A COMPREHENSIVE STUDY ON DENGUE FEVER IN WEST BENGAL, INDIA, 2020

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Abstract :

Dengue Fever is the most rapidly spreading vector-borne viral disease in the world. The disease which spreads through the bite of the infected female *Aedes aegypti* species of mosquito has now emerged as a serious threat to human health in India as well. The state of West Bengal has been identified as one of the severely affected states. In this paper, the nuisance and outbreaks of this vector-borne disease continue to increase every year with Kolkata at its prime focus. Urbanization, improper construction, and poor drainage facilities in most urban and semi-urban areas have provided ample habitat for mosquitoes to breed lead to an increasing number of dengue cases.

Keywords : Dengue ; *Aedes aegypti ;* Mosquito ; West Bengal

INTRODUCTION

Dengue is an endemic vector-borne disease preeminently seen in the tropics. Dengue is evolved from the Swahili phase “Ka-dingapepo”, meaning “cramp-like seizure caused by an evil spirit” “Dinga” might have originated from the Spanish word “dengue” meaning fastidious or careful, describing the posture of a person suffering joint pain of dengue fever (Saha et al., 2014). Dengueis the most common and widespread arboviral infection in the world today (Paul et al., 2017). It isan increasingly dominant tropical arbovirus infection with significant morbidity and mortality. Dengue infection has been known to be native in India for over two centuries as a benevolent andself-limited disease (Gupta et al., 2006). In recent years, the disease has changed its course provoking in the severe form as DHF (Dengue Haemorrhagic Fever) and with increasing frequency of outbreaks (Khan et al., 2018). The dengue infection, in a firstly non-immune host, generates a primary response of antibodies characterized by a slow and low-titer antibody response. IgM antibody is the first immunoglobulin iso-type to appear (Vaughn et al., 2008). In a suspected individual, the presence of anti-dengue IgM antibody suggests that a recent infection has taken place. Anti-dengue IgM detection using enzyme-linked immunosorbent assay (ELISA) illustrates one of the most important progressives and has become an indispensable tool for routine dengue diagnosis (Guzmán& Kourı, 2004). Dengue fever is an unending problem in West Bengal. Denguewas first reported in Kolkata (Calcutta) in 1824, and several outbreaks took place in the city duringthe years 1836, 1906, 1911, and 1972 (affecting 40% of the city people) (Chatterjee et al., 2013). In India, DHF was first officially announced in Kolkata in 1963-64. Thereafter, several outbreaksoccurred in India including Kolkata. (Bandyopadhyay et al., 2013). Urbanization, improper construction and poor drainage facilities in most urban and semi urban areas have provided ample habitat for mosquitoes to breed lead to an increase number of dengue cases. (Patel et al., 2020).

CAUSE OF DENGUE FEVER

Dengue viruses are expanding to people through the bite of an infected female *Aedes* species (*Aedes aegypti* or *Aedes albopictus*) mosquito (Thavara et al., 2006). It is caused by any one of four types of dengue viruses spread by mosquitoes that thrive in and near human habitation (Patelet al., 2020). When a mosquito bites a dengue virus infected person, the virus enters the mosquito. When the infected mosquito then bites another person, the virus enters that person's bloodstream (Guzman et al., 2016). After a person has recovered from dengue fever, development of specific immunity to the type of virus that had infected the person is seen to develop. However the antibodies for the other three dengue fever virus types are not developed by the person. The risk ofdeveloping severe dengue fever, also known as dengue hemorrhagic fever, increases many folds if the same person is infected a second, third, or fourth time. (Chakraborty, 2018)

LIFE CYCLE OF DENGUE CAUSING MOSQUITO & MODE OF TRANSMISSION

Dengue fever and dengue haemorrhagic fever are dominant in West Bengal, as *Aedes aegypti* mosquito, the vector of dengue (family: Culicidae; genus: *Aedes*, subgenus: *Stegomyia;* species: *Aedes aegypti*), usually breeds in urban and peri-urban areas.(Bisaws et al., 2014). *Aedes aegypti* is a holometabolous insect, meaning that it goes through a complete metamorphosis with an egg, larva, pupa, and adult stage (Chatterjee et al., 2015). *Aedes aegypti* has three polytypic forms: domestic, sylvan, and peridomestic. The domestic form breeds in urban habitat, often around or inside houses (Zahoor et al., 2019). After receiving a complete blood meal, females reproduce on average 100 to 200 eggs per batch. Females can be made up to five batches of eggs during a lifetime.Eggs of *Aedes aegypti* are approximately one millimeter long, smooth, and ovoid-shaped. (Brady & Hay, 2020). In warm temperature places, such as the tropics, eggs may develop in as little as two days, whereas in coolertemperate climates, development can take up to a week. Mosquito larvae are frequently called or said "wigglers" or "wrigglers," because they arrive to wiggle sporadically in the water when disturbed. Larval *Aedes aegypti* breathe oxygen through a siphon which is located in the posterior end, that is held above the water surface while the rest of the body hangs vertically.Larval development is temperature-dependent. Males develop earlier than females, so males generally pupate faster. In cool temperatures, *Aedes aegypti* can stay in thelarval stage for months so long as the water supply is sufficient. After the fourth instar, *Aedes aegypti* enters in the pupal stage. Mosquito pupae are diverse from many other holometabolous insects in that the pupae are mobile and respond to stimuli. Pupae are also called "tumblers," do not feed and take approximately two days to develop.Adults are emerged by ingesting air to expand the abdomen thus splitting open the pupal case and emerge head first. (Pliego et al., 2017).

MODE OF TRANSMISSION

Mosquito to human transmission: The virus is transmitted to humans through the bites of infected female mosquitoes, primarily the *Aedes aegypti* mosquito (Althouse et al., 2011). Other species within the Aedes genus can also act as vectors, but their contribution is secondary to *Aedesaegypti*. After feeding on an infected person, the virus replicates in the mosquito midgut, before it disseminates to secondary tissues, including the salivary glands. The time it takes from ingesting the virus to actual transmission to a new host is termed the extrinsic incubation period (EIP).(Monteiro et al., 2019). The EIP takes about 8-12 days when the ambient temperature is between 25-28˚C. Variations in the extrinsic incubation period are not only influenced by ambienttemperature, a number of factors such as the magnitude of daily temperature fluctuations virus genotype, and initial viral concentration can also after the time it takes for a mosquito to transmit virus. Once infections, the mosquito is capable of transmitting virus for the rest of its life (Gloria-Soria et al., 2017).

HUMAN TO MOSQUITO TRANSMISSION:

Mosquitoes can become infected from people who are viremic with Dengue Virus. It can be a person who has symptomatic dengue infection, someone who may still have a noticeable infection (they are pre-symptomatic), but also people who show no signs of illness (they are asymptomatic). Human to mosquito transmission can occur up to 2 days before someone shows symptoms of the illness, up to 2 days after the fever has resolved. Risk of mosquito infection is positively associated with high viremia and high fever in the patient, conversely, high levels of Dengue Virus specific antibodies are associated with a decreased risk of mosquito infection. Most people are viremic for about 4-5 days, but viremia can last as long as12 days. (Lauren. et al.,2014)

SYMPTOMS OF DENGUE FEVER

Dengue causes flu-like symptoms and hold out for 2-7 days. Dengue fever usually arrives after anincubation period of 4-10 days after the bite of the infected mosquito. High fever (40˚C/ 104˚F) isusually accompanied by symptoms such as headaches, pain behind eyes, nausea, vomiting, swollen glands joint, bone or muscle pained and rash. Mild Dengue symptoms cause by biting of mosquito can appear up to 7 days after the mosquito that carries the virus. Symptoms usually disappear after a week, and mild dengue rarely involves serious or fatal complications. (Paddock et al., 2009) . When severe dengue occurs, the critical phase takes place around 3-7 days after the first sign of illness. Temperature is generally seen to decrease, this does not mean the person is necessarily recovering. Where severe dengue is suspected the person should be rushed to the emergency roomor to the closest health care provider as it may cause plasma leaking that may lead to shock and/or fluid accumulation with/without respiratory distress, severe bleeding and severe organ impairment.(Khosavanna et al., 2020)

DENGUE HEMORRHAGIC FEVER (DHF)

At first symptoms of Dengue Hemorrhagic Fever is mild, but they gradually worsen within a fewdays. A person with Dengue hemorrhagic fever may experience bleeding from the mouth, gums, or nose and clammy skin. DHF often leads to damage to lymph and blood vessels and internal bleeding, which can lead to black vomit and feces, or stools. The blood platelate number also decreases significantly leading to weak pulse and small blood spots under the skin. Without prompttreatment, DHF can be fatal. (Kasbe et al., 2016)

OVERVIEW OF EPIDEMIOLOGY & NATURAL HISTORY OF DENGUE

Dengue is an endemic vector-borne disease predominantly seen in the tropics. Before 1970, only 9 countries had experienced severe dengue epidemics (Pathak & Mohan, 2019). The disease is now endemic in more than 100 countries in the WHO regions of Asia, Africa, The Americas, Europe, and Australia the Eastern Mediterranean, South-East Asia and the Western Pacific. The 2.5 billion people worldwide live in dengue-endemic areas is estimated by World Health Organization, and 50 million new infections occur annually. There has been a significant rise in the number of epidemics and reported cases of dengue fever over the last 50 years. It represents an increase in detection rates with improved reporting, plus a true increase in incidence due to changes in environmental, climatic factors, and human-vector interaction. From 1955-1959 the World Health Organization was reported average annual number of dengue infections just 908 from less than 10 countries. From 2000-2007, the reported number was high as 925,896 from morethan 60 countries (Rajapakse et al., 2012). Thus, the incidence of infection has been rising at an minacious rate. Near about 75% of the world's dengue burden is in South East Asian and Western Pacific regions (Shirin et al., 2019). The threat of a possible prevalence of dengue now exists in Europe; local transmission were reported for the first time in France and Croatia in 2010 and imported cases were detected in 3 other European countries. In 2012, an outbreak of dengue on the Madeira islands of Portugal resulted in over 2000 cases and imported cases were detected in mainland

Portugal and 10 other countries in Europe. (Raheel et al., 2011) . The largest number of dengue cases ever reported globally was in 2019. All regions were affected,and dengue transmission was responded in Afghanistan for the first time. The large dengue outbreaks were characterized in the year 2016 with the Region of the Americas reporting more than 2.38 million cases. During that year, approximately 1.5 million cases was contributed by Brazil, approximately three times higher than in 2014; 1032 dengue deaths were also reported in the region. In the same year, more than 375,000 were suspected cases in the Western Pacific, of which the Philippines reported 176,411 and Malaysia 1,028 cases, representing the same burden for both countries the previous year. In 2017, it was reported that the number of dengue cases were deducted significantly in the Americas - from 2 177 171 cases in 2016 to 584 263 cases in 2017. This represents a reduction of 73%. Panama, Peru and Aruba were the only countries that registered an increase in cases during 2017. (Sheppard et al., 1969) However, with increased numbers of travelers in and out of endemic areas, dengue infections are increasingly encountered by physicians in non-endemic areas as well. Hence the disease burden is no longer limited to "endemic" areas. The natural history of dengue infection is fairly straightforward. The incubation period following inoculation of the virus is around 4-7 days. The symptomatic phase of illness is divided into three phases i.e, a febrile phase, a critical phase, a recovery phase. (Rajapakse et al., 2012) .

PRESENT SCENARIO OF DENGUE FEVER IN WEST BENGAL:

The spread of dengue from urban to rural areas is thought to be related to socio-economic and human ecological changes, such as increased transport contact, mobility and spread of peri urbanization, although improved reporting may also contribute (Kakarla *et al*., 2020).West Bengal has reported the highest number of dengue deaths in the country so far this year with the figure tillthe end of August standing at 22, Union Health Ministry has said on its website In West Bengal dengue death case is up from 14 in 2015 when Delhi had earned the distinction of recording the highest number of deaths due to the disease at 60.A list on the website of National Vector Borne Disease Control Programme under the Directorate General of Health Services of the Ministry of Health Services of the Ministry of Health and Family Walfare showed that 5,129 dengue cases were reported in the state till August 31, 2015. Dengue virus was first isolated in Kolkata in 1944 from the serum of US soldiers, Sabin and Schlesinger. In the late 1990's, the dengue fever as an epidemic was first recorded in the rural areas of West Bengal. In Kolkata, dengue was first documented in 1824, since then several epidemics occurred in Kolkata in 1836, 1906, 1911, 1923and 2005. During 2005-07, the percentage of dengue fever cases was highest in Kolkata (63.76%)and least in Jalpaiguri (0.02%). The total cases detected as dengue from August-November, 2005 by the Government of West Bengal were 6,293 and the total deaths were 34, Haiti. The number of DF cases in India has accelerated steadily according to the National Vector Borne Diseases Control Programme (NVBDCP), from 3306 in 2001 to 50222 in 2012; deaths have risen from 53 in 2001 to 242 in 2012. In West Bengal, in 2012 3306 confirmed dengue cases were reported, nearly 2000 cases from the Kolkata Metropolitan Corporation areas. (Bandyopadhyay et al., 2013)

DENGUE SERO-SURVEILLANCE IN WEST BENGAL (2005-2007)

A comprehensive picture of dengue epidemic occurred in West Bengal state in (Table 1). A total of 302 dengue (secondary) cases were obtained, constituting 18.10% of the people examined. Year-wise distribution of cases were 224,62 and 16 indicating 25.8, 9.88 and 9.24% of fever casessuffering from dengue in 2005, 2006 and 2007, respectively. Number of primary dengue cases was77 (34.37%) in 2005, 23 (37.09%) in 2006 and 1 (6.25%) in 2007; whereas of 201 total secondary dengue cases, 147 (65.62%), 39 (62.90%) and 15 (93.75%) were found in 2005, 2006 and 2007 respectively. As a whole secondary dengue cases constituted 66.55% of all dengue cases. This surveillance study indicated that as a whole 20.44% (341) of fever cases examined were not suffering from dengue, the range varied from 18.81% (118) in 2006 to 21.54% (187) in 2005. It also pointed out that 61.45% (1025) of the surveyed population were old dengue cases. Such old dengue cases amounted to 457 (52.65%) in 2005, 447 (71.29%) in 2006, and 121 (69.94%) in 2007. (Gupta et al., 2005)

District/ Area	Number	Cases (%)	Deaths
Kolkata	4013	63.76	**13**
24 Parganas (N)	524	8.33	**7**
Howrah	264	4.19	**4**
24 Parganas (S)	253	4.02	**3**
Hooghly	171	2.71	**0**
Maldah	155	2.46	**0**
Salt Lake City	135	2.15	**1**
Burdwan	104	1.65	**1**
Nadia	85	1.35	**1**
Midnapore (W)	50	0.75	**0**
Birbhoom	47	0.7	**1**
Midnapore (E)	27	0.43	**0**
Dinajpur (S)	13	0.21	**0**
Bankura	9	0.14	**1**
Darjeeling	4	0.06	**1**
Purulia	2	0.03	**0**
Dinajpur (N)	2	0.03	**0**
Coochbehar	2	0.03	**0**
Jalpaiguri	1	0.02	**0**
Outside State	16	0.24	**0**
Not known	416	6.61	**0**
Total	**6293**	**100**	**34**

Table 1. District and area-wise distribution of confirmed cases and deaths due to Dengue/DHF inWest Bengal (2005-2007) (Adapted from Gupta et al., 2005

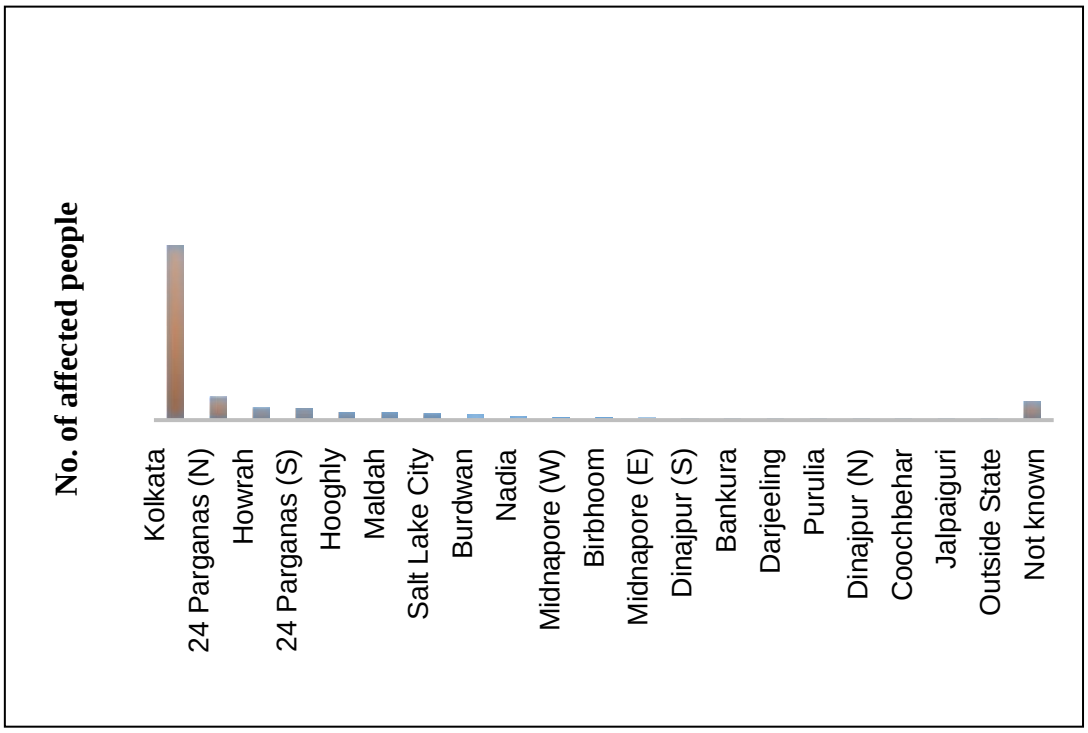

Figure 1: District wise distribution of Dengue in West Bengal (2005-2007)

(Adapted from Guptaet al., 2005)

Year	Total No of sera of fever cases tested	No patients having no dengue antibody (not suffering from dengue)	No patients having IgG antibody only (Old dengue cases)	No of patients having either IgM or bothIgM and IgG antibodies (Total denguecases)	No patients having IgM antibody alone (Primary dengue cases)	No patients having IgMand IgG antibodies (Secondary dengue cases)
2005 (Aug-Dec)	868	187 (21.54)	457 (52.65)	224 (25.8)	77 (8.87)	**147 (16.93)**
2006 (Jan-Dec)	627	118 (18.81)	447 (71.29)	62 (9.88)	23 (3.66)	**39 (6.22)**
2007 (Jan-Dec)	173	36 (20.8)	121 (69.94)	16 (9.24)	1 (0.57)	**15 (8.67)**
Total	1668	341 (20.44)	1025 (61.45)	302 (18.1)	101 (6.05)	201 (12.06)

Table 2. Serological studies on dengue in Kolkata (2005–07) (Adapted from Gupta et al., 2005)

This surveillance study indicated that as a whole 20.44% (341) of fever cases examined were notsuffering from dengue, the range varied from 18.81% (118) in 2006 to 21.54% (187) in 2005. It also pointed out that 61.45% (1025) of the surveyed population were old dengue cases. Such old dengue cases amounted to 457 (52.65%) in 2005, 447 (71.29%) in 2006, and 121 (69.94%) in 2007 (Table 2). (Hati, 2009) .

Age (Yr)	Patients suffering From primary dengue	Patients suffering From secondary dengue	Total cases
0-5	27 (26.73)	15 (7.46)	**42**
6-10	21 (20.79)	17 (8.45)	**38**
11-20	32 (31.68)	59 (29.35)	**91**
21-30	12 (11.88)	49 (24.37)	**61**
31-40	7 (6.93)	25 (12.43)	**32**
41-50	1 (0.99)	15 (7.46)	**16**
51-60	0	10 (4.97)	**11**
61-70	0	5 (2.48)	**5**
71-80	0	3 (1.49)	**3**
>80	0	3 (1.49)	**3**
Total	**101 (100)**	**201 (100)**	**302**

Table 3. Age gradation of 302 patients suffering from primary and secondary dengue infection:- (Adapted fom Hati, 2009)

The age gradation of primary and secondary dengue cases is presented. It was found that 79.2% ofprimary dengue cases occurred in age group 0-20 yr. Only 1.98% of cases were found in the age group 41-60 yr. No primary dengue case was found in person beyond 50 yr of age (32) that had suffered from dengue earlier were in the age groups 1-10 yr. Such old dengue cases were found more in the age groups 11-50yr (769, i.e. 77%), than in any other age group. Test samples of 81.8%of patients (279) where no dengue antibody was found were in 0-30yr age groups and 22.8% (78) in the age group 0-5yr, 10.8% (37) in the age group 6-10yr, and 26.9% (92) in the age group 11- 20yr. (Hati, 2009)

Month	2005						2006						2007					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
January							6	2	3	1	0	0	4	2	2	4	5	6
February							1	1	0	0	0	0	6	3	2	0	1	
March							1	1	0	0	0	0	3	1	2	0	0	
April							3	0	1	1	1	50	1	0	1	0	0	
May							4	1	2	0	1	100	2	1	1	0	0	
June							7	1	5	0	1	100	5	1	4	0	0	
July							39	8	26	1	4	80	3	0	3	0	0	
August	43	16	15	8	4	33.3	51	10	38	2	1	33.3	19	1	17	0	1	
September	506	117	279	41	69	62.7	40	7	28	0	5	100	15	5	8	0	2	
October	212	29	111	19	53	73.6	258	44	183	11	20	64.51	39	10	27	0	2	
November	79	16	34	9	20	69	185	40	134	7	4	36.36	44	9	30	1	4	
December	28	9	18	0	1	0	32	3	27	0	2	100	32	3	24	0	5	
Total	**868**	**187**	**457**	**77**	**147**	**238.6**	**627**	**118**	**447**	**23**	**39**	**664.17**	**173**	**36**	**121**	**1**	**15**	**0**
	224						**62**						**16**					

Table 4 : Serological Studies on Dengu in Kolkata (2005-07) : Month Wise analysis of cases
(Adapted from Hati , 2009)

1.Total Sera Tested **; 2**. Dengue Negative Cases **3.** Old Dengue Cases **4.** Primary Dengue Cases **5.** Secondary Dengue Cases **6.** Percentage of Secondary Cases ***** Total number of Primary and Secondary Dengue Cases

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Primary Dengue Cases													
2005	0	0	0	0	0	0	0	8	41	19	9	0	77
2006	1	0	0	1	0	0	1	2	0	11	7	0	23
2007	0	0	0	0	0	0	0	0	0	0	1	0	1
Total	1	0	0	1	0	0	1	10	41	30	17	0	101
Secondary Dengue Cases													
2005	0	0	0	0	0	0	0	4	69	53	20	1	147
2006	0	0	0	1	1	1	4	1	5	20	4	2	39
2007	0	1	0	0	0	0	0	1	2	2	4	5	15
Total	0	1	0	1	1	1	4	6	76	75	28	8	201
Total Dengue Cases													
2005	0	0	0	0	0	0	0	12	110	72	29	1	224
2006	1	0	0	2	1	1	5	3	5	31	11	2	62
2007	0	1	0	0	0	0	0	1	2	2	5	5	16
Total	1	1	0	2	1	1	5	16	117	105	45	8	302

Table- 5: Month-wise distribution of primary, secondary and total dengue cases during Month-wise distribution of primary, secondaryand total dengue cases during dengue surveillance in Kolkata (2005- 2007) (Adapted from Hati, 2009)

Month-wise number of total primary and secondary dengue is given in Table 4 and 5. Number of primary dengue cases was highest in September (41) in 2005, in October (11) in 2006, and in 2007,only one primary case (out of 16 cases) was found in November. Number of secondary dengue cases was also highest in September (69) in 2005, in October (20) in 2006m and December (5) in 2007 (Tables 4 and 5).Secondary dengue cases were distributed in all age groups (45.26% in 0- 2yr age group and 10.43% in>50yr of age) (Table 3). Only 3.12% of the patients number of total cases of dengue was highest in September (117), followed by October (105) and November (45). Of all the patients (302) suffering from dengue, 191 (63.24%) were males. Age and sex-wise distribution of dengue cases is given in Table 6. (Bhattacharya et al., 2008)

Age group (yr)	Male	Female	Total
0-5	22	20	**42**
1-10	24	14	**38**
11-15	40	16	**56**
16-20	24	11	**35**
21-25	21	10	**31**
26-30	18	12	**30**
31-35	5	4	**9**
36-40	17	6	**23**
41-45	3	2	**5**
46-50	6	5	**11**
51-55	3	4	**7**
56-60	2	2	**4**
>60	6	5	**11**
Total	**191**	**111**	**302**

Table- 6 Surveillance of dengue cases: age and sex-wise distribution (Bhattacharya et al., 2008)

The distribution of dengue was observed to be maximum in the age groups 11-20yr and graduallydeclined with increase of age. At young age (0-10yr), primary dengue infection was more frequentthan secondary infection. As age increased (from age group 10-20yr), secondary dengue case occurred more frequently as compared to primary dengue infection. In >41yr age groups, secondary dengue cases dominated primary dengue cases significantly. When compared, secondary dengue cases were always higher than primary dengue cases. There was significant decline in the frequency of cases tested positive for dengue from 2005 through 2007. The rate of decrease in total dengue cases in the period 2006-07 was higher than that in 2005-06). The declinein 2006-07 was steeper than that in 2005-06. Both primary dengue cases and secondary dengue cases declined steeply in 2005-06 than in 2006-07.(Bisaws et.al., 2014)

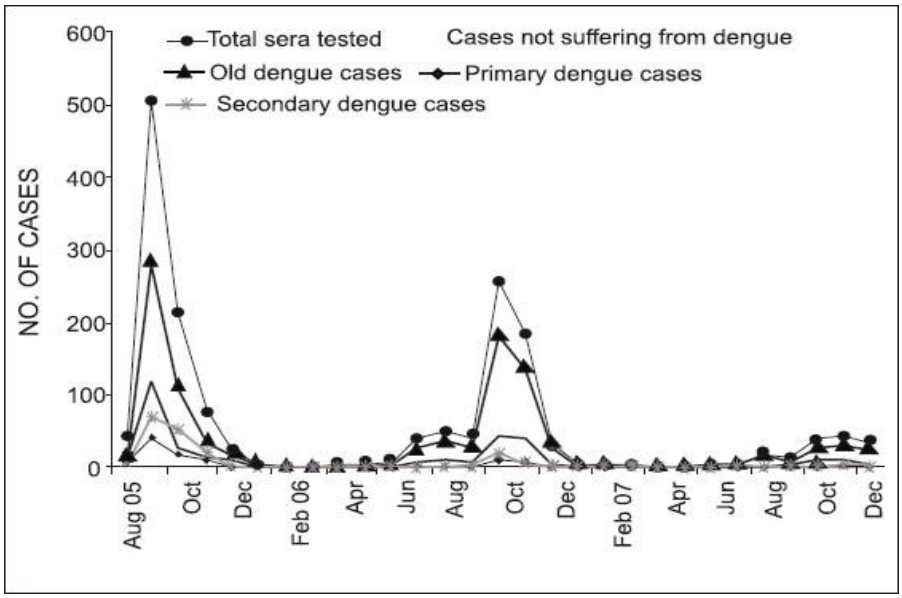

Figure 2: Serological studies on dengue in Kolkata (Aug 2005– Dec 2007): month-wise analysis(Bisaws et al., 2014)

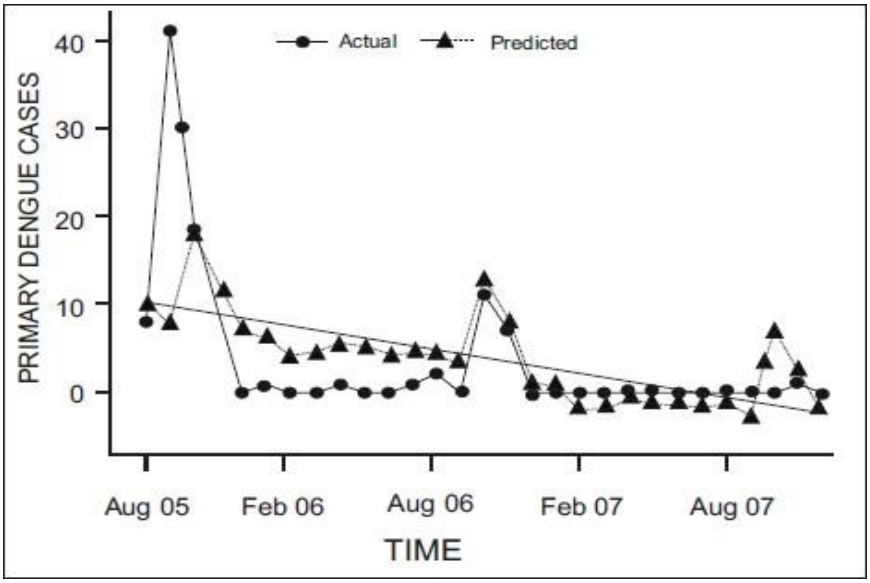

Figure 3: Actual and predicted figures for primary dengue cases in Kolkata showing the trend line (Aug 2005– Dec 2007) (Biswas et al., 2014)

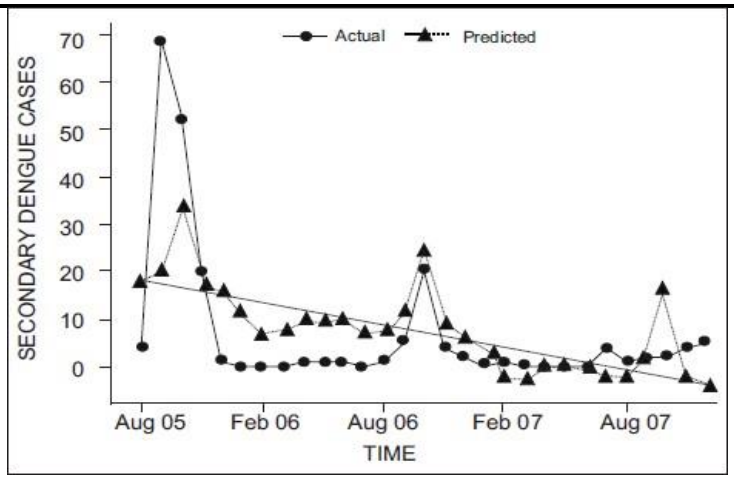

Figure 4: Actual and predicted figures for secondary dengue cases in Kolkata showing the trendline (Aug 2005– Dec 2007) (Bisaws et al., 2014)

Figs. 2 and 3 showed the actual and predicted values for the primary and secondary dengue casesrespectively. There is a trend line indicating the long-term movement of the data. Firstly, dengue not only affected the City of Kolkata, but also spread to 18 districts of the State of West Bengal, which was spectacular and unprecedented. Dengue was essentially an urban disease, confined to Kolkata in this state. But in 1994 epidemic of dengue was recorded in rural areas, with no death. Death virus was isolated from locally caught *Aedes aegypti*. Facing this epidemic and keeping in view that Kolkata was worst-affected, dengue surveillance in Kolkata was conducted from August2005 to December 2007, on the basis of both dengue specific IgG and IgM antibodies. This observation to some extent reflected the stratification of the people of the community in Kolkata. This was a sort of small-scale passive study. A large-scale active sero surveillance would be necessary to get the clear picture of these important epidemiological determinants. This study clearly depicted the seasonal incidence of dengue in Kolkata. During the post-monsoon season majority of the case were reported, with a peak in September where majority of cases are reported. Distribution of stray cases throughout the year pointed out that perennial transmission is going onin Kolkata which requires attention, because this can be effectively reduced through proper vector control measures. (Bisaws et al., 2014)

DENGUE FEVER CASES IN WEST BENGAL (2009-2012)

The month July in the year 2012 was observed as the ‘anti dengue month’. During 2005-07 the percentage of confirmed cases to total outbreak was highest in Kolkata (63.76%) under Presidency administrative division and least in Jalpaiguri (0.02%) under Jalpaiguri administrative division. It is noteworthy to mention that all the districts under Jalpaiguri administrative division recorded 0.02-2.46 percent of confirmed cases while the districts under Presidency administrative divisionexcluding the district of Murshidabad has recorded 1.35-63.76 percent of confirmed cases.

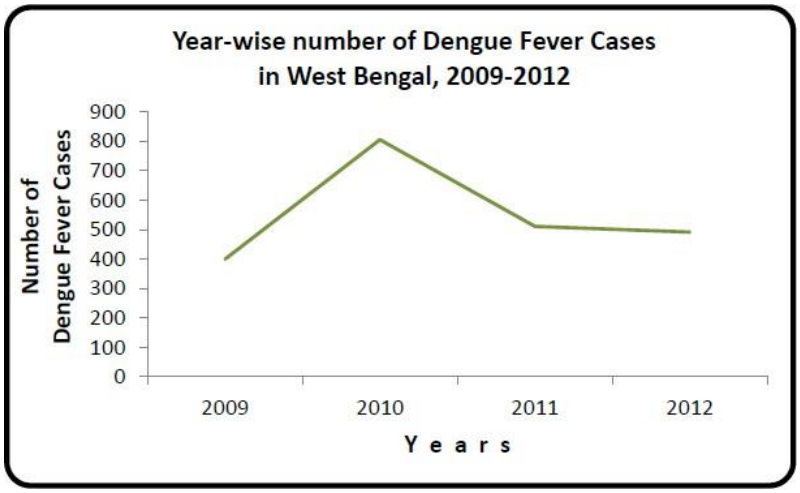

Figure 5: Year-wise number of Dengue Fever Cases in West Bengal, 2009-2012

Among the districts of Jalpaiguri division Coochbehar, Jalpaiguri and Uttar Dinajpur recorded no incidences of dengue fever cases during the year 2009 while among the districts of Burdwan division Burdwan recorded the highest number of cases of the disease during the same year. In Kolkata an abnormal occurrence of dengue fever cases were observed in 2009 though the official figures counted no death in the city with highest health infrastructure in the state. It was estimated that 68.42 percent of the districts recorded less than 15 cases of dengue fever, 15.79 percent of thedistricts recorded 15-30 cases, 10.53 percent of the districts recorded 30-45 cases and only 5.26 percent of the districts recorded more than 45 cases of the disease under study during 2009. (Dawn, 2014). The study of year-wise number of incidence of dengue fever in three administrative divisions of West Bengal has revealed that during the period 2009-12 the number of incidence of the disease has been highest in the Presidency administrative division and least in the Jalpaiguri administrativedivision as shown in Figure 5. The study of year-wise number of incidences of dengue fever in three administrative divisions of West Bengal has revealed that during the period 2009-12 the number of incidences of the disease has been highest in the Presidency administrative division andleast in the Jalpaiguri administrative division.

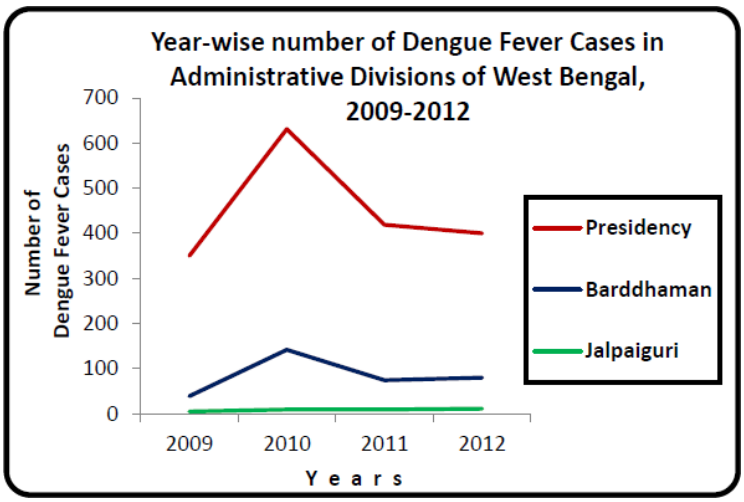

Figure 6: Year-wise number of Dengue Fever Cases in Administrative Divisions of West Bengal, 2009-2012
Data source- Govt of West Bengal

THE SCENARIO OF DENGUE FEVER IN KOLKATA (2009-2012)

The incidences of the disease reached its peak during September and October though stray cases of dengue are reported from various corners of the city all around the year. DHF (Dengue Hemorrhagic Fever) is distinct from classical DF (Dengue Fever) and is characterized by an acute febrile illness followed by hemorrhagic diathesis, dengue shock syndrome, and haemo concentration. It was the massive outbreak during 1990 that claimed quite number of lives especially of the children due to DHF/DSS. The child population from the Central, North-easternand Southern parts of the city was found to be suffering from acute from of the disease in 1990 (Chatterjee et al., 2015). It was during this time that children below one year especially the one three years age group were exposed to DHF/DSS (Dengue Shock Syndrome) which was rare priorto 1990. (Dawn, 2014).

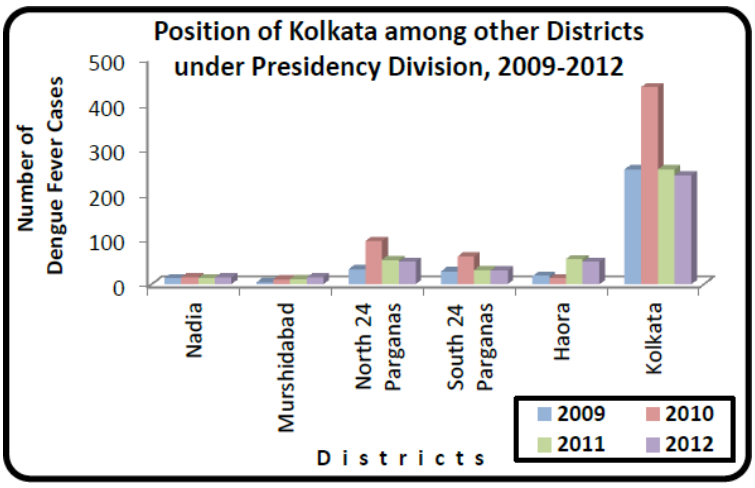

Figure 7: Position of Kolkata among other Districts under Presidency Division, 2009-2012
Data source- Govt of West Bengal

Among all other districts under Presidency division which includes Nadia, Murshidabad, North 24 Parganas, South 24 Parganas and Howrah the city of Kolkata leads in the number of incidences of DF (Dengue Fever) during 2009-12 [Fig.8]. The number of patients during 2009 in Kolkata was 254 which experienced a tremendous rise of 437 in 2010 and a consecutive decline of 58 percent (approx.) in 2011. (Halsa et.al., 2011)

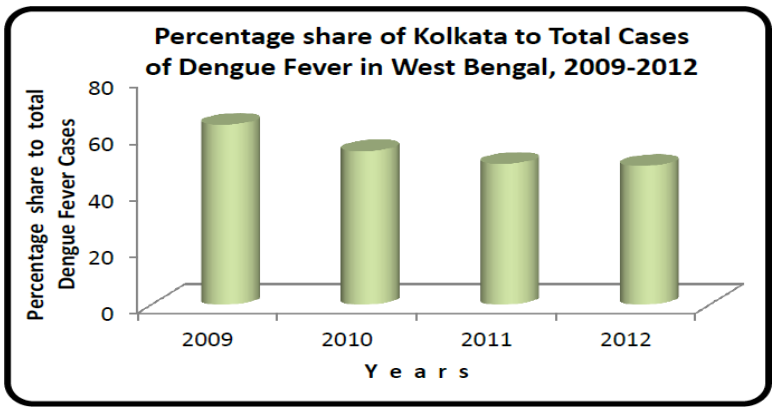

Figure 8:Year-wise Number of Dengue Fever Cases in Kolkata, 2009-2012
Data source- Govt of West Bengal

The percentage share of Kolkata to total cases of dengue fever in the state was 63.66 percent in 2009 which declined to 49.08 percent in 2012. The number of patients during 2009 in Kolkata was254 which experienced a tremendous rise of 437 in 2010 and a consecutive decline of 58 percent (approx.) in 2011. The incidences of an outbreak of dengue fever have been quite high in case of slum dwellers than non-slum communities in the city. The inadequate urban amenities which include unhygienic environ of living, open drains, condition of water logging during monsoon season and seasonal spells of shower and lack of proper sanitary conditions. Their condition is even more worsened bytheir state of poverty, illiteracy, low level of awareness and failure of the Government health workers to reach these areas. Among the slum dwellers of the city the female population in the age groups of 0-15 years, 15-30 years and 30-45 years have been found to be more vulnerable than their male counterparts. The picture is quite reverse in case of 45-60 years age group as well as above 60 age group of population as can be seen from Figure 8. (Sharma et al., 2010).

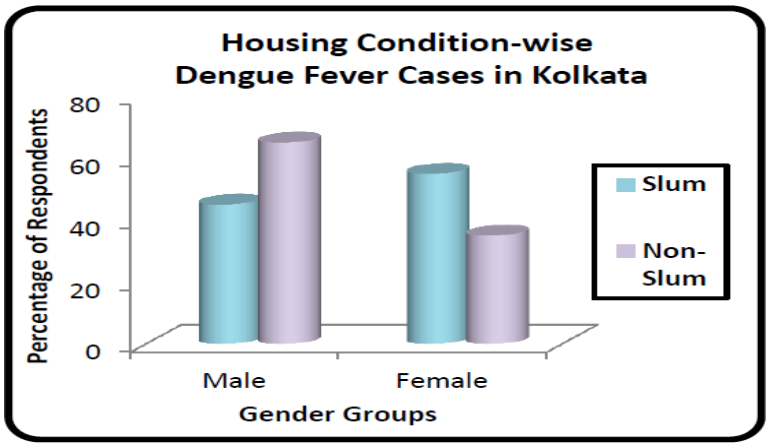

Figure 9: Housing condition wise, age and sex wise incidence of Dengue fever in Kolkata (2012-13) (Adapted from Sharma et al., 2010)

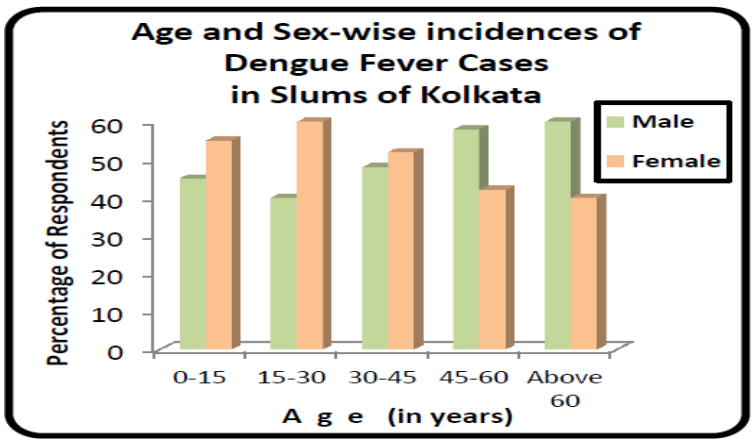

Figure 10: Age and sex wise incidence of Dengue fever in Kolkata (2012-13) (Adapted from Sharma et al., 2010)

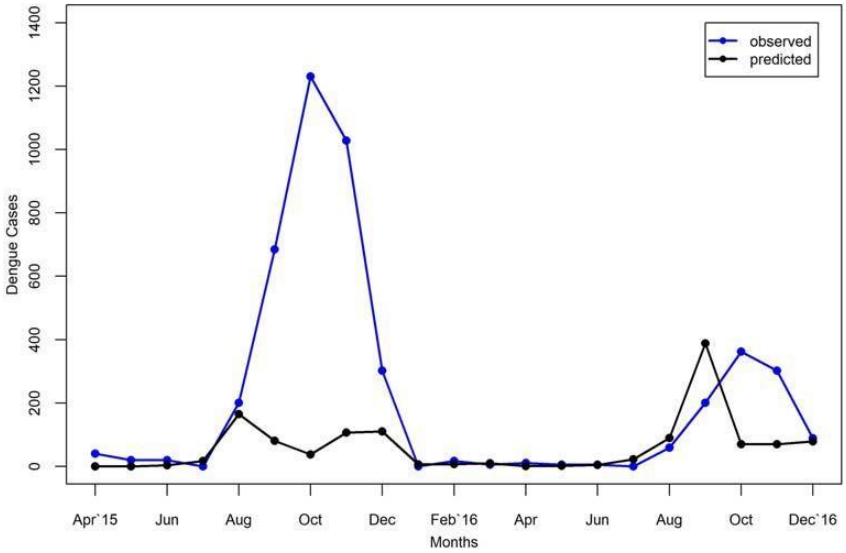

Figure 11: Comparison of observed (solid blue line) and predicted (solid black line) dengue casesusing zero-inflated Poisson regression model for the period (April 2015 to December 2016) (Adapted from Bal et al., 2020)

DENGUE CASE IN KOLKATA (2015-2016)

Dengue infections in Kolkata showed a seasonal pattern with almost no cases from January to March and incidences beginning in July and continuing until December. In Kolkata, a total of 16,697 dengue cases were recorded from 2015 to 2016with a mean of 116 dengue fever cases permonth significantly. (Bal et al., 2020) .

DENGUE CASE IN WEST BENGAL (2016- 2018)

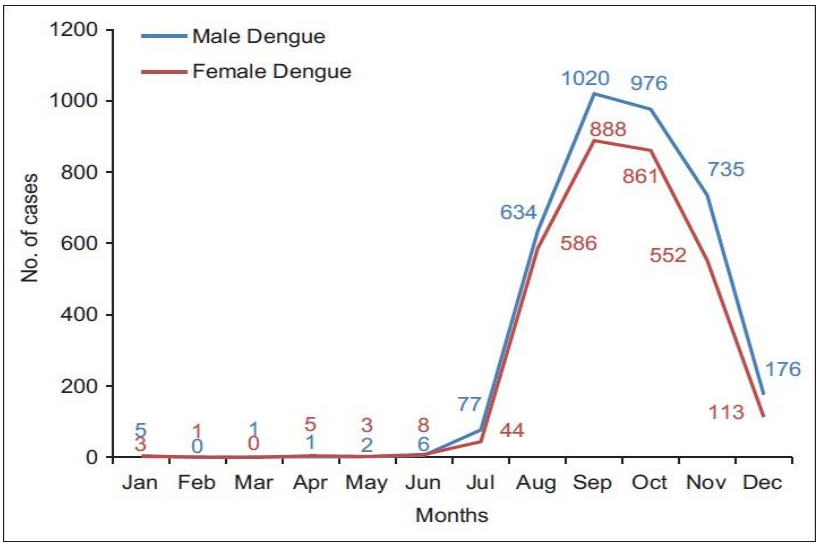

Figure 12: Line diagram showing seasonal distribution of dengue cases (2016–2018) (Adaptedfrom Roy et al., 2020)

The study showed that peak incidence of dengue cases during September–October months inboth genders in West Bengal. (Adapted from Roy et al., 2020)

PREVENTION & CONTROL OF DENGUE

To determine effectiveness of control interventions species composition will carry active monitoring and surveillance of vector abundance. Prospectively monitor prevalence of virus in the mosquito population, with active screening of sentinel mosquito collections also requires attention(Ebi & Nealon, 2016). Emergency vector control measures such as applying insecticides as space spraying during outbreaks should be used by health authorities. (Roy et al., 2020).The dengue virus is carried by the mosquitoes typically live in and around houses, breeding in standing water that can collect in such things as used automobile tires (Alok et al., 2020). The elimination of mosquitohabitats is another effective measure that needs to be undertaken preventing the mosquitoes to they lay eggs and propagate (Pang et al.,2017). Standing water containers should be covered between cleanings. Educating the community on the risks of mosquito-borne diseases is a necessary step at preventing dengue. Engaging with the community to improve participation and mobilization for sustained vector control is required (Kusuma et al., 2020). Protective clothes and **mosquito repellent can be used when travelling in a mosquito infested area.** Permethrin can be applied to clothing, shoes, camping gear and bed netting (Kathiriya et al., 2020).

DIAGNOSIS AND TREATMENT OF DENGUE AND VACCINATION

Diagnosis:-Several methods can be used for diagnosis of DENV (Dengue Virus) infection. The virological tests (that directly detect elements of the virus) and serological tests are include for dengue diagnosis, which detect human-derived immune components that are produced in responseto the virus). In this time the patient presentation, the application of different diagnostic methods may be more or less appropriate. Patient samples collected during the first week of illness should be tested by both serological and virological methods. The Virological method is done by RT-PCRassay by specialized equipments and technical training for staff implementing the test. For recognize the genotypes of the virus RT-PCR products from clinical samples may also be used, allowing comparison with virus samples from various geographical sources. The Serological method is done by Enzyme-linked immunosorbent assays (ELISA) to confirm the presence of a recent or past infection, with the detection of IgM and IgG anti-dengue antibodies are detectable ~ 1 week after infection and are highest at 2 to 4 weeks after the onset of illness. (Tang et al., 2012)

Treatment:-No specific treatment for dengue fever exists. Doctor may recommend that drink plenty of fluids to avoid dehydration from vomiting and a high fever. Dehydration should be avoided by supplying enough fluid to the body.

The patient who affected in dengue virus should drink clean water, ideally bottled rather than tap water. Rehydration salts can also help replaces fluids and minerals. Painkillers, such as Tylenol or paracetamol: These can help lower fever and ease pain. Non-steroidal anti-inflammatory drugs (NSAIDs), such as aspirin or ibuprofen (Advil, Mortin IB, others) and naproxen sodium, are not advised, as they can increase the risk of internalbleeding.

Most severe forms of Dengue fever may need:

- Intravenous (IV) fluid supplementation, or drip, if the person cannot take fluids by mouth
- Blood transfusion, for patients with severe dehydration
- Blood pressure monitoring
- Transfusion to replace blood loss

Hospitalization will allow the individual to be properly monitored, in case symptoms get worse. Rehydration salts, Tylenol, and Paracetamol should be kept neat hand. (Rajapakse *et al.* 2012).

Vaccination:-The first dengue vaccine, Dengvaxia (CYD-TDV) [Chimeric yellow fever virus– DENV (CYD)- Tetravalent dengue vaccine (TDV) or CYD-TDV] was developed by Sanofi Pasteur was licensed in December 2015 and regular authorities selected this in ~ 20 countries. In November 2017, the results of an additional analysis to retrospectively determine serostatus at thetime of vaccination were released. As such, the persons who are living in endemic areas are targeted for the

use of this vaccine, ranging from 9-45 years of age, who have had at least 1 documented dengue virus infection previously. Decisions about pre-vaccination screening strategy is implemented would require careful assessment at the country level, including consideration of the sensitivity and specificity of available tests and of local priorities, dengue epidemiology, country-specific dengue hospitalization rates, and affordability of both CYD-TDV and screening tests. As part of an integrated dengue prevention and control strategy vaccination will consider. There is an ongoing need to clining to other disease preventive measures such as well-executed and sustained vector control. Individuals, whether vaccinated or not, should seek prompt medicalcare if dengue-like symptoms occur. (Guy et al., 2015)

CONCLUSION

In the present day Dengue fever is a cause of major concern in West Bengal as well as in Kolkata. The nuisance and outbreaks of this vector borne disease continues to increase every year with Kolkata at its prime focus. Out of these study years, 2005 was worst-affected with large number of cases (224). But there was sizeable reduction of dengue cases in two subsequent years, i.e. in 2006 (9.88%) and 2007 (9.22%) in comparison to 2005 (25.80%), when epidemic occurred. The Government run health institutions have revealed that the maximum inflow of patients is received from neighboring states of Bihar, Jharkhand and Assam while huge inflow of patients is experienced from surrounding districts of North 24 Parganas, South 24 Parganas, Howrah, Purba Medinipur, Paschim Medinipur and from the city in the year of 2009 to 2012. In Kolkata among the slum dwellers of the city the female population in the age groups of 0-15 years, 15-30 years and 30-45 years have been found to be more vulnerable than their male counterparts. In Baranagarand North 24 parganas dengue cases are mostly seen from the month of September to December in 2015. Similar trends are visible for the year 2016-2018 where highest number of dengue cases are recorded in the months of Septrmber-October for both the gender. So it can be concluded that the effect of dengue in West Bengal is greater in the month from September to December. Community participation is required at grass root level both in urban and rural areas of the state to combat the situation. Adverse meteorological conditions and unplanned urbanization favoured thebreeding of *Aedes* sp. mosquitoes in various parts of the city. Mass awareness should be created ata higher level for the slum dwellers and BPL (Below Poverty Line) group of population by the Government and Non-Government Organizations. Involvement of government sectors and community youth groups to clean up the discarded tyres and containers in the neighborhoods, and raise awareness among the villagers addressed the dengue outbreak. The health care facilities provided at the health units should be improved in terms of infrastructure and obtainability of skilled health recruits. Methods of draining out of storm water should be a rapid process to controlits outbreak in the urban slums. It is better to change water of buckets everyday reducing the scopeof mosquito reproduction. Entomological surveys should be carried out at regular interval to investigate the dengue cases in West Bengal as well as throughout the country.

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