SEASONAL OCCURRENCE OF *AEDES AEGYPTI* (LINNAEUS, 1762) LARVAE IN DIFFERENT WATER STORAGE CONTAINERS IN SIX AREAS OF HINTHADA DISTRICT, AYEYARWADY REGION

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Abstract

The seasonal study was carried out in six areas of Hinthada District, Ayeyarwady Region, from 2018 to 2020 using descriptive field investigation method. All potential breeding sites were examined seasonally by different larval positive container types (major, minor and miscellaneous) from 50 households in each village of all study areas and the occurrence of *Aedes aegypti* larvae was investigated in accordance with different seasons. Seasonal variations of *Ae. aegypti* in key containers and key premises in all areas were compared. In different positive containers such as concrete jars, earthen pots and bamboo bowls were found to be the most positive and predominated ones for breeding sources throughout the survey period. The larval occurrences in positive containers were significantly different among six areas in accordance with different seasons. Seasonal prevalence of *Ae. aegypti* larvae in various containers was investigated and found to be higher in wet season than other seasons. Hence, this study revealed that wide-spread breeding of *Ae. aegypti* occurred in cleaned and uncovered containers, and untreated water. Information on reduction of breeding sites of *Ae. Aegypti* such as daily practices with covering, emptying out, changing and filtering of water containers, and awareness of vector-borne diseases namely Dengue and Dengue Haemorrhagic Fever (DF and DHF endemicity) could be contributed to local community.

Keywords seasonal occurrence, *Aedes aegypti* larvae, water storage containers, DF, DHF

Introduction

Aedes aegypti and *Aedes albopictus* are belonging to the subgenus *Stegomyia* and they are closely associated with peri-domestic environments (Balasubramanian *et al.,* 2015). The species *Aedes aegypti* is one of the world's most widely distributed mosquitoes and is of considerable medical importance as a major vector of dengue, dengue haemorrhagic fever and dengue shock syndrome (DF, DHF and DSS) in many tropical and subtropical countries throughout the world (Akram *et al.,* 2010).

The abundance of dengue is closely associated with the abundance of vectors and environmental factors (rainfall, temperature and relative humidity). Infestation of vectors to new geographical areas, and related to 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 (Simmons *et al.,* 2012).

Aedes density, as well as the number of dengue cases, increased in the wet season in Malaysia, India, Sri Lanka, Myanmar, Indonesia, Philippines and Thailand. A severe outbreak of DHF occurred for the first time in Yangon in 1970. Ayeyarwady Region is the second position wise DF/DHF cases and deaths in 2015-2019 (Vector Borne Disease Control Program (Myanmar), 2016). The number of DF/DHF cases and deaths usually were higher in raining season than other seasons (Maung Maung Mya *et al.,* 2016).

There are several factors that influencing on *Aedes* mosquitoes, including water container types, seasons and socio-culture practices, topographic, climatic and vectoral factors (Chumsri *et al.,* 2018). Container type is probably the most important factor determining breeding sites of

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mosquito species (Rajesh *et al.,* 2013). The positive number of various water containers was higher in rainy season than other seasons (Maung Maung Mya *et al.,* 2016). *Aedes aegypti* breeds in a wide assortment of domestic containers whereas *Aedes albopictus* more likely to be found in actual containers (Scott *et al.,* 1993).

Key containers are the primary source of adult *Aedes* mosquitoes. The use of oviposition traps or ovitraps was to estimate the vector population and this technique was recognized by WHO as it can attract female *Aedes* to oviposit.

Prevention of DHF outbreaks is based on long-term anti-mosquito control measures mainly in household and environmental sanitation with emphasis on larval source reduction (Xu *et al.,* 2016). In drawing up strategy for *Aedes* control, it is essential that distribution and density of the mosquitoes should be studied and clearly understood. Thus, prevention of mosquito bite by personal protection and control of vectors are the only methods available to prevent dengue fever (DF) and dengue haemorrhagic fever (DHF) (Maung Maung Mya *et al.,* 2016).

The human population of Ayeyarwady Region is over six million and the Region comprises six districts and 26 townships, and it has relatively high temperature, population and humidity which serve as favorable conditions for the existence of *Aedes aegypti* mosquito during the rainy season especially in July and August. Among six districts, Hinthada District is involved in high risk areas of dengue endemic disease in Ayeyarwady Region because it has yearly high rainfall, temperature, relative humidity and human population that serve as favorable conditions for the distribution, breeding and existence of *Aedes* mosquitoes. The present survey areas have not been studied yet by previous researchers.

Therefore, the aim of the present study was to provide the basic information on the larval densities in the six study areas where children predominated in the population. This study was conducted to determine the seasonal occurrence of *Aedes aegypti* larvae in different water storage containers in selected six areas.

Materials and Methods

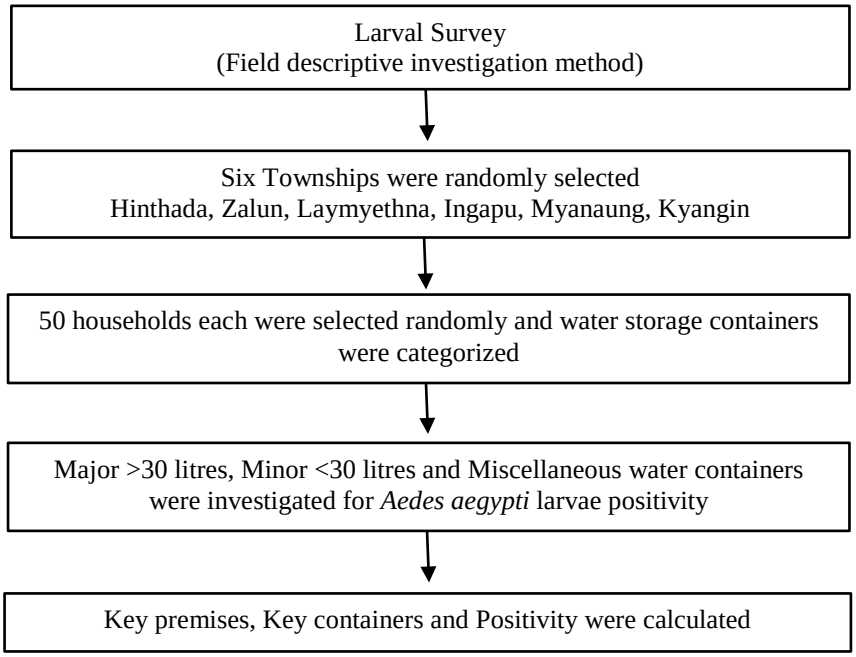
Study sites

The present study was conducted in six field areas such as Ywa Thit village in Hinthada Township (17° 38′ N and 95° 22′ E), Set Kyi Tan village in Zalun Township (17° 28′ N and 95° 33′ E), Lal Tan Ngal village in Laymyethna Township (17° 41′ N and 95° 41′ E), Tha Phan Pin village in Ingapu Township (17° 48′ N and 95° 15′ E), Set Kwin village in Myanaung Township (18° 17′ N and 95° 17′ E) and Shwe Taung Su village in Kyangin Township (18° 20′ N and 95° 15′ E). All study areas were included in Hinthada District, Ayeyarwady Region (Fig.1).

Study period

The present study was carried out from 2018 to 2020.

Study design



Utilization of equipment

Torch light, hand lens (magnification of ×4 & ×6), plastic cups, stereomicroscope, dissecting microscope, sweeper, plastic pipette, measuring slender tube, thermometer, litmus paper and thermo-hydrometer were utilized.

Larvae collection

Larvae collection was conducted by using sweeping method (Tun Lin *et al.*, 1995).

Species identification

Identification of collected *Aedes aegypti* larvae followed after Peyton and Harrison (1980), and Reid (1967).

Weather parameters

Weather parameters were obtained from Department of Meteorology and Hydrology in Hinthada Township.

DHF cases and death

DHF cases and death in six areas were obtained from Rural Health Center (RHC) and Public Health Center in Hinthada District.

Larval indices

Larval examination method of Sheppard *et al.* (1969) was used to confirm the presence of larvae in the different containers.

(a) Key container = 500 and above larvae positive per container

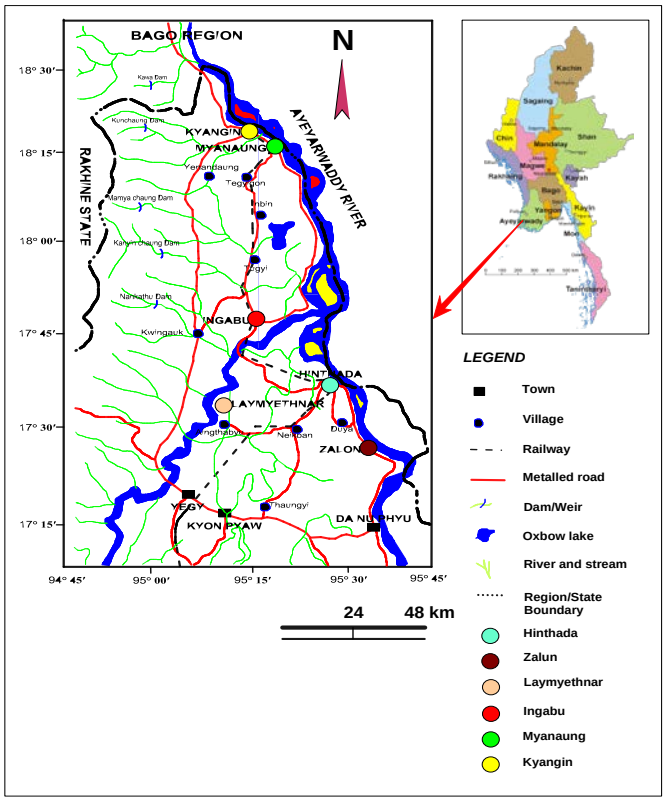
(b) Key premises = 3 and above positive containers with *Aedes* larvae per house

Data collection form

Standard sheet for data collection was developed adjusting that of Department of Medical Research, Yangon).

Data analysis

Key containers, key premises and percentage (%) were calculated.



(Source - Geology Department of Hinthada University, 2007)

Figure 1 Location map of the study area

Results

Seasonal occurrence of different containers harboring *Aedes aegypti* larvae in six areas of Hinthada District

In seasonal distribution of *Ae. aegypti* larvae, the highest number of positive containers was found in three container types as 28, 18 and eight in wet season and the lowest was 16, six and one in cool season (2018). The positivity rates of *Ae. aegypti* larvae in houses were recorded as 21 (42%), 40 (80%) and 21 (42%) in dry, wet and cool seasons (2019) respectively. In seasonal distribution of *Ae. aegypti* larvae, the highest number of positive containers was recorded in three types as 46, 25 and 27 in wet season though the lowest was 19, seven and two in cool season in Hinthada Township (Table 1). In Zalun Township, the highest number of positive containers was found in all three container types as 30, 19 and one in wet season and the lowest was nine, seven and three in dry season (2018). The highest number of positive containers was recorded in three types as 37, 13 and four in wet season though the lowest was nine, six and only one in dry season (2019) (Table 2). In Laymyethna Township, the highest number of positive containers was found in all three container types as 51, seven and five in wet season and the lowest was 24, six and five in dry season (2018). The highest number of positive containers was recorded in three types as 33, 30 and 13 in wet season though the lowest was 30, nine and three in dry season (2019) (Table 3). In Ingapu Township, the highest number of positive containers was found in all three container types as 38, 21 and eight in wet season and the lowest was 30, nine and one in dry season (2018). The highest number of positive containers was recorded in three types as 42, 33 and 20 in wet season though the lowest was 25, 13 and one in

dry season (2019) (Table 4). In Myanaung Township, the highest number of positive containers was found in all three container types as 26, 16 and three in wet season and the lowest was seven, four and two in dry season (2018). In seasonal distribution of *Ae. aegypti* larvae, the highest number of positive containers was recorded in three types as 23, 16 and three in wet season though the lowest was eight, six and one in dry season (2019) (Table 5). In Kyangin Township, the highest number of positive containers was found in all three container types as 44, 41 and four in wet season and the lowest was four, two and one in dry season (2018). The highest number of positive containers was recorded in three types as 27, 36 and one in wet season though the lowest was two, seven and one in dry season (2019) (Table 6).

Seasonal variation of recorded key containers harboring *Aedes aegypti* larvae in six areas of Hinthada District

In seasonal variation of key containers, one container each in dry, wet and cool season (2018) was recorded as the breeding habitats of *Aedes aegypti* larvae. Among three seasons in 2019, only one container was studied in cool season (2019) in Hinthada Township. The number of key containers in cool season (2018) was investigated to be higher than other seasons. The number of key containers in wet season was investigated to be higher than other seasons in Zalun Township. The highest number occurred in cool season while the lowest was in dry season (2018). The number of key containers in cool season was higher than other seasons (2019) in Laymyethna Township. The highest number occurred in dry season while the lowest was in wet season (2018). The number of key containers in cool season was studied to be higher than other seasons (2019) in Ingapu Township. The highest number was determined in wet season while the lowest was in dry season (2018). Among three seasons in 2019, two containers were studied only in cool season (2019) in Myanaung Township. The highest number was found in wet season (2018). Among three seasons in 2019, one container was recorded only in cool season (2019) in Kyangin Township

In seasonal variation of key containers in six areas from dry season (2018) to cool season (2019), the number of key containers was higher in Ingapu Township than other areas in dry season (2018). In wet season (2018), the highest number was recorded in Kyangin Township. The highest number of key containers was found in Laymyethna Township while the lowest in Hinthada Township in cool season (2018). Among all study areas, Laymyethna Township was found to have the highest number of key containers in dry season (2019). In wet season (2019), the highest number was observed in Ingapu Township. In cool season (2019), the number of key containers was determined to be higher in Ingapu Township than other areas. (Table 7 and 8)

Seasonal variation of recorded key premises harboring *Aedes aegypti* larvae in six areas of Hinthada District

The highest number of key premises was found in both dry and wet seasons while the lowest was in cool season (2018). The number of key premises in wet season was determined to be higher than other seasons (2019) in Hinthada Township. The number of key premises in wet season was found to be higher than other seasons (2018). The highest number was recorded in wet season while the lowest was in dry season (2019) in Zalun Township. The highest number was recorded in both wet and cool seasons while the lowest was in dry season (2018). The highest number was observed in wet season while the lowest was in cool season (2019) in Laymyethna Township. The highest number was found in wet season while the lowest was in dry season (2018). The highest number was determined in wet season while the lowest was in dry season (2019) in Ingapu Township. The highest number was found in wet season, followed by cool season and the lowest was in dry season (2018). The highest number occurred in wet season, followed by cool season and the lowest was in dry season (2019) in Myanaung Township. The number of key premises in wet season (2018) was observed to be higher than

other seasons. The number of key premises in wet season was found to be higher than other seasons (2019) in Kyangin Township.

In seasonal variation of key premises in six areas from dry season (2018) to cool season (2019), the number of key premises in Hinthada Township occurred to be higher than other areas in dry season (2018). In wet season (2018), the highest number was recorded in Kyangin Township and the lowest was in Hinthada Township and Myanaung Township. The highest number of key premises was found in Kyangin Township while the lowest was in Zalun Township in cool season (2018). The number of key premises in Laymyethna Township was found to be higher than other areas in dry season (2019). In wet season (2019), the highest number was determined in Ingapu Township while the lowest was in Zalun Township. In cool season (2019), the highest number was observed in Ingapu Township although the lowest was in Hinthada Township (Table 9 and 10).

Seasonal variation of positive different containers in Hinthada District

The highest number of major and minor positive containers occurred in wet season (217, 208, 122 and 153), 2018 and 2019 while the lowest was found in dry season (110, 94, 35 and 49), 2018 and 2019. In miscellaneous type, the highest number of positive containers was found in wet season (29 and 68), 2018 and 2019 although the lowest was recorded as 13 in cool season (2018) and nine in dry season (2019). Relationship between various container types and weather parameters was shown in Figure 2.

Seasonal occurrence of DHF patients in six areas of Hinthada District

The highest numbers of DHF patients occurred in wet season (840 and 741) while the lowest were found in dry season (52 and 47) in all areas (2018 and 2019). Among six study areas, the highest number of DHF patients (1165) was found in Hinthada Township and the lowest was in Kyangin Township (68). Relationship between DHF patients and weather parameters was shown seasonally in Figure 3.

Table 1 Number of different water storage containers harboring *Aedes aegypti* larvae in Hinthada Township

Survey	Total no. of houses	Positive houses	Containers					
			Major		Minor		Miscellaneous	
			Inspected	Positivity	Inspected	Positivity	Inspected	Positivity
Dry season (2018)	50	29(58%)	81	36(44.44%)	115	11(9.57%)	7	6(85.71%)
Wet season (2018)	50	32(64%)	83	28(33.73%)	123	18(14.63%)	13	8(61.54%)
Cool season (2018)	50	16(32%)	77	16(20.78%)	94	6(6.38%)	3	1(33.33%)
Dry season (2019)	50	21(42%)	66	20(30.30%)	95	8(8.42%)	4	2(50%)
Wet season (2019)	50	40(80%)	81	46(56.79%)	126	25(19.84%)	30	27(90%)
Cool season (2019)	50	21(42%)	65	19(29.23%)	99	7(7.07%)	3	2(66.67%)

Table 2 Number of different water storage containers harboring *Aedes aegypti* larvae in Zalun Township

Survey	Total no. of houses	Positive houses	Containers					
			Major		Minor		Miscellaneous	
			Inspected	Positivity	Inspected	Positivity	Inspected	Positivity
Dry season (2018)	50	15(30%)	56	9(16.07%)	91	7(7.69%)	3	3(100%)
Wet season (2018)	50	26(52%)	56	30(53.57%)	86	19(22.09%)	1	1(100%)
Cool season (2018)	50	29(58%)	52	23(44.23%)	71	11(15.49%)	1	1(100%)
Dry season (2019)	50	11(22%)	55	9(16.36%)	98	6(6.12%)	2	1(50%)
Wet season (2019)	50	32(64%)	63	37(58.73%)	98	13(13.27%)	4	4(100%)
Cool season (2019)	50	19(38%)	55	20(36.36%)	86	9(10.47%)	1	1(100%)

Table 3 Number of different water storage containers harboring *Aedes aegypti* larvae in Laymyethna Township

Survey	Total no. of houses	Positive houses	Containers					
			Major		Minor		Miscellaneous	
			Inspected	Positivity	Inspected	Positivity	Inspected	Positivity
Dry season (2018)	50	22(44%)	102	24(23.53%)	78	6(7.69%)	8	5(62.5%)
Wet season (2018)	50	30(60%)	113	51(45.13%)	60	7(11.67%)	9	5(55.56%)
Cool season (2018)	50	31(62%)	96	36(37.5%)	88	16(18.18%)	4	3(75%)
Dry season (2019)	50	24(48%)	90	30(33.33%)	62	9(14.52%)	7	3(42.86%)
Wet season (2019)	50	35(70%)	114	33(28.95%)	112	30(26.79%)	21	13(61.90%)
Cool season (2019)	50	26(52%)	94	30(31.91%)	73	10(13.70%)	6	3(50%)

Table 4 Number of different water storage containers harboring *Aedes aegypti* larvae in IngapuTownship

Survey	Total no. of houses	Positive houses	Containers					
			Major		Minor		Miscellaneous	
			Inspected	Positivity	Inspected	Positivity	Inspected	Positivity
Dry season (2018)	50	30(60%)	144	30(20.83%)	80	9(11.25%)	2	1(50%)
Wet season (2018)	50	33(66%)	133	38(28.57%)	77	21(27.27%)	11	8(72.73%)
Cool season (2018)	50	28(56%)	135	25(18.52%)	71	14(19.72%)	9	5(55.56%)
Dry season (2019)	50	28(56%)	136	25(18.38%)	72	13(18.06%)	1	1(100%)
Wet season (2019)	50	38(76%)	145	42(28.97%)	114	33(28.95%)	23	20(86.96%)
Cool season (2019)	50	24(48%)	147	41(27.89%)	71	8(11.27%)	4	2(50%)

Table 5 Number of different water storage containers harboring *Aedes aegypti* larvae in Myanaung Township

Survey	Total no. of houses	Positive houses	Containers					
			Major		Minor		Miscellaneous	
			Inspected	Positivity	Inspected	Positivity	Inspected	Positivity
Dry season (2018)	50	10(20%)	137	7(5.11%)	60	4(6.67%)	5	2(40%)
Wet season (2018)	50	22(44%)	141	26(18.44%)	54	16(29.63%)	3	3(100%)
Cool season (2018)	50	12(24%)	145	10(6.90%)	100	10(10%)	14	2(14.29%)
Dry season (2019)	50	12(24%)	132	8(6.06%)	50	6(12%)	1	1(1000%)
Wet season (2019)	50	21(42%)	142	23(16.20%)	63	16(25.40%)	8	3(37.5%)
Cool season (2019)	50	14(28%)	131	12(9.16%)	53	13(24.53%)	2	1(50%)

Table 6 Number of different water storage containers harboring *Aedes aegypti* larvae in Kyangin Township

Survey	Total no. of houses	Positive houses	Containers					
			Major		Minor		Miscellaneous	
			Inspected	Positivity	Inspected	Positivity	Inspected	Positivity
Dry season (2018)	50	6(12%)	93	4(4.30%)	73	2(2.74%)	1	1(100%)
Wet season (2018)	50	41(82%)	88	44(50%)	77	41(53.25%)	4	4(100%)
Cool season (2018)	50	27(54%)	91	3(3.30%)	127	55(43.31%)	1	1(100%)
Dry season (2019)	50	9(18%)	88	2(2.27%)	38	7(18.42%)	1	1(100%)
Wet season (2019)	50	25(50%)	93	27(29.03%)	54	36(66.67%)	1	1(100%)
Cool season (2019)	50	20(40%)	86	13(15.12%)	110	31(28.18%)	1	1(100%)

Table 7 Seasonal variation of recorded key containers in six areas of Hinthada District (2018)

Areas	Key containers		
	Dry (2018)	Wet (2018)	Cool (2018)
Hinthada Township	1	1	1
Zalun Township	0	6	9
Laymyethna Township	3	6	13
Ingapu Township	8	3	5
Myanaung Township	3	14	5
Kyangin Township	2	19	2

Table 8 Seasonal variation of recorded key containers in six areas of Hinthada District (2019)

Areas	Key containers		
	Dry (2019)	Wet (2019)	Cool (2019)
Hinthada Township	0	0	1
Zalun Township	0	2	1
Laymyethna Township	1	0	5
Ingapu Township	0	6	8
Myanaung Township	0	0	2
Kyangin Township	0	0	1

Table 9 Seasonal variation of recorded key premises in six areas of Hinthada District (2018)

Areas	Key premises		
	Dry (2018)	Wet (2018)	Cool (2018)
Hinthada Township	5	5	2
Zalun Township	0	6	1
Laymyethna Township	1	8	8
Ingapu Township	1	10	2
Myanaung Township	1	5	2
Kyangin Township	0	15	11

Table 10 Seasonal variation of recorded key premises in six areas of Hinthada District (2019)

Areas	Key premises		
	Dry (2019)	Wet (2019)	Cool (2019)
Hinthada Township	1	14	1
Zalun Township	1	7	2
Laymyethna Township	6	9	5
Ingapu Township	1	15	10
Myanaung Township	1	8	3
Kyangin Township	0	11	9

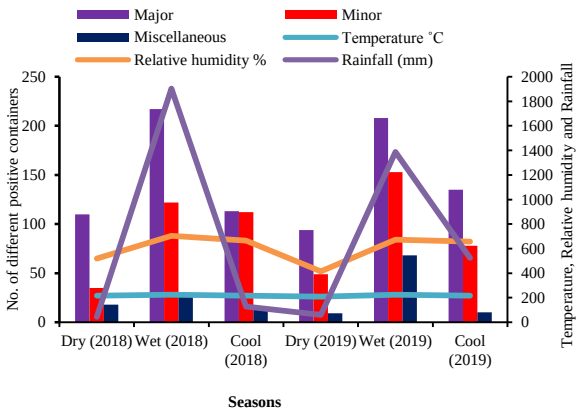


Figure 2 Relationship between positive different containers and weather parameters

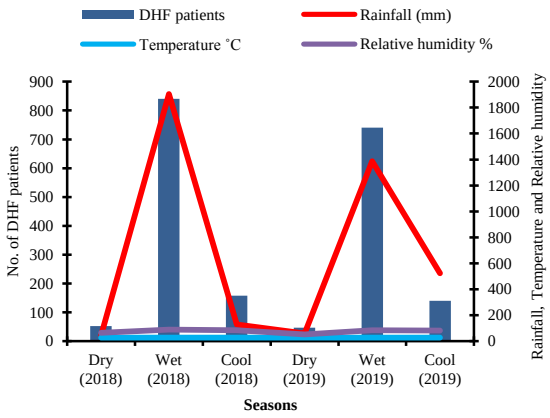


Figure 3 Relationship between DHF patients and weather parameters

Discussion

Aedes aegypti is a vector of dengue in urban areas but now the species are distributed in rural areas in Myanmar. Mosquito-borne diseases are a major public health problem which threats in Myanmar. The highest number of DHF patients also occurred in wet season while the

lowest was found in dry season in all six study areas of Hinthada District according to public health center report in Hinthada Township, in 2020.

In the present study, the highest number of positive containers and key containers, and highest positivity rate were recorded in concrete jars of major type followed by bago jars, plastic drums, concrete barrels, metal drums and concrete tanks which were found to be more widely used for storing water, and not completely covered and treated of water, and concrete jars were predominated ones for larval breeding in all areas of Hinthada District. Among major containers, the concrete jars were found to be more widely used to store water for multipurpose in Hinthada District. Other researcher revealed that same positivity of water storage containers and metal drums were recorded as key containers in Hpa-an Township, Kayin State. Moreover, these containers were mostly placed under the roof gutters to keep rainwater in the wet season (Maung Maung Mya *et al.,* 2015).

In minor type, the highest number of positive containers and key containers, and highest positivity rate were observed in small bago jars, followed by earthen pots in Laymyethna Township; earthen pots, followed by flower bidets in Zalun Township; and earthen pots, followed by plastic bowls and plastic buckets in the remaining areas in three seasons. The earthen pots were widely used for multipurpose and found to be higher positive number amongst the different minor containers in Hinthada District. These containers were also examined to be not carefully cleaned or changed of water and became good breeding places of larvae. Similarly, it revealed that the highest number of larvae positivity was in small bago jars in Thakayta Township, Yangon Region (Ni War Lwin, 2013).

In positivity of miscellaneous containers, the highest number and positivity were observed in bamboo bowls, followed by broken earthen pots, broken plastic bowls, broken bago jars, discarded tins, coconut shells, discarded tires and milk tins; and key containers were bamboo bowls, broken bago jars and discarded tires in Hinthada District. These positive containers were examined to be not carefully discarded and filled with clean water and they became attractive breeding sources of *Aedes aegypti* larvae. The highest number of positive containers was found in wet season and the lowest in dry season. Cutting bamboo stumps or bowls were mainly full of rain water in wet season which provided high positive containers or good breeding habitats for *Aedes* mosquitoes in Hinthada District.

Maung Maung Mya *et al.* (2015) also found that the bamboo stumps were key containers in Hpa-an area. Gould *et al.* (1970) mentioned that the natural breeding sites are more difficult to control than artificial containers, but for disease and pest control, it will be necessary to reduce or possibly eliminate these sources of vector species. The present survey found that the bamboo bowls in miscellaneous type were widely distributed and highly positive as the breeding places under natural condition which were more difficult to reduce and eliminate ones for disease and vector control than artificial containers.

In seasonal occurrence of *Aedes aegypti* larvae in different types of container, the present finding pointed out that the positive rate of households in wet season was higher than other seasons in all study areas. In number of positive containers in three container types, the highest number of positive containers was found in major type, followed by minor type whereas the lowest was in miscellaneous type in all seasons. In positivity rate of different container types, the positive rate was recorded to be higher in miscellaneous than other container types in all seasons. The highest seasonal occurrence of *Ae. aegypti* larvae was found in wet season because it was well collected rainwater in various containers which serve as the harboring places for appropriate breeding activities of *Aedes* mosquitoes. Maung Maung Mya *et al.* (2015) also stated that the distribution of *Aedes* larvae in wet season was higher than in cool and dry seasons.

The present observation showed that the seasonal variation of recorded key containers in positive containers from 50 houses was significantly found to be higher in cool season than other seasons. Because, the breeding of *Aedes aegypti* larvae was examined to be the highest in various water storage containers that stored rain water without changing or cleaning of water or covering completely with lids and with retaining of water for long periods for a requirement of domestic usage. Similarly, Ahmed *et al.* (2019) reported that the containers that retained water for long periods of time make good suitable breeding habitats for mosquitoes such as the different water holding artificial containers. In the present finding, the seasonal variation of recorded key premises in positive households from 50 houses was higher in wet season than other seasons in all six study areas. In addition, the high number of households was observed that had three and above positive containers without completely covering of lids and placed under roof gutter to store rainwater in this season. Tin Mar Yi Tun (2007) described that the high number of key premises in all areas was high in rainy season than other seasons.

Among six study areas, Hinthada Township was a high-risk area of DHF. Among six study areas, the highest number of DHF patients was found in Hinthada Township and the lowest was in Kyangin Township. Hinthada District had highest rainfall (1387 to 1904 mm), maximum relatively humidity (84-88%) and moderate temperature (28ºC) which were favorable for the breeding of *Aedes* mosquitoes; increased the maximum number of positive containers and caused to the high number of DHF patients. The suitable breeding, distribution and oviposition of *Aedes* mosquitoes are mainly depending on the availability of rainfall. Wongkoon *et al.* (2013) similarly mentioned that rainfall, daily maximum rainfall and minimum/ maximum/ mean temperatures were associated with the dengue incidence.

Large containers may contain a more permanent aquatic habitat than smaller containers (Harrington *et al.,* 2008). It was agreed that the present study revealed the large water containers (such as concrete jars, concrete barrels, concrete tanks, bago jars, plastic and metal drums, etc.) were highly positive with optimal harboring larvae for favorable long period of breeding, resting and existing; and found to be more permanent aquatic habitats for *Aedes* mosquitoes than smaller water containers.

Conclusion

The results of the present study indicated that the seasonal variations of positive houses, positive containers, larval positivity rates and larval indices were significantly different among study areas according to three seasons and observed to be higher in wet season than other seasons. The abundance of dengue and dengue haemorrhagic fever (DF and DHF) was closely associated with the seasonal prevalence and breeding of *Aedes* larvae in different water storage containers which were widely distributed and permanently served for harboring and breeding places. The monthly or weekly container assessment survey will be able to promote the daily practices and contribute an awareness of vector-borne diseases for the local people seasonally, and may be useful for elimination of breeding habitats and oviposition sites, and reduction of eggs, larvae and pupae of *Aedes* mosquitoes in various water storage containers.

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