Correlation of Dengue Fever with Rainfall and Other Environmental Indices in Dehiwala Medical Officer of Health Area during 2011 & 2012

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Abstract— *The present study examined the relationship between weather pattern and trend of dengue fever. It also assessed the incidence of dengue fever according to gender and Public Health Inspector (PHI) areas in 2011 and 2012 by using the notification register & the weekly return of communicable diseases (WRCD) of the Dehiwala Medical Officer of Health (MOH).*

The sample consisted of 1842 confirmed cases of dengue fever. Variables were weekly confirmed dengue cases, weekly rainfall, weekly mean humidity, weekly mean temperature, PHI areas, and gender.

Findings suggested that the occurrence of confirmed dengue cases were positively correlated with, the rainfall 7 weeks preceding the registration of cases. There was no significant correlation between humidity and temperature with the confirmed dengue cases. Findings also revealed that females had higher incidence than males, and one PHI area (Badowita) reported the highest incidence for both years.

We recommend that notification data of Dengue fever be analysed at MOH level to forecast outbreaks and intensify preventive measures.

Keywords: incidence, rainfall, gender

I. INTRODUCTION

Dengue is an arboviral infection transmitted by day-biting *Aedes aegypti* and *Aedes albopictus* mosquitoes. There are four serotypes, DEN-1, DEN-2, DEN-3 and DEN-4 (Chaturvedi U C., 2008; Gunasekara M., 2009). These mosquitos breed in small collections of water, in and around human habitats, especially in urban areas. *Aedes aegypti* is a day time feeder (Jacobs M., 2005). Its peek biting periods are early in the morning and in the evening before dusk. Female *Aedes aegypti* bites multiple times during each feeding.

Over 2.5 billion people (over 40% of the world population) are now at risk from dengue and about 50 – 100 million dengue infections occur worldwide every year. (WHO, 2013). In 2010 epidemics has been declared in the Philippines, the Caribbean, Central America and Sri Lanka (Elizabeth A.A., 2010). In Sri Lanka dengue infection was serologically confirmed in 1962 and first outbreak in 1965. First major epidemic reported in 1989 and, the disease has been endemic since 1989 with dengue haemorrhagic fever (DHF) involvement. Dengue fever (DF) has become a notifiable disease in 1996. Since year 2000 approximately 5,000 cases were reported annually (Media Seminar, 2009). During last 9 months of year 2013, 23507 suspected dengue cases have been reported from Sri Lanka. Approximately 47.64% of dengue cases were reported from the western province. The highest numbers of dengue cases in Sri Lanka were reported during the 3rd week of January 2013.

II. OBJECTIVE

General objective is to describe the epidemiological pattern of Dengue fever in Dehiwala MOH area during 2011 & 2012 based on data maintained at the MOH office.

Specific objectives of this study are to calculate incidence of DF, calculate incidence according to PHI areas in Dehiwala MOH area, and correlate

confirmed dengue cases with rainfall, wind patterns and humidity, population density according to PHI areas, housing conditions, different age groups and gender.

III. METHODS

This study is a descriptive study based on retrospective data. The study setting was Dehiwala MOH area, and covered an area of 21.09km^2 consists 14 PHI areas and 29 wards. The largest is Kandawala (3.05km^2), and the smallest is Mount Lavinia (0.29km^2).

The study was conducted according to PHI divisions such as Kohuwala, Nadimala, Saranankara, Dehiwala D1, Park, Karagampitiya, Dehiwala Central, Mount Lavinia, Mount Lavinia Central, Wedikanda, Badowita, Aththidiya, Kothalawalapura and Kandawala.

Dehiwala MOH area lying in the wet zone, receives an average annual rainfall between 2000 to 3000 mm mainly during the south west monsoon and the inter-monsoon periods. Mean temperature is around 28^0 C. (City profile, 2003).

The total population was estimated as 224102 in 2011 (City profile, 2003). The sample of this study is total confirmed cases of DF, DHF & Dengue Shock Syndrome (DSS) in Dehiwala MOH area during 2011 & 2012. We used tables to obtained weekly data from Dehiwala MOH Office, Meteorology Department and check list for observational data.

The following data was recorded using the notification register & the WRCD of the Dehiwala MOH office (All data collected are from year 2011 & 2012 and was collected weekly, and according to different PHI areas). No. of confirmed cases

- Out of the confirmed cases the no. of patients in different age groups (<5yrs / 6-15yrs / 16-25yrs / 26-45yrs / >45yrs).
- Out of the confirmed cases the no. of female patients & no. of male patients.
- Out of the confirmed cases the no. of patients admitted to government hospitals & no. of patients admitted to private hospitals.

Rainfall, temperature & humidity in Dehiwala MOH area during 2011 & 2012 was collected from the Meteorology Department and recorded in the tables. Data was acquired by direct observation of housing conditions, factories, hotels, schools, religious places & recreational areas in Dehiwala MOH area.

Ethical clearance for the research was obtained from the Ethics Review Committee of South Asian Institute of Technology and Medicine (SAITM) the Ethics Review no 0017/13. Administrative permission from the Provincial Director of Health Services (PDHS)-Western Province & Regional Director of Health Services (RDHS)-Colombo was obtained to get the relevant data from Dehiwala MOH office. Data was collected with minimum disturbance to the duties of the PHIs and the Supervising PHIs and the MOH. Identity of the patients was kept confidential.

The confirmed data was classified according to gender and PHI area and got total confirmed new cases per each year. Total population of Dehiwala MOH area and gender percentage in Sri Lanka was taken according to The Census Department of Sri Lanka and incidence was calculated in 2011 & 2012. Then incidence of DF calculated according to the following equation. Estimated population according to gender and PHI area were taken separately as the total population to calculate incidence according to each section.

$$\text{Incidence} = \frac{\text{No. of new confirmed cases per year}}{\text{Total Population}} \times 1000$$

Then we included weekly rainfall, weekly mean temperature, and weekly mean humidity in our data analysis. We assessed the relationship between weekly rainfall, weekly mean temperature, weekly mean humidity and weekly confirmed dengue cases by using SPSS software.

III. RESULTS

Table 1. Confirmed dengue cases by gender, age, hospital and location

Variable	Category	Number of cases	
		2011	2012
Gender	Male	482	402
	Female	530	428
Age	<5	183	117
	6-15	397	323
	16-25	225	182
	26-45	172	159

	45<	34	48
Hospital	Government	696	559
	Private	316	275
PHI Area	Kohuwala	130	86
	Nadimala	56	70
	Saranankara	88	77
	Dehiwala D1	73	45
	Park	63	53
	Karagampitiya	111	100
	Dehiwala Central	27	17
	Mt Lavinia	166	64
	Mt Lavinia Central	28	39
	Wedikanda	40	75
	Badowita	51	51
	Atthidiaya	60	45
	Kothalawalapura	54	56
	Kandawala	65	56
Total*		1012	834

**Total confirm cases PHI-Public Health Inspector*

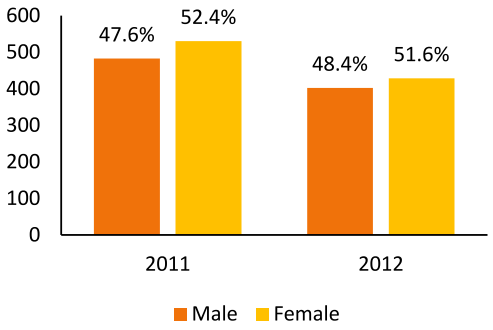

Figure 1. DF cases by gender Results revealed that number of female cases are slightly higher than male cases (see Figure 1).

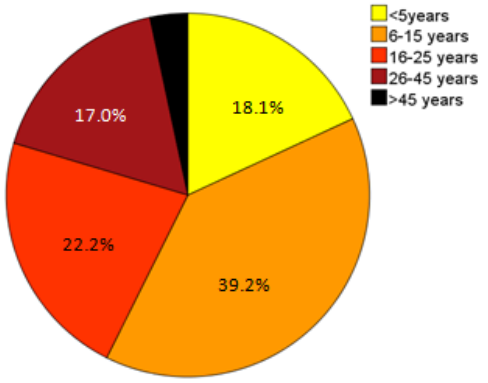

Figure 2. DF cases by age category 2011

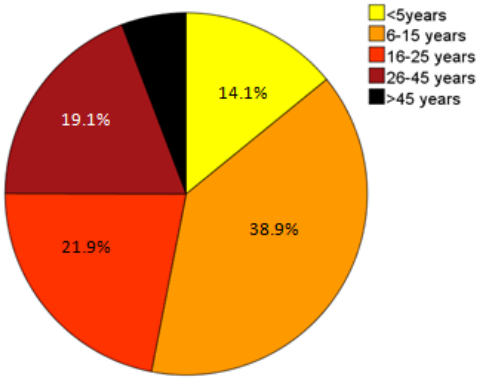

Figure 3. DF cases by age category 2012

Results revealed that 6-15 age group has the highest number of cases in 2011 & 2012. (see Figure 2 & 3)

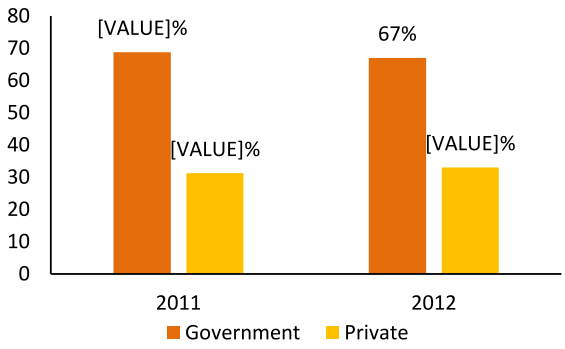

Figure 4. DF cases by hospital category

Results revealed that highest number of patients were admitted in government hospitals in both 2011 & 2012. (see Figure 4)

Table 2. Incidence of dengue fever according to gender and PHI areas

Variable	Category	Estimated Population	Incidence*	
			2011	2012
Total Population		224102	4.52	3.72
Gender	Male	108689	4.43	3.70
	Female	115413	4.59	3.71
PHI Area	Kohuwala	20035	6.49	4.29
	Nadimala	16337	3.43	4.28
	Saranankara	18376	4.79	4.19
	Dehiwala D1	17211	4.24	2.61
	Park	16046	3.93	3.30
	Karagampitiya	22410	4.95	4.46
	Dehiwala Central	11496	2.35	1.48
	Mt Lavinia	37716	4.40	1.70
	Mt Lavinia Central	12370	2.26	3.15
	Wedikanda	7911	5.06	9.48
	Badowita	3518	14.50	14.50
	Atthidiaya	14320	4.19	3.14
	Kothalawalapura	17278	3.13	3.24
	Kandawala	9076	7.16	6.17

**Incidence per 1000* *PHI-Public Health Inspector*

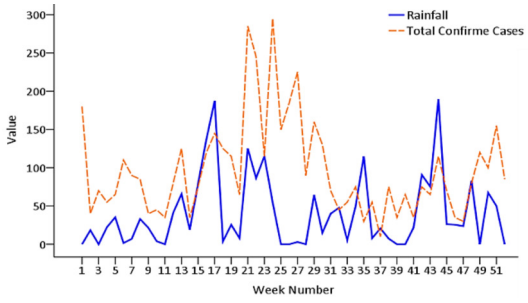

Figure 5. Rainfall & Dengue trends during 2011

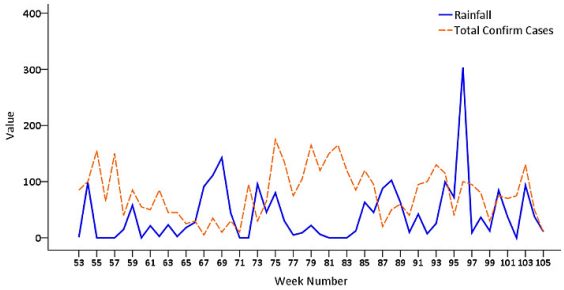

Figure 6. Rainfall & Dengue trends during 2012

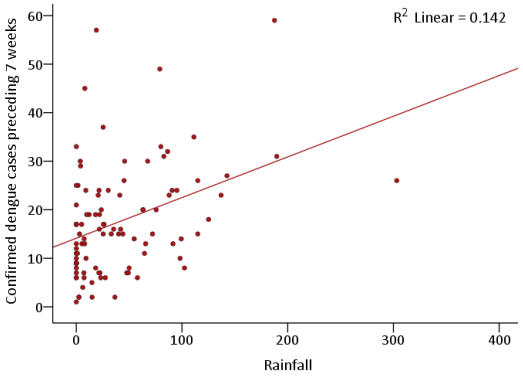

Figure 7. Rainfall & Dengue trends during 2011 & 2012

Rainfall was correlated with DF confirmed cases, for 7 weeks preceding the registration period. There was significant correlation between rainfall and confirmed dengue cases, $r = 0.38$, $p < .01$, $R^2 = 0.144$, & rainfall accounts for 14.4% of the variability in DF. There were no significant relationship with humidity and temperature with dengue cases, $r = 0.01$ & $r = 0.11$.

We found more water collecting areas, shanty houses and poor sanitary conditions in Badowita PHI area when comparing observational data with other PHI areas.

V. DISCUSSION

The present study calculated the incidence of confirmed dengue cases according to gender and PHI areas. Females had higher incidence than males. This study provides further evidence of previous work indicating that females have higher incidence than males (Mendis 2011). Higher incidence has been reported in Badowita PHI area (14.50 per 1000) in both years. Lowest incidence for 2011 was reported from Mount Lavinia Central (2.26 per 1000) and for 2012 was from Dehiwala Central (1.48 per 1000). Incidence of Total MOH area, in 2011 was higher than 2012. Observational

data prove that Badowita PHI area has more breading places for *Aedes aegypti* and *Aedes albopictus* mosquitoes than other areas. Highest number of patients has admitted to government hospitals due to free service.

Notified date differs from the date the patient acquired the disease in some cases, due to the failure of hospitals to report the cases in time. Our data was obtained using the notification registers of MOH office. Most of the unconfirmed cases are due to inability to trace back to the patient, reporting of viral fever as DF, and patients were not living in the particular MOH area. There were only two stations to calculate rainfall data in Dehiwala MOH area. Therefore we took both readings to calculate the mean value. But this can differ from the rainfall in different PHI areas. And also humidity and temperature data was taken only from one station.

VI. CONCLUSIONS

This study suggested a positive correlation between rainfall patterns and dengue trends. Further, results indicated that dengue epidemic was started at the 7^{th} week, after the highest rainfall. Although rainfall was positively correlated with dengue trends proceeding 7^{th} weeks, it accounts for only 14.4% variation in rainfall. When considering R^2 value, this leaves 85.6% of the variability still be accounted for by other variables such as environmental factors, garbage disposal procedures, housing conditions, etc. Based on these findings we recommend that notification data of Dengue fever be analysed at MOH level to forecast outbreaks and intensify preventive measures.

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REFERENCES

Chaturvedi, U. C., & Nagar, R. (2008). Dengue and dengue haemorrhagic fever: Indian perspective. *Journal Bio science*, *33*, 429–441.

City Profile of Dehiwala-Mount Lavinia. (2003). *Ministry Of Housing and Plantation Infrastructure.*

Dengue and severe dengue-WHO media centre fact sheet 117 update September 2013. Retrieved from <http://www.who.int/mediacentre/factsheets/fs117/>

Dengue update 16th September 2013, Epidemiology unit, Ministry of Health. Retrieved from <http://www.epid.gov.lk/web/index.php?option=com_content&view=article&id=163&Itemid=450&lang=en>

Elizabeth, A. A. (2010). Dengue Fever: Elsevier. Retrieved from <www.elsevier.com/locate/tacc>

Gunasekera, M. (2009). *Severe Dengue Epidemics in Sri Lanka, 2003–2006* Emerging Infectious Diseases, <www.cdc.gov/eid>. 15, 2.

Jacobs, M. (2005). Dengue.Viral Tropical Infections. MEDICINE. *33*(7), 18-20.

Media Seminar for Dengue Fever (2009), *Current Situation & epidemiology of Dengue in Sri Lanka, September 9th* [Power Point Slide]

Mendis, D. S. W. (2011). Dehiwala MOH, *Dengue Control Programme* [Power Point Slide]

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