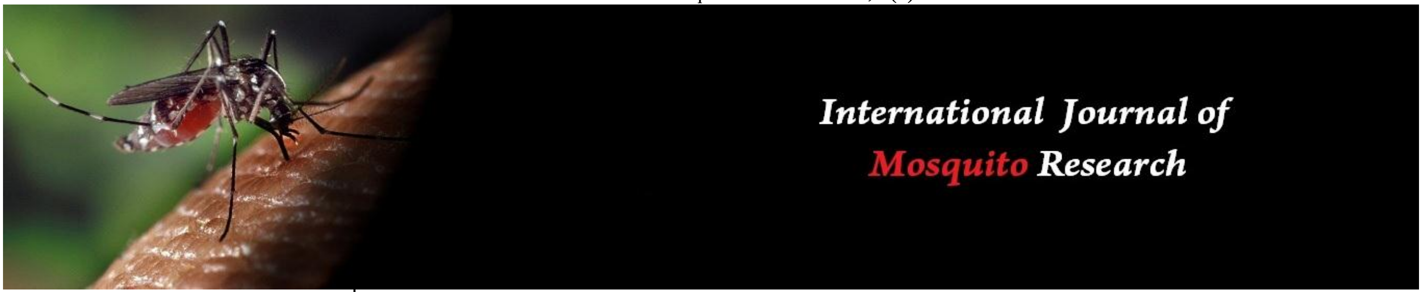

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Pupal index (PI) as a reliable tool for assessing adult population and prediction of dengue epidemic (DF/DHF)

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Abstract
Objective of this study is to evaluate the pupal productivity (a close proximity of adult population) and to correlate the onset and transmission of dengue fever in the study areas. This Pupal Index (PI) tool is accurate, dependable and comparable, if viruses are found in asymptomatic population. Epidemiologically, pupae per person have been proposed as a measure of entomological risk for DENV transmission.

Keywords: *Aedes aegypti* –Pupal Index - dengue prediction

Introduction
The *Aedes aegypti* mosquito is responsible for the transmission of many arthropod-borne viruses (arbo viruses), including dengue virus, yellow fever virus, Zika virus, and chikungunya virus [1]. Pupal Index (PI) of *Aedes aegypti* in the containers will be proxy to the number of adults. [2] *Ae. aegypti* (Linnaeus) is currently distributed in urban areas and usually breeds in indoor and outdoor settings in a wide variety of natural and artificial water-holding containers [3,4] The likelihood of Aedes mosquito mediated outbreaks can be predicted by the use of risk indices such as the house index (HI), container index (CI), and Breteau index (BI) [4]. These indices are based on the simple determination of the presence or absence of Aedes mosquito larvae either in individual containers or somewhere in each house. These indices indicate the presence of Aedes mosquitoes and the potential risk of arboviruses and can be used to deploy appropriate interventions for the control of arboviral infections [5, 6].

Methodology
At this study Alandur area of Chennai was chosen as Dengue cases have earlier reported in this area. For the observational study about the proliferation of *Aedes aegypti* in this Alandur area four wards of number 156, 157, 158 and 164 were studied, from June 2016 to May,2017 in which 200 houses from each ward in a locality, was identified and due permission was obtained from the house hold for the study. The same house and its neighborhood were surveyed for the immature and adult *Ae. Aegypti*. All kinds of breeding habitats in the study areas like overhead tanks, curing tanks, plastic containers (tubs / drums / tanks, iron drums) in and around the premises were screened for the presence of immature stages of Ae. *Aegypti* mosquitoes and collected using appropriate established methods and techniques using immature collection Kit. Total count of pupae made in each containers were grouped for estimation. All *larvae* and pupae were reared to adult stage for species identification. The larval collections were made from each locality with the help of flash-light, by dipping and pipetting methods (WHO, 2009) [7]. Adults Aedes species both males and females collected in and around the premises have taken for virus isolation. Meteorological data that was prevailing was obtained from meteorology department. Stegomyia indices *viz.*, house index (HI), container index (CI) and Breteau index (BI) were calculated in addition to pupal index were calculated as per the protocol. Dengue fever cases (DF / DHF) occurred in the study area was noted down from the health workers / health inspectors from the state government, who used to visit the wards

Results

Marked 200 houses were surveyed in the selected each four zones ie.in total 800 houses, during wet and dry season and 19.45% of houses were positive for *Ae. Aegypti* larval stages and pupal stages. (Fig 1 - 3) (Tables 1 -3). A total of 1250 water-holding containers were analyzed, of which 5.3% were positive for *Ae. Aegypti* larvae and pupae. Dengue cases observed in City and the Study areas were recorded. (Table.3).Ward wise Pupal Index and respective dengue fever cases observed are shown in Table 2 & 3,Figures 2 & 3.Climatic factors prevailed were analyzed against the obtained pupal indices and dengue cases observed in the same study areas. (Table 4 & Figure 4).

Discussion

This study shows that prevailing pupal Index contribute to the adult *Aedes aegypti* population and indirectly to the transmission of dengue fever cases in the study ares which followed the increase in pupal index (Fig-1 and table-1) In urban region, the increasing numbers of dengue cases have been highly associated with increasing number of vector breeding habitat [8]. The population of mosquitoes is affected by the amount intensity and duration of rainfall [9]. Rainfall also helps in raise in relative humidity and changes temperature, which affects the life time of mosquitoes, hence transmission of disease [10]. Temperature is an important driver of-and limitation on-vector transmission, so accurately describing the temperature range and optimum for transmission of DENV, CHIKV, and ZIKV is critical for predicting their geographic and seasonal patterns of spread [11, 12]. Dengue disease is a climate sensitive with are important effects caused by temperature and rainfall through both direct and indirect path [13, 14]. Biophysical functioning of the mosquito and the breeding habitat are affected by meteorological fluctuates such as temperatures and rainfall [15]. Aedes species to thrive in urban area that can be endophillic and endophagic allowing Aedes species to reap the benefit of with rain water for breeding [16]. The population of mosquitoes is affected by the amount intensity and duration of rainfall [17]. Rainfall also helps in raise in relative humidity and changes in temperature, which affects the life time of mosquitoes, hence transmission of disease [18]. In urban region, the increasing numbers of dengue cases have been highly associated with increasing number of vector breeding habitat. [19]. about 40% population of the world is exposed to dengue fever, and 100countries are reporting its cases every year. [20] [21]. Stagnant water and water collected in utensils, tires, flower vases, and coconut shells are the areas where Ae. *Aegypti* breeds. The mosquito eggs can be viable in high and low temperature and survives for a prolonged period. During rainy season the larval population tends to increase drastically. This might be the reason there were frequent occurrences of dengue fever epidemics during the rainy season [22].

Table 1: DF/DHF and Stegomia indices

Months	DF/DHF	HI	CI	BI	PI
Jun-16	0	13.9	19.8	16.1	3.3
Jul-16	0	3.8	5.5	4.9	3.8
Aug-16	49	5.4	6.5	6.6	10.9
Sep-16	52	11.8	17.8	20.6	11.8
Oct-16	62	18.5	16.2	25.6	9.8
Nov-16	40	8.9	7.7	9.5	11.3
Dec-16	20	2.8	2.4	2.9	7.0
Jan-17	0	2.5	2.4	2.6	6.5
Feb-17	0	2.4	2.2	2.6	4.5
Mar-17	0	2.8	2.3	2.9	3.8
Apr-17	0	2.1	2.0	2.5	3.5
May-17	8	2	1.7	2.0	3.5

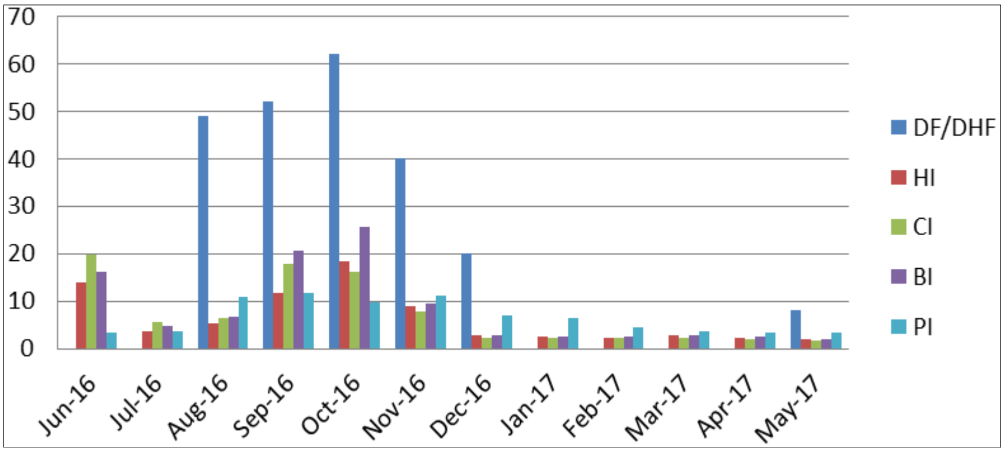

Fig 1: DF/DHF and Stegomia indices

Table 2: Pupal index in study area

	Pupal Index			
Month	**ward-156**	**ward-157**	**ward-158**	**ward-164**
Jun-16	4	4	2	3
Jul-16	3	5	4	3
Aug-16	6	7	15.5	15
Sep-16	8	11	13	15
Oct-16	5	8	16	10
Nov-16	6	9	9	21
Dec-16	4	6	9	9
Jan-17	3	5	3	10
Feb-17	2	4	2	6
Mar-17	1	1	4	4
Apr-17	2	2	3	3.5
May-17	3	3	2	6

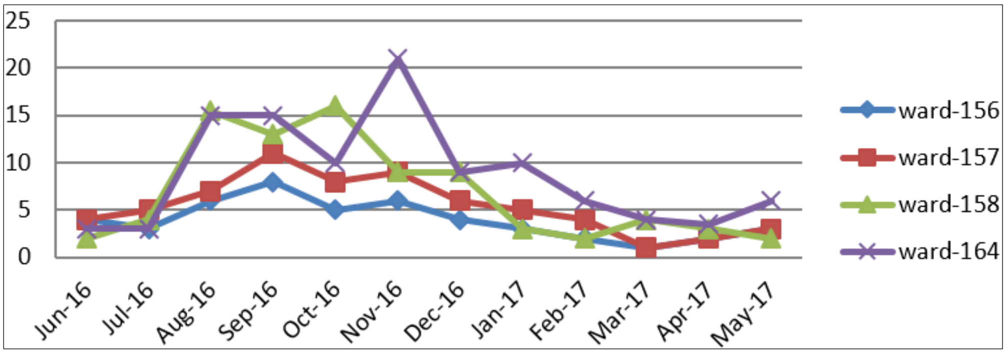

Fig 2: Pupal index in study area

Table 3: DF/DHF study area

Months	**DF/DHF**	**HI**	**CI**	**Bi**	**PI**
Jun-16	0	13.9	19.8	16.1	3.3
Jul-16	0	3.8	5.5	4.9	3.8
Aug-16	49	5.4	6.5	6.6	10.9
Sep-16	52	11.8	17.8	20.6	11.8
Oct-16	62	18.5	16.2	25.6	9.8
Nov-16	40	8.9	7.7	9.5	11.3
Dec-16	20	2.8	2.4	2.9	7.0
Jan-17	0	2.5	2.4	2.6	6.5
Feb-17	0	2.4	2.2	2.6	4.5
Mar-17	0	2.8	2.3	2.9	3.8
Apr-17	0	2.1	2.0	2.5	3.5
May-17	8	2	1.7	2.0	3.5

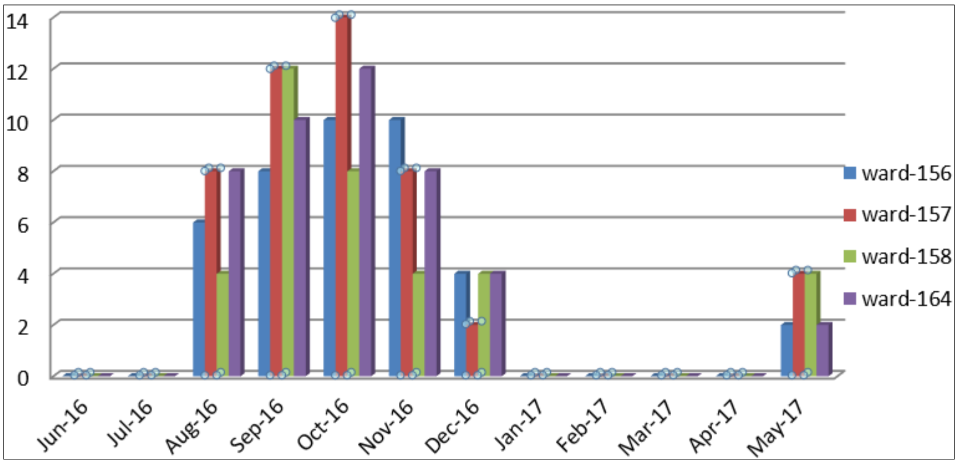

Fig 3: DF/DHF study area

Table 4: Monthly DF/DHF and Rainfall report

Year	Month	DF/DHF	Rainfall (mm)	Temp o C	Humidity %	wind	Baro. Pres	PI
2016	Jun	0	141.8	35.5	73.0	7	1005.1	3.25
2016	Jul	0	43.6	35.1	75.0	8	1005.8	3.75
2016	Aug	49	44.3	36.1	64.0	8	1006.0	10.88
2016	Sep	52	296.6	34.1	76.0	6	1007.0	11.75
2016	Oct	62	22.4	34.5	71.0	5	1009.3	9.75
2016	Nov	40	50.5	31.7	77.0	7	1012.5	11.25
2016	Dec	20	251.7	30.0	80.0	8	1013.0	7.00
2017	Jan	0	4.7	30.2	80.0	9	1014.6	6.50
2017	Feb	0	0.0	31.1	76.0	6	1014.8	4.50
2017	Mar	0	0.0	33.1	75.0	6	1011.4	3.75
2017	Apr	0	0.0	35.4	73.0	7	1009.0	3.50
2017	May	4	3.0	37.6	62.0	7	1006.6	3.50

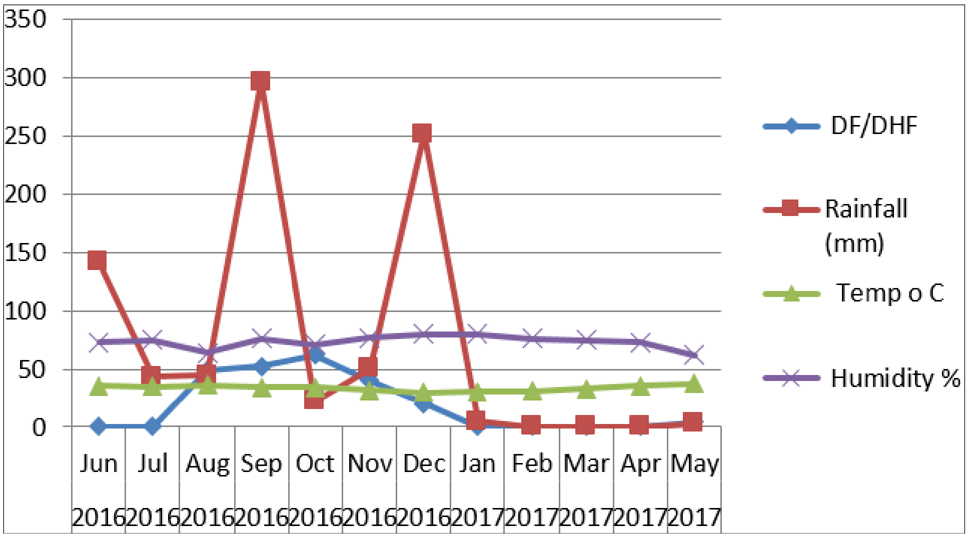

Fig 4: Monthly DF/DHF and Rainfall report

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