. of positive containers with *Aedes aegypti* larvae per 100 houses

Stegomyia Index = No. of positive containers with *Aedes aegypti* larvae per population of 1000

Landing/Biting Rate = Average No. of adult female *Aedes aegypti* larvae caught during the act of biting human bait/man/hour

Resting Rate = The average number of female adult *Aedes aegypti* caught while resting/man/hour

### 3. Results

The present study conducted to assess the infestation rates and positive larval incident rate of the mosquito vector species *Aedes aegypti* causing the Dengue Hemorrhagic fever, at five wards of South Dagon Township, the suburban area of Greater Yangon Region. The containers, Jars, metal drums and earthen pots filled with water, disposed at inside and outside the houses of that area are the ovipositing sites of the *Aedes aegypti*. Their abundance is remarkably due to highly potential mosquito breeding sites.

Myanmar has favorable weather condition for the breeding of mosquitoes, especially in Yangon which has the humid and moist throughout the year. The semi-urban area of Yangon Region had an average temperature of (19.1°C - 38.2°C) and humidity (62 mgh - 96 mgh). However, the rainfall was found in four months, June, July, August and September. The rainfall started in June and the highest rainfall was in July (44 inches) (Table 1). These are favourable condition of the breeding of the mosquitoes.

Incident rate of larvae and adult revealed to vary in the five wards of South Dagon Township. Breeding habitats of *Aedes aegypti* of five different categories were classified in the study sites. The infested rate of Containers was highest (56.52%) in June 2018 and second highest was in July 2017. The containers are mostly plastic containers and aluminum inside which the domestic water is temporarily stored for cooking, washing and taking bathes. The water is stored in the containers during the water supplying time by Municipal Department of Yangon Region. Sometimes, they have to take the water from ground water. Most containers are uncovered although some have covers or lids and that is good chances for the ovipositing of the mosquitoes.

In the Ceramic, the infested rate was highest (36.49%) in June 2018 and second

**Table 1.** Infestation rates of container, jar, metal drum and earth pots in South Dagon Township.

Study	Container			Jar			Metal Drum			Earth pots		
	Date	IS	IF	%	IS	IF	%	IS	IF	%	IS	IF
Jul, 2017	184	89	48.36	263	19	7.22	16	1	6.25	38	16	42.1
Aug, 2017	170	24	14.11	287	8	2.72	15	0	0	40	15	37.5
Sep, 2017	255	17	6.66	468	25	5.34	83	0	0	51	2	39.2
Oct, 2017	219	15	6.84	294	70	23.8	90	4	4.44	29	1	39.2
Nov, 2017	194	12	6.1	316	42	13.29	1	0	0	22	2	9.09
Dec, 2017	209	16	6.69	327	42	12.84	62	0	0	57	0	0
Jan, 2018	239	18	7.53	290	31	10.8	10	0	0	55	7	11.33
Feb, 2018	226	19	8.4	323	28	8.66	72	0	0	73	11	15.05
Mar, 2018	247	16	6.47	396	3	0.75	135	0	0	49	0	0
Apr, 2018	138	7	5.07	438	22	5.02	0	0	0	20	0	0
May, 2018	213	19	8.92	370	0	0	0	0	0	32	0	0
Jun, 2018	184	104	56.52	496	181	36.49	43	6	13.95	83	63	7.95

IS = Inspection rate, IF = infestation rate.

was in July, 2017. In the earthen pots, and the average of infested rate was highest (7.95%) in June 2018 and second was in July 2017. In the Metal drums, the infested rate was highest (13.95%) in June 2018 and second was in July 2017. However, the miscellaneous containers did not showed the incident rates of *Aedes aegypti* larvae. Monthly variation during the period, from July 2017 to June 2018 also showed in those five wards. Miscellaneous containers is not used for the purpose of storing water but for keeping water only for things like flower vases, ants guards etc. (Table 1 and Figure 1). Inspection rate and infestation rate was observed in throughout the years, the main weather parameter for the breeding potential was rainfall (Table 4).

According to the House Index, the highest larval incident rate was in June, the first month of raining season, after that it declined in July, August, continued declines in April and May. The most commonly used container was ceramic jars, earthen pots, cement tanks and metal drums was the least used. These are the in order of preference. Miscellaneous containers was not be accounted for the larval incident rate, because miscellaneous containers is not used for the purpose of water storage. The storage water was kept only in the items like flower vases, ants guards etc. Therefore, the main four water storage containers were ceramic jars, metal drums, earthen pots and cement tanks. Table 1 show that the most productive item for *Aedes aegypti* larvae was in ceramic jars during the whole period of twelve months survey, which was followed by containers, miscellaneous, cement tanks, metal drums and earthen pots (Table 2 and Figure 2).

For the larval incident rates, the index of the Container Index (C.I) showed the highest value in June while those of the House Index (H.I) was highest in

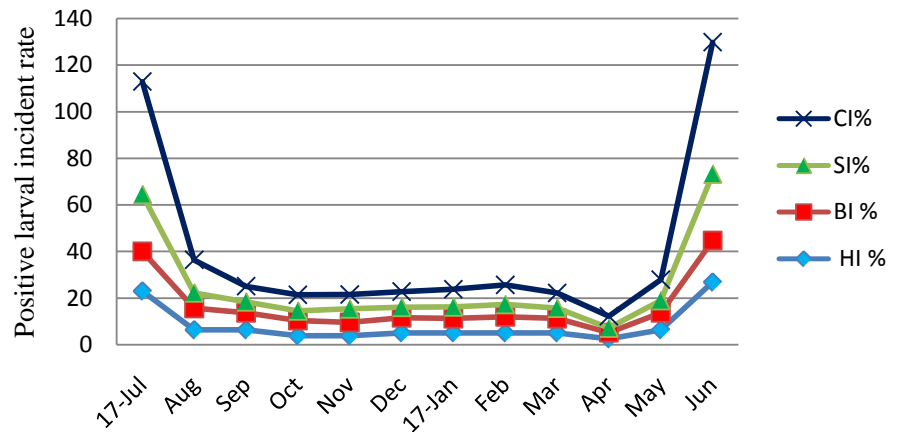


Figure 1. Positive larval indices of *Aedes aegypti* in South Dagon Township.

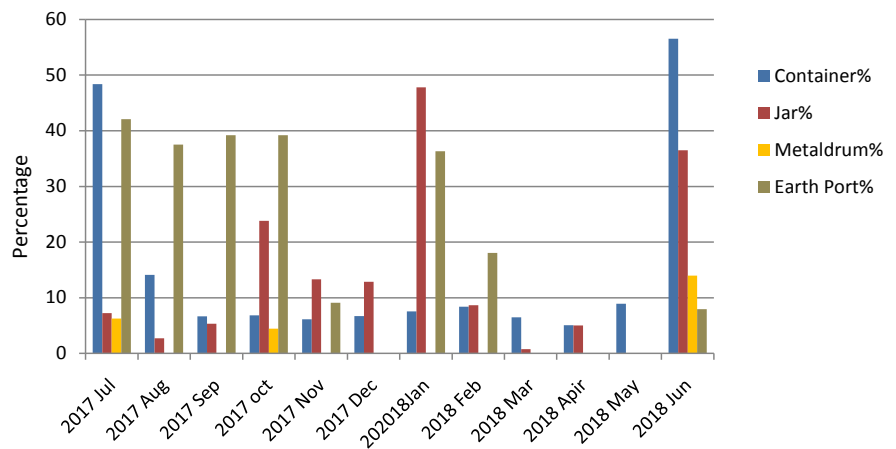


Figure 2. Percentage (%) positive of water storages in South Dagon Township.

Table 2. Positive larval indices of *Aedes aegypti* in South Dagon Township.

Month	HI	HI%	CI%	BI	BI%	SI	SI%
Jul-17	36	23.08	48.36	220	16.79	89	24.38
Aug	10	6.41	14.11	120	9.16	24	6.57
Sep	6	3.85	6.66	85	6.49	17	4.66
Oct	6	3.85	6.84	75	5.73	15	4.11
Nov	8	5.13	6.1	105	8.02	21	5.75
Dec	8	5.13	6.69	80	6.11	16	4.38
Jan 18	8	5.13	7.53	90	6.87	18	4.93
Feb	10	6.41	8.4	95	7.25	19	5.20
Mar	8	5.13	6.47	80	6.11	16	4.38
Apr	4	2.56	5.07	35	2.67	7	1.91
May	10	6.41	8.92	95	7.25	19	5.20
Jun	42	26.92	56.52	230	17.56	104	28.49

HI = House Index, CI = Container Index, BI= Breteau Index, SI = Stegomyia.

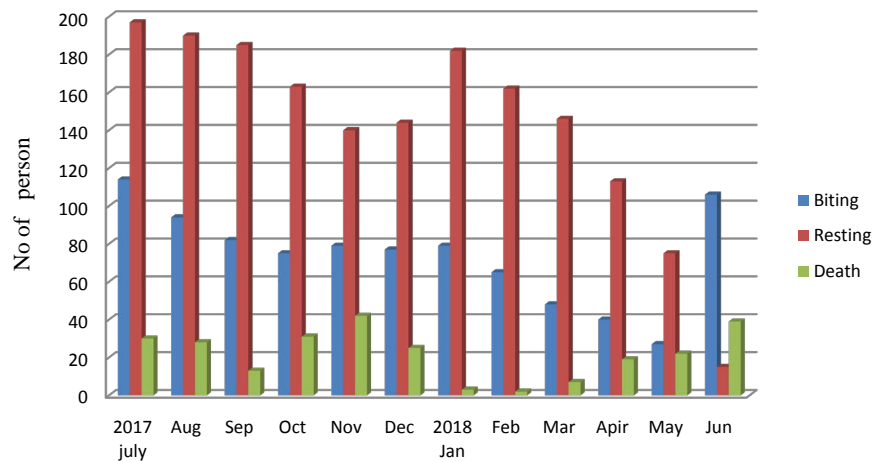
throughout the rainy season. Maximum values of Breteau Index (B.I) and Stegomyia Index (S.I) were also examined in June (Table 2 and Figure 2). The highest rate was observed in the first month of the rainy season. According to adult biting and resting Collection, biting rate of the female was highest in July 2018 and that of resting rate was also in July in all five wards (Table 3 and Figure 3). Generally, all most all data showed that highest values of all indices was in the first month of rainy season and then decreased in other remaining months of the rainy season. It was correlated with the intensity of rainfall parameters (Table 4).

**Table 3.** Occurrence of biting rate, resting rating and death rating.

Month	Biting rate	Resting rate	Death rate
July, 2017	114	197	30
Aug	94	190	28
Sep	82	185	13
Oct	75	163	31
Nov	79	140	42
Dec	77	144	25
Jan, 2018	79	182	3
Feb	65	162	2
Mar	48	146	7
Apr	40	113	19
May	27	75	22
Jun	106	15	39

**Table 4.** Some environmental weather parameter of south Dagon Township.

Studied Months	Average Maximum Temperature (°C)		Average Minimum Temperature (°C)		Average Humidity 9:30 am		Average Humidity 18:30 pm		Average Rainfall	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Jan	32.1	32.8	17.3	19.1	70.5	65.5	60.5	55.0	0	0
Feb	35.5	34.3	18.3	19.4	58.5	78.5	43.5	54.0	0	0
Mar	36.1	36.9	19.5	21.0	69.5	70.0	48.0	48.5	0	0
April	35.8	38.2	23.3	23.0	76.0	73.0	49.5	48.5	0	0
May	37.5	38.2	24.4	24.0	66.5	62.5	61.5	61.0	0	0
Jun	31.0	28.7	24.1	23.9	90.5	94.0	85.5	100.0	18	6
Jul	30.4	29.8	24.1	24.0	96.0	96.5	92.5	98.0	44	8
Aug	30.8	31.7	25.8	23.3	90.5	94.0	90.0	88.0	35.5	20.5
Sept	33.1	34.6	24.0	22.9	85.0	92.5	84.5	94.0	1.5	25.5
Oct.	34.8	34.0	22.0	22.1	85.0	77.0	92.5	84.5	28.5	0
Nov	33.3	33.5	18.4	22.7	74.0	79.0	86.0	92.5	0	0
Dec	33.2	33.4	18.5	20.2	74.5	80.5	69.5	77.0	0	0



**Figure 3.** Comparison of the biting & resting of *Aedes aegypti* with the death rate of DHF.

According to larval incident rate on the domestic water containers, the rate was much higher on the container among other kinds of containers, in which the highest rate was in June (56.52%). The lowest inspection was observed in the pots among other kinds of containers. The inspection rate was higher in rainy season than in the rest of months (Table 1 and Figure 1).

In the comparison of the biting and resting of *Aedes aegypti* with the death rate of DHF, they all showed that highest month was in June and July. This is DHF data of South Dagon Township (Table 3 and Figure 3). The Government and Medical care centers provided the pesticide to people to control those vectors of *Aedes aegypti* in the South Dagon Township. The local people sprayed the pesticides on the inside and outside the houses, not under the house, where there is the water puddle. They left to spray the insecticides. The vector *Aedes aegypti* can survive in the water puddle under their houses (Table 3).

#### 4. Discussion

The infestation rate and larval indices were observed to be highest in the month of June 2017 although it was the lowest in 2018 May. Similarly, all the indices showed that the highest rate was in the same month and they declined gradually for the remaining months. The first rain during June was the most favorable time for the breeding of *Aedes aegypti*. The subsequent months of the rainy season were also the favorable condition. The reason for the decline of indices values in subsequent months was the applying of the insecticides by the Regional Public Health Department. Then they also educated the local people to control the breeding sites of the mosquitoes. They announced the program to follow for the control measure of the larval oviposition sites as “covered”, “discarded”, “filtered” and “change the storage water”. The first measure of the program is to cover any water containers. The second one is to discard the water stored in the containers. The third one is to filter the water storing in the container. The fourth program is to change frequently the water stored in the containers. The spraying of the insecticides does not cover the whole breeding sites as puddles,



and small pieces. Hence, the larvae were found only in puddle under the houses. No mosquito larvae were found in any other water sources because of the controlling measures.

All water sources including drainage water flooded under house are pH7 which is the most suitable condition for breeding of *Aedes aegypti*. One of the control measures of the insect is to change the water pH under the houses by applying lime powder to be alkalinity or any other mild organic acids into it on the aspect of water pH level.

In the wards living the poor man, the highest biting rate of the adult vectors was in the month of June and the lowest was in the month of April. For the first few months, regarding landing/resting density was irregular, but after September it was more or less in a regular pattern. The first two months, June and July which gave the highest densities might be due to heavy rain and where there were proliferations of breeding places, hence, there were high densities of resting rate during those months. From biting and resting collections in the first few month the graph was distorted but later it was found be in a regular manner. It was observed that biting and resting patterns were not consistent. Not all resting insects are biting, only female mosquitoes can bite the victims. This is natural that the biting rate is lower than the resting rate.

The control measure should start as soon as the coming of the rainy season. Since DHF is permanent treatment and health education should be started as soon as monsoon season and provision should be regularly, beginning at schools and continuing throughout life based on accurate information. The importance of DHF and control measure should be announced using all available media. While health education to the school aim to cover the whole population, more specific efforts should be directed towards providing information for key components of the community, such as public health services staff and teachers. In recent years, this DHF case was found not only to the children but also to the adults. Hence, this case becomes more serious due to the more frequent death cases in the adults.

### **Acknowledgements**

I would like to thank Dr. Aye Mi San, Head and Professor of Zoology Department, Yangon University for her permission to conduct the research work. Thanks are also due to Daw Khin Mar Win, Senior Entomologist, Department of Health (Malaria Control), Nay Pyi Taw and Grateful thank are due to my husband, Professor Dr. Khin Maung Swe, Head and Professor (Retd.) of Zoology Department, Dagon University for his moral and financial support, encouragement and suggestion for the work.

### **Conflicts of Interest**

The authors declare no conflicts of interest regarding the publication of this paper.

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