



PREVALENCE AND BIONOMICS OF *Aedes* MOSQUITOES IN AMUEHTAN WARD THANLYIN TOWNSHIP, YANGON REGION

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ABSTRACT

Prevalence *Aedes aegypti* larvae and its bionomics study was conducted in Amuehtan ward in Than Lyin Township Yangon Region using non-intervention descriptive field investigation method. A total of 53 households were randomly inspected for *Aedes* larvae breeding water storage containers in Amuehtan ward. *Aedes* larvae habitats or *Aedes* larvae positive containers of different container categories as major, minor and miscellaneous sources and types were recorded as well as compared with each other. *Aedes* larvae positivity was also measured against place, condition of containers (covered or un covered). Larva indices as House Index (HI), Container Index (CI), Breteau Index (BI) and percentage of Key containers, Key premises and Pupal indices were also calculated. Result found that a total of 32(60.38%) households were found to be *Aedes* larvae positive in water storage containers in Amuehtan ward. Larva positivity were found 27.27% of major, 11.80% of minor and 58.33% of miscellaneous containers in Amuehtan ward respectively. In Amuehtan ward 36.11% of plastic drums in major, 33.33% paint buckets in minor, and 64.30% of discarded car tire in miscellaneous containers were found highest percentage of positive containers. Positivity of key premises was higher 10(18.87%) in Amuehtan ward although key container was found 4.79%. Larval indices such as House Index (HI) Container Index (CI) and Breteau Index (BI) were found to be 60.38%, 21.26%, and 133.96 respectively in Amuehtan ward. Pupal indices in villages were found to be highest in children 13.67 Pupae/child followed by pupae/household i.e. 7.45 in Amuehtan ward. Black and blue coloured containers, open area placed and without covered containers were found highly larval positivity. In conclusion Plastic drum, paint buckets and car tires were highly positive for *Aedes* larvae. Mostly plastic drum, metal drums, concrete jars, paint buckets, plastic bucket, Spirit bowls and discarded car tires were found (over 500 each larvae) key containers. Therefore, there were urgently need to control *Aedes* larvae in Amuehtan ward Thanlyin Township using different larval control methods as nets sweeper, chemical method as abate, larvivorous fishes which is more suitable and also need community base participation.

KEYWORDS: *Aedes* larvae, larvivorous fishes.

INTRODUCTION

There are three genera of mosquitoes. They are *Aedes*, *Culex* and *Anopheles*. *Aedes aegypti* is one of the world's most widely distributed mosquitoes and is of considerable medical importance as a vector of dengue fever, dengue haemorrhagic fever (DHF) and yellow fever (Service, 1992). *Culex quinquefasciatus* transmits: Japanese encephalitis, West Nile fever, Viral arthritis, Polyarthrits and *Anopheles* transmits Malaria (Gordon *et al.*, 1962). Mosquito is prevalent world over especially between latitude 45° north and latitude 40° south and the tropic regions (WHO, 1996). Especially in recent years, the distribution space of both mosquitoes and mosquito-borne disease has been changing and expanding for reasons such as increasing rates of environmental corruption, climatic changes, vector and pathogen

resistance to insecticides and drugs, progressive urbanization and population movement (WHO, 1984). *Aedes aegypti* is generally thought to be the vector of dengue in more urban areas, so *Ae. Aegypti* is the more important to treat. The species *Ae. Aegypti* is considered as the major vector of dengue fever, dengue haemorrhagic fever and dengue shock syndrome (DF, DHF, DSS) in many subtropical and tropical countries throughout the world. Prevention of DHF outbreaks in endemic areas is based on long term anti mosquito control measures particularly household and environmental sanitation with emphasis on larval source reduction. Only vector control promises permanency and a cost effective solution (Halstead, 1988).

Clinically recognizable DHF was first noticed in 1969 in Yangon Children's Hospital followed by the first epidemic in Yangon in the year 1970 (Tun Tun Aung *et al.*, 1996). The incidence of DHF increased over the two decades. The spread of DHF from Yangon to other States and Regions started at the beginning of 1975 (VBDC, 1990). High number of dengue haemorrhagic fever (DHF) transmission occurs during raining season from May to October. Water storage practices in Yangon city provide year round breeding opportunities for the vector. In States and Regions, *Aedes* breeding sites become established only in raining season when the locals store rain water for the domestic usages.

In the last 50 years incidence have increased 30-folds with increasing geographic expansion to new countries and in the present decade, from urban to rural setting. An estimate that 50 million peoples are at risk in dengue endemic countries (WHO 2008). In South East Asia and Western Pacific Regions, which bear nearly 75% of the current global disease burden due to dengue (WHO 2009). Dengue Fever and DHF are increasingly becoming serious public health problems in Myanmar especially among the 5-10 and 11-15 years old age groups and now noted 15 years above, a vast majority of the cases occur in 5-8 years old age group (Chusak *et al.*, 1998, Hlaing Myat Thu, 2009). In Myanmar, the highest numbers of DHF cases were reported from Irrawaddy, Kachin, Magway, Mandalay, Mon, Rakkine, Sagaing, Tanintharyi and Yangon regions (Tun Tun Aung *et al.*, 1996). A severe outbreak of DHF occurred for the first time in Yangon in 1970 (Ohn Khin, 1985). The urban areas within the Yangon Regions limits were more affected than the suburban townships of Yangon Division. This epidemic had an affected mostly school going are groups. Generally more DHF cases predominate during the raining season especially in July and August. Highest number of cases was recorded in July (Ohn Khin, 1985). However, the intervals between dengue outbreaks become shorter in the last two decades. High dengue cases in the raining season correspond to the seasonal high densities of *Aedes aegypti* mosquitoes. Only symptomatic treatment is available for the patients. Preventive vaccines are not yet available commercially.

Population growth and industrial installation in Thanlwin Township, Yangon Region is necessary accompanied by simultaneous urban development. Therefore, a considerable number of inhabitants living in over crowded periurban districts with unhygienic living conditions provide favourable breeding sites for mosquitoes. In drawing up strategies of *Aedes* control, it is essential that detail bionomic of the mosquito should be studied and clearly understood. As the DHF cases are correlated to the density of *Aedes aegypti* of the locality, factors influencing the seasonal abundance of the vector needed to be studied in detail. The present study was conducted with the following objectives; (1) to determine the prevalence of immature *Aedes aegypti* population in water storage containers in one ward of Thanlwin

Township and (2) to investigate the larval and pupal indices, key containers and key premises of *Aedes* larvae as well as containers placing site, covered and without covered containers and coloured of the containers were recorded and calculated.

MATERIAL AND METHODS

Study area, study sites and study period.

Thanlyin Township is situated at Yangon Region. The population of Than Lwin Township is about (301051 persons) and is divided into (264) villages (Census, 2015). Periurban areas of Amuehtan Ward 95° 2' 4.11" east longitude and 21° 19' 38.14" north latitude of Thanlwin Township, Yangon Region with high DHF prevalence within the last five years were chosen as study sites. In the ward nursery and day care centers, pre and primary schools were recorded. The inspected site was chosen randomly in cluster. This study was conducted in December, 2018 in Amuehtan Ward, Thanlwin Township, Yangon Region.

Study design

The study was conducted using non-intervention descriptive field investigation method. All potential breeding sites in suspected high risk areas were examined in order to carry out the systematic study. Larva positive containers of different container categories and types were recorded and compared with each other. The breeding sources were divided into major, minor and miscellaneous sources. Metal drums, concrete tank, concrete jar, glazed or unglazed earthen jars (big bago jar) (size 30 L-100 L), were considered as major sources. Other sources such as small bago jars (glazed jars), water buckets, plastic bowls, flower vases, small glazed earthen bowls and ant-guards were considered as minor sources. Miscellaneous container categories contain discarded utensils (coconut shell, old cans discarded car tires etc.), earthen pots, broken bago jars, tree hole and hollow bamboo pole.

Larval indices

Larval survey in the selected areas were carried out according to WHO, 1996. *Aedes* larvae positivity in all kinds of water storage containers (major, minor and miscellaneous) were detected and recorded in the study area. House Index (HI), Container Index (CI), Breteau Index (BI) and percentage of Key containers (>500 larvae/container) and Key premises (three and above positive containers/house) were calculated. Pupal indices as pupae/ child, pupae/ person and pupae/ container were also calculated as well as containers placing site, covered and without covered containers and coloured of the containers were recorded and calculated.

Larval indices were calculated as follows:

$$(a) \text{ House Index (HI)} = \frac{\text{No. of house positive for } Aedes \text{ aegypti} \text{ larvae} \times 100}{\text{Total number of house examined}}$$

$$(b) \text{ Container Index (CI)} = \frac{\text{No. of container positive for } Aedes \text{ aegypti} \text{ larvae} \times 100}{\text{Total number of container examined}}$$

(c) Breteau Index (BI) = No. of positive containers per 100 houses.

(d) Key containers = 500 and above larvae positive per container.

(e) Key premises = three and above positive containers with *Aedes* larvae per house.

Identification of specimens

Aedes species identification was done according to Rampa and Prachong, 1994.

Data collection method

Standard sheet for data collection was developed and noted down for the particulars including total water holding containers with water, type of water containers, larva positivity, larva and pupa count and percentages of positive containers.

Statistical analyses

Field data were recorded in appropriate forms and statistical analyses were conducted using Microsoft Excel. In addition comparison in percentage of positive containers in studied area was also used Microsoft Excel.

RESULT

Table 1: Larva positive rate of major water storage containers during survey period in Amuehtan Ward in Thanlyin Township (Water pH 7 & 23-24 °C). (A) Major containers.

Sr. No.	No. Containers	Total container	Positive container	% of Positive density
1	Metal drum	29	9 (31.03%)	25.00
2	Plastic drum	38	13 (34.20%)	36.11
3	Concrete tank	15	2 (13.33%)	5.56
4	Big Bago jar	14	3 (21.43%)	8.33
5	Over head tank	11	0	0
6	Concrete drum	2	1 (50.00%)	2.78
7	Concrete jars	23	8 (34.78%)	22.22
Total		132	36 (27.27%)	100%

Table 1. shows that the highest percentage 36.11% of *Aedes* larvae positivity was found in Plastic drum followed by Metal drum 25.00% and lowest positivity

was found 2.78% in Concrete drum. And also Concrete jars was found 22.22% larva positivity. Overhead tank was found no positivity.

Table 2: Larva positive rate of minor water storage containers during survey period in Amuehtan Ward in Thanlyin Township (Water pH 7 & 23-24 °C).

Sr. No.	No. Containers	Total container	Positive container	% of Positive density
1	Small Bago jar	15	2 (13.33%)	9.52
2	Spirit flower pot	12	1 (8.33%)	4.76
3	Sprit earthen pot	1	0	0
4	Spirit bowl	8	2 (25.00%)	9.52
5	Spirit cup	6	0	0
6	Metal bucket	5	2 (40.00%)	9.52
7	Plastic bucket	69	3 (4.35%)	14.29
8	Paint bucket	19	7(36.84%)	33.33
9	Plastic bowl	26	1(3.85%)	4.76
10	Metal bowl	2	0	0
11	Earthen pot	11	2(18.18%)	9.52
12	Small metal drum	3	1(33.33%)	4.76
13	Small concrete tank	1	0	0
Total		178	21 (11.80%)	100%

Table 2. shows that the highest percentage 33.33% of *Aedes* larvae positivity was found in Paint buckets followed by Plastic bucket 14.29 % and lowest positivity was found 4.76% in Spirit flower pot, Plastic bowl and Small metal drum.

Table 3. Larva positive rate of miscellaneous water storage containers during survey period in Amuehtan Ward in Thanlyin Township (Water pH 7 & 23-24 °C).

Sr. No.	No. Containers	Total container	Positive container	% of Positive density
1	Tyre	10	9 (90.00%)	64.29
2	Plastic bowl	1	0	0
3	Paint bucket	5	1(20.00%)	7.14
4	Sprinkle water bucket	1	1(100%)	7.14
5	Concrete jar	1	1(100%)	7.14
6	Earthen pot	2	0	0
7	Big pure water bottle	2	1 (50.00%)	7.14
8	Bago jar	1	1(100%)	7.14
9	Freeze vegetable tray	1	0	0
Total		24	14 (58.33%)	100%

Table 3. shows that the highest percentage 64.29% of *Aedes* larvae positivity was found in Car tyres and other miscellaneous containers as Paint bucket, Sprinkle water

bucket, discarded Concrete jar, big pure water bottle and discarded Bago jar one each was found *Aedes* larvae positive (7.14%).

Table 4: *Aedes* larvae positivity in water storage containers of houses in Amuehtan Ward in Thanlyin Township (Water pH 7 & 23-24 °C).

Total inspected households	Total positive households	Total inspected containers	Total positive containers	Key containers	Key premises	Major containers		Minor containers		Miscellaneous containers	
53	32	334	71	16	10	132	36	178	21	24	14
% positivity	60.38		21.26	4.79	18.87		27.27		11.80		58.33

Table 4 shows that 60.38 of houses and 21.26% of the water storage containers were found *Aedes* larvae positive of this 4.79% key containers (>500 and above larvae positive container) and 18.87% of the key premises (> 3 & above containers positive houses) were positive as well as 27.27% of major, 11.80% of minor and 58.33% of miscellaneous containers were positive in Amuehtan Ward Thanlyin Township.

Table 5: Larval indices of water storage containers in Amuehtan Ward in Thanlyin Township.

House Index	Container Index	Breatue Index
60.37%	21.26%	138.96%

Table 5 shows that the *Aedes* larval indices in Amuehtan Ward, Thanlyin Township, it was found that 60.37% of HI, 21.26% CI and 138.96% of BI were observed.

Table 6: Key containers and key premises of water storage containers and houses in Amuehtan Ward in Thanlyin Township.

Key containers	Key premises
16	10
4.79%	18.17%

Table 6: Shows that 4.76% Key containers and 18.17% Key premises were found in Amuehtan Ward in Thanlyin Township.

Table 7: Pupal indices of Amuehtan Ward in Thanlyin Township.

Inspected materials	Sin Lan village		
	Total samples	Pupa positivity	Pupa indices
Total household	53	395	7.45 P/h
Total population	218	395	1.81 P/p
>12yr = adult	188	395	3.35 P/a
<12 yr. = children	30	395	13.17 P/c
Total inspected containers	334	395	1.18 P/ic
Total larvae positive containers	71	395	5.56 P/pc

P/h =Pupae/ household, P/p=Pupae/ person, P/a=Pupae/ adult, P/c=Pupae/child,

P/ic=Pupae/ inspected container, P/pc=Pupae/positive container

Table 7. shows that The pupal indices of Amuehtan Ward in Thanlyin was found to be highest in children 13.17 pupae/child followed by 7.45 pupae/household, lowest was found in 1.18 pupae/inspected container.

Table 8: Larval positivity rate according to uncovered, covered and half covered domestic water storage containers.

	Major Container			Minor Container			Miscellaneous			% positivity	
	Water Container	Larva (+) Container %	% positivity	Water Container	Larva (+) Container %	% positivity	Water Container	Larva (+) Container %	% positivity	Total %	Larva + ve container
Un covered	75	24 (32.00%)	66.67	164	20 (12.20%)	95.24	24	14 (58.33%)	100	263 (78.74)	58 (81.69%)
Covered	45	10 (20.00%)	27.78	11	1 (9.10%)	4.76	0	0	0	56 (16.77)	11 (15.49%)
Half covered	12	2 (16.67%)	5.56	3	0	0	0	0	0	15 (4.49)	2 (2.82%)
Total % (+ ve)	132	36 (27.27%)	100%	179	21 (11.80%)	100%	24	14 (58.33%)	100%	334 (100%)	71 (100%)

Table 8. Showed that a total of 334 domestic water containers were investigated and found that 263 (78.74%) of containers were uncovered, 56 (16.77%) containers were covered and 15(4.49%) containers were found half covered. Of this 66.67% of major, 95.24 % of minor and 58.33% of miscellaneous of uncovered containers were found highest larvae positivity, followed by covered water storage container i.e 27.78% major, 4.76% minor and larva positivity in half covered containers were found only in major water storage containers i.e. 5.56%.

DISCUSSION

Mosquitoes are the single largest group of insects, which serve as intermediate hosts in the transmission of many important human diseases as malaria, dengue fever, yellow fever and filariasis. Dengue Fever mosquito breeding grounds is differ in different water storage container with pure water such as old tires, flower pots, aluminum cans, bird baths, rain gutters, tree holes, and many other items that can hold even small amounts of water. Many will lay their eggs in damp soil; the eggs will hatch when flood waters cover them (Seng & Jute 1994).The mosquito *Ae. aegypti* usually lays their eggs on the oviposition site wall, just above water level, generally in man-made containers that are located around cities (Fay & Perry 1965, Reiter 2007).

In the present study gravid *Aedes* mosquitoes laid their eggs in metal drum, Plastic drum, Concrete tank, Big Bago jars, Concrete drum and Concrete jars of major containers, Small Bago jar, Spirit flower pot, Spirit bowl, Metal bucket, Plastic bucket, Paint bucket, Plastic bowl, Earthen pot, and small metal drum of minor containers and Tyre, Paint bucket Sprinkle water bucket, discarded Concrete jar, Big pure water bottle, discarded Bago jar of miscellaneous containers. Of this the highest percentage of *Aedes* larvae were found in plastic drum 36.11%, Metal drum 25.00% and Concrete jars 22.22% in major containers, 33.33% of Paint buckets and Plastic bucket(14.29%) in Minor containers and Car Tyre

(64.29%) in Miscellaneous container. Although Zin May Htet (2018) revealed that in Pakokku Township, highest percentage of *Aedes* larvae were found 89.66% in Concrete jars in major containers, 39.32% of flower pots, 20.875 of small bago jars, 29.13% of earthen pots in minor containers and 86.87% of Earthen bowls in miscellaneous were found highest positivity in three container categories of water storage containers. Moe Kyaing (2017) observed that when compare the containers positivity of *Aedes* larvae in Sin Lan village and Anout Taw village of Pakokku Township, Magway Region, the highest number of big bago jars were positive with *Aedes* larvae in major containers followed by concrete tank, in minor containers, earthen pots were found highest larval positivity followed by flower pots. In the present study mostly spirit flower pots and spirit bowls were used in semi outdoor for worshipping flowers to Spirit and 81.69% of the major minor and miscellaneous containers were placed out door of the houses without cover. Same result has been found in Hpa-an Township Kayin State, because these water storage containers were placed forward and back ward of the house's under the gutters, without covers to keep water for household used and found big bago jars were highly positivity with *Aedes* larvae (Than Than Kyi, 2015, Maung Maung Mya et al., 2016). Although other researchers found that metal drums, bago jars, concrete jars and discarded car tyres were highly larvae positive in Yangon areas. Because metal drums, bago jars and concrete jars which containers were placed under the gutters to keep rain water in raining season and lage number of discarded car tyres were placed in outdoor of car workshops (Tun Lin et al., 1995, Pe Than Htun et al., 2010, Maung Maung Mya et al., 2011). Researchers revealed that metal drum and big Bago jars in major and earthen pot and small Bago jars, flower pots in minor and discarded earthen pot and car tier were found highly positive with *Aedes* larvae in Kyi Myint Tine Township, Shew Pyi Thar Township, and Thakayta Township (Tun Lin et al., 1995, Maung Maung Mya et al., 2011,2013). Although Pe Than Htun et al., 2010) observed that concrete jars were found *Aedes* larvae were highly

positive in dry season in Dala areas in Yangon region. Flower pots were found highly positive in Word No. 6. Same results has been observed in Hpa-an Township, high numbers of minor containers were inspected in Taung Nar village because the villagers used high number of flower vases in household for worshipping of religious purposes (Than Than Kyi, 2015). Although other researchers observed that in Yangon areas, mostly larvae were positive in spirit bowls, metal drums and concrete jars (Pe Than Htun *et al.*, 2010, Maung Maung Mya *et al.*, 2011). In the present study Plastic drums, Metal drums, Concrete jars, Paint bucket, Plastic bucket and Car tyres were found high number of *Aedes* larvae positivity.

In the present study 16(4.79%) key containers were found in Amuehtan Ward in Thanlyin Township Yangon Region. Same study in Pakakku revealed that 2 concrete jars and 1 concrete tank in major, 2 earthen pots in minor and 1 earthen bowl in miscellaneous respectively (Zin May Htet 2018). A recent study in pakakku Township found that seven Key containers (over 500 larvae positive container) five in major containers (one big bago jar, one metal drum, one plastic drum and two concrete tanks) and two in miscellaneous containers (two hole of tree stems which were used as food pat of cattle) were recorded in Sin Lan village and six Key containers in major containers (five metal drum and one water cleaning tank) were recorded in Anout Taw village (Moe Kyaing 2017). Than Than Kyi (2015) also revealed that big bago jars are highly key containers of *Aedes* larvae in Hpa-an Township and one of the bago jar which was used for preservation of Thittothi in Taung Nar village was found with plenty of *Armijaris* and *Culex* larvae but in the study areas of Pakokku there were not found any preservative containers. Although in some containers *Aedes* larvae were found co-breeder with *Culex* larvae in earthen pots which pots were used in latrine. Other researchers mention that metal drums, concrete jars, spirit bowls and bamboo stems were found key containers in Yangon Region (Tun Lin, *et al.*, 1995, Pe Than Htun, *et al.*, 2010 Maung Maung Mya, *et al.*, 2005). Metal drum and bago jars are highly positive for *Aedes* larvae and metal drums are regarded as key containers in Tha Key Ta, Shan Chaung and Dagon North Township, Yangon Region (Maung Maung Mya, *et al.*, 2011, Tun Lin, *et al.*, 1995, Maung Maung Mya, *et al.*, 2013). A study of Than Than Kyi (2015) in both Mingalar Ywar Thit and Taung Nar villages, in Hpa-an Township, some major containers such as concrete tanks, metal drum and concrete jars were found positive with Aquarian fishes and dragonfly nymphs. Those containers were found absent of *Aedes* larvae. In present study there was found predators as Dragon fly nymphs, *Toxorhynchites* larvae and larvivorus fish in some larva absent concrete tanks, Bago jars, Concrete jars Metal drums, Car tyre and other containers in outdoor of the households. Other researchers also revealed that dragonfly nymphs were mostly found in concrete tank, concrete jars and some metal drums (inner surface

covered with cement) and ponds in outdoor of the households in Yangon Region which nymphs are highly predator of mosquito larvae (Sebastian, *et al.*, 1990, Maung Maung Mya, *et al.*, 2013).

Most of the major containers were found as Key containers in the study areas such as concrete tank, Concrete jars, Metal drum, Plastic drum, Spirit Bowl, discarded Bago jar and Tyre in outdoor of houses. *Aedes aegypti* and *Aedes albopictus* larvae were observed co-breeders in the Key container of Concrete jars, Bago jars and Car tyre. Although both *Aedes* larvae were co-breeders in the Key containers of manmade three hole was found in Hpa-an Township Kayin State (Than Than Kyi, 2015) Same observation of *Aedes aegypti* and *Aedes albopictus* larvae were observed in a spirit bowl in Hmawbi Township, Yangon Region (Maung Maung Mya, *et al.*, 2005). A similar study done by other researcher in Insein Township revealed that *Aedes* larvae were bred together with *Toxorhynchites* larvae in car tyre. *Toxorhynchites* larvae were easily found in unused bago jars, earthen pots and discarded old car tyres. (Myint Myint Chit, 2009) and mostly they were found together with *Aedes* larvae due to the fact that they are predators of mosquito larvae (Chuah &Yap 1984). Present study observed that *Toxorhynchites* larvae and Dragon fly nymphs were abundantly present in water storage containers in outdoor condition. And miscellaneous containers were found highest positivity in present study although a study in Thailand revealed that miscellaneous containers outdoors show significant variation, the greatest number occurring in the wet season (Tonn *et al.*, 1969).

In the present study high percentage (18.17%) of Key premises houses were found in outdoor condition in Amuehtan Ward in Thanlyin Township. Although other researcher revealed that high number of Key premises 56(70%) were observed in indoor of households in ward 6 in Pakakku. Mostly larva were positive in Concrete tank, Concrete jars, earthen pot, earthen flower pot, bago jars and some discarded earthen pot(Zin May Htet 2018). The results of the present study was agreed with the results of other researchers they had found high number of Key premises and Key containers in Tha key Ta Township, North Dagon Township and Shwe Pyi Thar Township in raining season (Htin Zaw Soe, *et al.*, 2004, Maung Maung Mya, 2005, Myint Myint Chit, 2009. Tin Maryi Tun, (2007) mentioned that in pre-monsoon survey, 62.19% of major containers were positive for *Aedes aegypti* larvae in North Dagon Township followed by 50% of Pazundaung area. Percentage of positive miscellaneous containers of Latha Township was higher than that of other Townships and the highest percentage of Key premises (70.59%) was found in North Dagon in post monsoon period in Yangon Region (Tin Maryi Tun, 2007). A recent study by Than Than Kyi (2015) revealed that 22(44%) Key premises of Taung Nar village was higher than 7(19.61%) Key premises of Mingalar Ywar Thit village in monsoon period. Same result of key

premises has been found in Tha Kay Ta and North Dagon Townships in Yangon Region (Htin Zaw Soe, *et al.*, 2004, Tin Maryi Tun, 2007, Maung Maung Mya, *et al.*, 2013). In the present study larval positivity in water storage containers, Key premises and Key containers were higher in Amuehtan Ward in Thanlyin Township, because most of the water storage containers were without covered and full with water.

The larval detection surveys were carried out in outdoor of houses of the Amuehtan Ward in Thanlyin Township Yangon Region and larval indices were found House Index (HI) 60.37%, Container Index (CI) 21.26% and Breteau Index (BI) 138.96% was lower than the study in word number 6 in Pakokku Townships, Magway Region and found that the larval indices HI 98.75 %, CI 43.658% and BI 370 were high in indoor condition of the study area (Zin May Htet 2018). A recent report of larval indices in two areas as Sin Lan and Anout Taw villages of Pakakku, in Sin Lan village Pakakky Township found that HI, CI and BI were lesser positivity than Anout Taw village (HI), (CI) and (BI). Although, CI and BI of the Anout Taw village were 2.8 fold higher in CI and 1.87 fold higher in BI than Sin Lan village (Moe Kyaing 2017). Than Than Kyi (2015) revealed that when compared with the Breteau Index (172.5) of Mingalar Ywar Thit village it was less than the BI (206) of Taung Nar village. These all finding of BI were lesser than the present study. Other researchers also revealed that BI was high in North Dagon Township and Tha Key Ta Township in Yangon Region (Maung Maung Mya, 2005, Tin Mar Yi Tun, 2007, Htin Zaw Soe, 2004, Maung Maung Mya, 2013). The positive water storage containers, Key premises and Key containers were found higher in the study area; it may be due to the fact that mostly, the water storage habit was outdoor in open areas without covered. This condition is favorable to breed the females gravid *Aedes* mosquitoes and easily be searched their oviposition sites in the water of different containers of the households.

The Pupal indices revealed that Pupae/Child (13.17) was the highest in study area followed by (7.45) Pupae/house in Amuehtan Ward in Thanlyin Township. In the comparison of Pupal indices in Word No. 6, the children were found to be high risk for transmission in study area (Zin May Htet 2018). Because Pupae/child and Pupae/household were higher in the Studied Word. When compare with Pupae/ person, Pupae/ adult and Pupae /container were found not significantly difference. The Pupae/child was higher than the other Pupae indices. Therefore, children are high risk for DHF in the Word. High risk of children has been also found in Thakeyta in Yangon Region and Hpa-an in Kayin State (Maung Maung Mya, *et al.*, 2013, Nan Than Than Kyi, 2015, Maung Maung Mya *et al.*, 2016). A researcher from Department of Medical Research reported that now DHF transmission is occurred in adult age in Myanmar (Hlaing Myat Thu, 2009). Previous reports of Focks & Chadee (1997) have suggested that most pupae of *Ae.*

aegypti were produced in few types of containers. These results observed that in heavily infested cities in the United States, infestation indices in poorest areas were found to be 4.5 times greater than in standard areas (Von Wideguth *et al.* 1969). In the present study metal drums, plastic drums, Concrete drums, black plastic bowls spirits bowls, discarded Car tires and bago jars were found high density of *Aedes* larvae and pupae. Maciel and his associates reported that unexpectedly, the more infra-structured district, the suburban area, had higher mean numbers of pupae collected per house than in the slum (Maciel *et al.*, (2007).

In the present study found that the water storage containers from Key premises were place outside of the houses and Key containers were mostly found in open areas as well as without covered. Although other researchers mentioned that the water storage containers of Key premises houses were placed in the houses (Zin May Htet 2018) and key containers were mostly placed under the roof and full with water which were favourable for gravid female *Aedes aegypti* to lay their eggs in these containers (Maung Maung Mya *et al.*, 2016). Most of the major containers, major breeding sources and key containers which were usually found under the roof gutters just outside the houses are usually replenished by rainfall (Tin Mar Yi Htun, 2007, Maung Maung Mya, 2013, Nan Than Than Kyi 2015).

A total of 334 domestic water containers were investigated and found that 78.74% of containers were uncovered, 16.77% of the containers were covered and 4.49% containers were found *Aedes* larvae positivity. Of this 65.72% of major, 95.95% of minor and 58.33% of miscellaneous of uncovered containers were found highest larvae positivity, followed by covered water storage container i.e 28.57% major, 4.55% minor and lowest larva positivity was found in half covered containers only in major water storage containers i.e. 5.71%. Maung Maung Mya and his associated mentioned that uncovered water storage containers were found high level of *Aedes* larvae positivity than half covered and covered containers (Maung Maung Mya *et al.*, 2013).

A total of 334 water storage containers were investigated and found that 45.81% containers were placed in open areas and 54.19% of water storage containers were placed in Shaddy areas. Of this the larval positivity was higher in shady area placed water containers of major and minor containers than placed in open areas. Although highest larval positivity was found in miscellaneous containers, of this 68.92% of the larval positive miscellaneous containers were placed in open areas. When compared with only positive containers, in open areas placed water containers were found higher larva positivity 54.92% than in shade areas placed water storage container 45.72%. Other researchers revealed that high numbers of *Aedes* larvae positive containers were placed mostly in under the roof of the houses (Tin Mar Yi Htun 2007, Than Than Kyi 2015, Maung Maung

Mya et al., 2013. Mostly larva were positive in Concrete tank, Concrete jars, earthen pot, earthen flower pot, bago jars which were placed in indoor (Zin May Htet 2018).

In conclusion The highest percentage of *Aedes* larvae positivity was found in miscellaneous containers such as discarded Car tyres, Bago jars, sprinkle water bucket and pure water bottles followed by major containers such as metal drum, plastic drum, concrete jars and paint bucket, spirit bowls and earthen pots in minor containers. High number of Key containers as metal drum, plastic drum, concrete jars, paint bucket, spirit bowls and earthen pots as well as high number of Key premises were observed in the study area. In the larval indices Breteau Index was found highest and followed by House Index. The highest pupal indices was found pupae/child and followed by pupae / house. it is very serious problem for children and public health in study area. In the ward uncovered water storage containers were found highest larvae 81.69% positivity than the covered containers. Of this 54.92% of the containers were placed in open area. Therefore mosquito control programme need to control *Aedes* breeding sources using Abate, larvivorous fish, net sweeper methods for larvae removing by community participation. And also need to covered the major and minor water storage containers properly and completely destroyed the miscellaneous containers to control mosquito population via to control DHF in community near future.

REFERENCES

- Service M.W., Importance of ecology in *Aedes aegypti* control. Southeast Asian Journal of Tropical Medicine and Public Health, 1992; 23(4): 681-688.
- Gordon, R. M., Lavoipierre, M.M.J., Entomology for students of medicine. Illustrated by Margaret. A. Johson, Fourth printing, Blackwell Scientific Publications, Oxford, Landon, Edinburgh, 1962.
- World Health Organization, Prevention and control of DEN/DHF in Sourth East Asia Region. Report of WHO 1996. Consultation, 1995; 10-13 Oct. New Delhi Sea/Haem. Fev/65/96.
- World Health Organization, Report of the WHO Expert Committee on vector biology, control and chemistry and specification of pesticides (Technical Report Series No. 699). Gevena, 1984.
- Halstead, S.n., *Aedes aegypti*: Why can't we control it? Bulletin of Vector Ecology, 1988; 13: 304-311.
- Tun Tun Aung, Soe Win and Soe Aung, Status report on epidemiology of dengue haemorrhagic fever in Myanmar. Gengue Bulletin, 1969; 20: 41-45.
- Vector Borne Diseases Control, Dengue Haemorrhagic Fever in Myanmar, 1970-89. Department of Health, Yangon, Myanmar, 1990.
- World Health Organization. Dengue guideline for diagnosis treatment, Prevention and control. *The WHO Regional committee for South East Asia*, 2008.
- World Health Organization. The global strategy for dengue/DHF prevention and control developed by WHO and regional strategy-New Edition, 2009.
- Chusak Prasittsuk AG. Andjaparidze & Vijay Kumar. Current status of Dengue / Dengue Haemorrhagic fever in WHO Southeast Asia Region. *Dengue Bulletin*, 1998; 22: 1-10.
- Hlaing Myat Thu. Virology report in Annual Report of Department of Medical Research Lower Myanmar. *DMRLM Annual Report*, 2009.
- Ohn Khin. Epidemiological situation of Dengue Haemorrhagic Fever in Rangoon Burma. *Dengue News WHO SEARO and Western Pacific Region*, 1985.
- Rathburn CB. Jr. Adulticide in the 90s: The changing picture. *Wing Beats*, 1990; 1: 12-13.
- Seng CM1 & Jute N. Breeding of *Aedes aegypti* (L.) and *Aedes albopictus* (Skuse) in urban housing of Sibutown, Sarawak. Southeast Asian J Trop Med Public Health, 1994 Sep; 25(3): 543-8.
- Fay RW, Perry AS. Laboratory studies of oviposition preferences of *Aedes aegypti*. *Mosq News*, 1965; 25: 276-281.
- Reiter P. Oviposition, dispersal and survival in *Aedes aegypti*: implications for the efficacy of controls strategies. *Vector-Borne Zoonot Dis*, 2007; 7: 261-273.
- Moe Kyaing, Occurance of *Aedes aegypti* larvae in water storage containers in two villages of Pakokku Township Magway Region, Myanmar. M.Res Zoology Thesis, 2016.
- Nan Than Than Kyi. Feeding rate of tow larvivorous fishes on *Aedes aegypti* in two villages in Hpa-an, Kayin State. M. Res Thesis. Department of Zoology, Hpa-an University, 2015.
- Maung Maung Mya, Nan Than Than Kyi, Nyunt Nyunt Oo, Myint Myint Kyi and Yan Naung Maung Maung. Occurance of *Aedes* larvae in water storage containers in two areas of Hpa-an Township, Kayin State. Myanmar Health Sciences Research Journal, 2016; 28(3): 164-170.
- Tun Lin W, Maung Maung Mya, Sein Maung Than and Tin Maung Maung Rapid and efficient removal of immature *Ae. aegypti* in metal drums by sweep net and modified sweeping method. Southeast Asian Journal of Tropical Medicine and Public Health, 1995; 26(4): 754-759.
- Pe Than Htun, Hla Myint, Myo Khin, Ye Htut, Tin Htoo Hlaing, Swe Zin Win and Sein Thaug, Why has dengue haemorrhagic fever (DHF) been transmitted during the dry season in Dala Township, Yangon Division? Myanmar Health Research Congress, 2010; 68.
- Maung Maung Mya, Myint Myint Chit, Saw Mitchell, Maung Maign Gyi and Tin Oo, Community based control of *Aedes aegypti* larvae by using *Toxorhynchites* larvae in selected Township of Yangon Division, Myanmar Health Sciences Research Journal, 2011; 23(2): 101-107.

23. Maung Maung Mya, Ni War Lwin, Saw Mitchell, Bo Bo and Maung Maung Gyi, Control of *Aedes* larvae in household water storage containers using dragonfly nymphs in Tha Key Ta Township, Yangon Division. Myanmar Health Sciences Research Journal, 2013; 25(3): 166-172.
24. Zin May Htet, The occurrence of *Aedes* larvae in water storage container of Pakokku township, Magwe Region. M Res. Thesis. Department of Zoology, University of Pakokku, 2018.
25. Maung Maung Mya, Sein Min, Khin Myo Aye, Yi Yi Myint, Sein Thaug, Thu Zar Nyein Mu, Le Mon Kyaw, Thet Thet Tun and Pe Than Htun, The efficacy of Alum-potash on *Aedes aegypti* larvae in laboratory and field areas in Yangon Division. Myanmar Health Research Congress, 2005; 64.
26. Sebastian A., Thu MM, Kyaw M & Sein M. The use of dragonfly nymphs in the control of *Aedes aegypti*. *Southeast Asian Journal of Tropical Medicine and Public Health*, 1980; 11(1): 104-107.
27. Myint Myint Chit, Biology of Elephant mosquito *Toxorhynchites splendens* (Wiedemann, 1819) (Diptera: Culicidae) and its application as bio-control agent for vector mosquitoes. Ph. D Dissertation, Department of Zoology, University of Yangon, 2009.
28. Chuah MLK and Yao HH. Studies on biological control potentials of *Toxorhynchites splendens* (Diptera: Culicidae) *Tropical Biomedicine*, 1984; 1: 145-150.
29. Tonn R. J., Sheppard P. M., Macdonald W. W. & Bang Y. H. Replicate Surveys of Larval Habitats of *Aedes aegypti* in Relation to Dengue Haemorrhagic Fever in Bangkok, Thailand. *Bull. Wld Hlth Org*, 1969; 40: 819-829
30. Htin Zaw Soe, Tun Lin and Saw Lwin, Community-based control of dengue haemorrhagic fever using alternative methods in a peri-urban area of Yangon. Abstracts Myanmar health Research Congress, 2004; 51.
31. Tin Mar Yi Htun, Biology and some ecological aspect of *Aedes aegypti* (Linnaeus, 1762) and in some high risk areas of Yangon City. Ph. D Dissertation, Department of Zoology, University of Yangon, 2007.
32. Focks DA, Chadee D. Pupal survey: an epidemiologically significant surveillance method for *Aedes aegypti*: an example using data from Trinidad. *Am J Trop Med Hyg*, 1997; 56: 159-167.
33. Von Wiedeguth DL, Eliason DA, Kilpatrick JW, Jakob WL. The transitory nature of *Aedes aegypti* larval habitats in an urban situation. *Mosq News*, 1969; 29: 495-496.
34. Maciel-de-Freitas R, William A Marques, Roberto C Peres, Sérgio P Cunha, Ricardo Lourenço de Oliveira Variation in *Aedes aegypti* (Diptera: Culicidae) container productivity in a slum and a suburban district of Rio de Janeiro during dry and wet seasons. *Mem Inst Oswaldo Cruz, Rio de Janeiro*, 2007; 102(4): 489-496.