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Original Research Article

DYNAMICS OF DENGUE VIRUS INFECTION ACROSS THE SEASONS

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ABSTRACT

Background: Dengue fever has evolved into a significant global emerging infectious disease and is now recognized as a widespread epidemic spanning over 120 countries. According to the World Health Organization (WHO), approximately two-fifths of the global population residing in tropical and subtropical regions faces a continual risk of contracting this infection. In India, dengue poses a substantial public health challenge and stands as a leading cause of hospitalization amongst all age groups.

Materials and Methods: This study was conducted jointly in the Departments of Microbiology at ESI-PGIMSR & ESIC Medical College, Joka, Kolkata, and Jagannath Gupta Institute of Medical Sciences & Hospital (JIMSH), Budge Budge, Kolkata. The duration of study was over a period of two years.The study population comprised of 3946 subjects. Of these, 398 cases were found to be positive for dengue infection.

Results: Of the 3946 individuals included in the study, 398 (10.1%) cases were positive for dengue and rest were negative. Of the 398 positive cases, 263 were males and 135 were females. This study showed that of the total positive cases, 113 belonged to age group 31-60 years followed by 0-15 years (88 cases), 61-70 years (79 cases), 16-30 years (72 cases) & >70 years age group (46 cases). It was also seen that most of the cases of dengue were found to be positive during the months from September to November.

Conclusion: The study concludes that dengue infection cases are more prevalent during the rainy and post-rainy seasons in the eastern part of India.

Keywords: Dengue Virus Infection, Dengue Shock Syndrome (DSS), Dengue Hemorrhagic Fever (DHF), sero-markers.

INTRODUCTION

The prevalence and distribution of dengue-related illnesses have experienced a significant increase in recent decades. Approximately 50 million cases of dengue infections are estimated to occur each year, with around 2.5 billion people residing in regions at potential risk of dengue transmission. The transmission of the dengue virus is facilitated by *Aedes* mosquitoes, leading to the manifestations of both classical dengue fever (DF) and the potentially lethal dengue hemorrhagic fever (DHF). The first documented epidemic of DHF was noted in Southeast Asia in 1953. Since the initial outbreak of dengue in Thailand in 1958, there has been a consistent upward trajectory in the occurrence of DHF. In 2010, Sisaket province in Thailand was designated as a high-risk area for dengue. During that year, the province reported the highest number of dengue cases in the northeastern region, totaling 2,618 cases with an incidence rate of 180.25 cases per 100,000 population. [1-3]

Environmental factors, including various weather variables, may play a crucial role in the transmission of dengue, a mosquito-borne disease characterized by seasonal distribution. Key parameters such as temperature, rainfall, and relative humidity exert significant influence on the incidence of dengue fever in the endemic regions. Studies have extensively explored the prediction of global climate change and its impact on the transmission and geographic spread of dengue. Due to the high

dependence of dengue transmission on local environmental factors, predicting incidence beyond specific locations may pose challenges. Nevertheless, scrutinizing local weather conditions and dengue occurrences in diverse environmental and regional contexts can enhance our comprehension of the connections between weather variables and dengue transmission. This, in turn, can contribute to robust scientific evidence for anticipating future transmission patterns. [4-9]

Dengue fever has evolved into a significant global emerging infectious disease and is now recognized as a widespread epidemic spanning over 120 countries. According to the World Health Organization (WHO), approximately two-fifths of the global population residing in tropical and subtropical regions faces a continual risk of contracting this infection. In India, dengue poses a substantial public health challenge and stands as a leading cause of hospitalization amongst all age groups. The incidence of dengue cases has shown an upward trend over the past three to five years. While it was previously considered predominantly a concern for urban and semi urban areas, it has now infiltrated affluent communities, intensifying the public health dilemma. [10-11]

Dengue is a severe, life-threatening viral infection transmitted through the bites of infected *Aedes* mosquitoes, primarily *Aedes aegypti*. It belongs to the Flavivirus genus and the Flaviviridae family, featuring four known serotypes of the dengue virus - DEN-1, DEN-2, DEN-3, DEN-4 with a recently identified fifth serotype DEN-5 in October 2013. Serious manifestations are more common in cases of re-infection. This disease represents one of the rapidly advancing mosquito-borne viral infections, exhibiting a broad clinical spectrum that ranges from mild febrile illness to severe conditions such as Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS).

Recovery from an infection provides lifelong immunity against the specific serotype involved but offers only partial and temporary protection against subsequent infections by other serotypes. Secondary infections with a different serotype than the one causing the primary infection can result in potentially fatal DHF and DSS. Detection of NS1 antigen and dengue-specific IgM / IgG remains pivotal for diagnosing dengue infection. In addition to these dengue-specific parameters, auxiliary laboratory tests like platelet count and leukocyte levels are available to support the diagnosis of DHF or DSS. [12-14]

MATERIALS AND METHODS

Study Area: This study was conducted jointly in the Departments of Microbiology at ESI-PGIMSR & ESIC Medical College, Joka, Kolkata, and Jagannath Gupta Institute of Medical Sciences & Hospital (JIMSH), Budge Budge, Kolkata.

Study Duration: The duration of study was over a period of two years.

Study Population: The study population comprised of 3946 subjects. Of these, 398 cases were found to be positive for dengue infection.

Methods: Serum samples were collected from all the suspected patients (study population) whose clinical features were similar to dengue infection. Samples were subjected to serological testing and the positive cases were identified. Additionally, platelet count evaluation was done for the positive samples. The data was analyzed on the basis of age, sex and seasonal distribution

In this study, immunochromatographic card kit (J. Mitra & Co.) was used for testing the samples. This card is based on principle of antigen-antibody reaction. This test was performed for the qualitative detection of NS1 antigen and differential IgM and IgG antibodies in the serum sample.

Dengue NS1 antigen device shows two lines; “C” (Control line) and “T” (Dengue NS1 antigen test line). Test line is coated with antibodies to NS1 Ag. The sample was added to the device. Dengue NS1 antigen present in the sample reacted to the anti-dengue NS1 gold colloid conjugate leading to the formation of an antigen-antibody complex. This complex migrated along the membrane to the test region and formed the visible pink line at “T” as antigen-antibody gold conjugate complex.

Dengue IgM / IgG test device consists of three lines; “C” (Control line), “M” (IgM test line) and “G” (IgG test line). IgM and IgG test lines are coated with anti-human IgM and IgG monoclonal antibodies respectively. When the sample was added to the device, IgM and IgG antibodies in the sample reacted with anti-human IgM and IgG antibodies coated on the membrane. Colloidal gold complexes containing dengue 1-4 antigen prepared from DENV culture was captured by the bound anti-dengue IgM or IgG on respective test band located in the test window causing a pale to dark red band to form at the IgM or IgG region of the test device window.

Data Analysis: Analysis of data was done using Microsoft excel.

RESULTS

This study involved a total population of 3946 individuals. Among them, 398 cases (10.1%) tested positive for dengue while the remaining were negative (Table 1). Among the positive cases, 263 were males and 135 were females (Figure 1). The study revealed that out of 398 cases, the highest number (113) belonged to the age group 31-60, followed by 0-15 (88), 61-70 (79), 16-30 (72) and >70 (46) age groups (Figure 2).

Tables 2 and 3 present the yearly distribution of cases in 2022 and 2023.

From January 2022 to May 2022, no positive cases were found. Between June 2022 and August 2022, only 4 positive cases were identified. The majority

of positive cases (154) occurred from September 2022 to December 2022. Overall, 158 cases were found to be positive in 2022. Of these, 29 patients tested positive for NS1 antigen, 32 for IgM antibody, 18 for IgG antibody, 29 for both NS1 and IgM, 22 for both NS1 and IgG, 19 for both IgM and IgG antibody, and 9 for all three NS1, IgM and IgG (Table 2).

In 2023, the months of March to June showed no positive cases. Overall 240 cases were found to be positive for dengue during the remaining months. Of these, 49 individuals tested positive for NS1 antigen, 50 for IgM antibody, 13 for IgG antibody, 37 for both NS1 and IgM, 19 for both NS1 and IgG, 62 for both IgM and IgG antibody, and 10 for all three NS1, IgM, and IgG (Table 3).

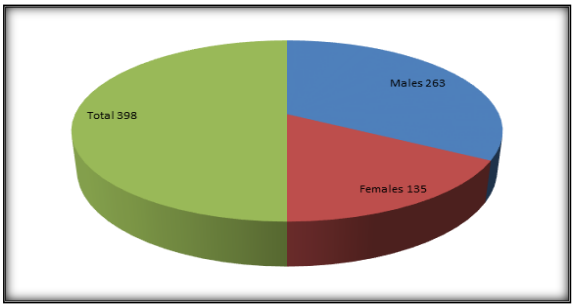
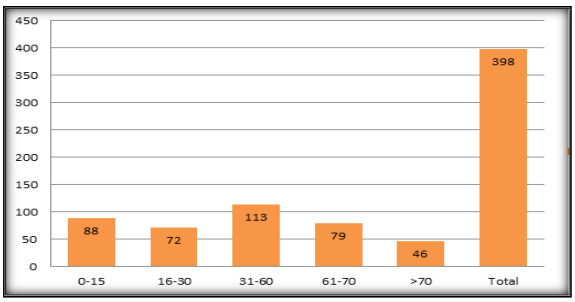


Figure 1: Gender distribution among the positive cases



X axis shows Age group; Y axis shows number of positive case

Figure 2: Age distribution among the positive cases

Table 1: Total cases of dengue in 2022 & 2023

Result of dengue test	Number of cases	Percentage
Positive	398	10.1
Negative	3548	89.9
Total	3946	100

Table 2: Number of positive and negative cases in 2022

Year 2022	Number of positive cases	NS1	IgM	IgG	NS1 & IgM	NS1 & IgG	IgM & IgG	NS1, IgM & IgG
JAN	0	-	-	-	-	-	-	-
FEB	0	-	-	-	-	-	-	-
MAR	0	-	-	-	-	-	-	-
APR	0	-	-	-	-	-	-	-
MAY	0	-	-	-	-	-	-	-
JUNE	1	-	-	1	-	-	-	-
JULY	1	-	-	1	-	-	-	-
AUG	2	-	-	1	-	-	1	-
SEP	56	9	11	-	8	9	13	6
OCT	82	17	14	11	21	13	4	2
NOV	14	3	7	4	-	-	-	-
DEC	2	-	-	-	-	-	1	1
TOTAL	158	29	32	18	29	22	19	9

Table 3: Number of positive and negative cases in 2023

Year 2023	Number of positive cases	NS1	IgM	IgG	NS1 & IgM	NS1 & IgG	IgM & IgG	NS1, IgM & IgG
JAN	1	-	-	1	-	-	-	-
FEB	1	-	-	1	-	-	-	-
MAR	0	-	-	-	-	-	-	-
APR	0	-	-	-	-	-	-	-
MAY	0	-	-	-	-	-	-	-
JUNE	0	-	-	-	-	-	-	-
JULY	1	-	1	-	-	-	-	-
AUG	3	1	2	-	-	-	-	-
SEP	96	22	33	-	16	-	25	-
OCT	79	17	8	7	12	16	19	-
NOV	47	7	6	4	3	-	17	10
DEC	12	2	-	-	6	3	1	-
TOTAL	240	49	50	13	37	19	62	10

DISCUSSION

The current study was conducted jointly at ESI PGIMSR & ESIC Medical College, Joka, Kolkata, and Jagannath Gupta Institute of Medical Sciences & Hospital (JIMSH), Budge Budge, Kolkata, in their Departments of Microbiology. The primary objective of this study was to explore the seasonal variation of dengue infection.

A total of 3946 samples were examined, with 398 cases testing positive for one or more serological parameters related to dengue infection. Among the 398 dengue seropositive cases, 78 (19.5%) showed positive results for NS1, 82 (20.6%) for IgM, and only 31 (7.7%) for IgG. The remaining cases (207) exhibited positivity for a combination of any two sero-markers (antigen and antibody) or all of them.

A study conducted by Biradar A et al at Alameen Medical College, Karnataka reported NS1 positivity in 46.55% of cases, IgM positivity in 6.89%, IgG positivity in 24.13% while 22.43% of cases tested positive for both antigen and antibody, or both antibodies, or a combination of serological parameters. [15] According to Chakravarti A et al, immunoglobulins begin to appear within 5-10 days of fever in primary infections and approximately 4-5 days in secondary dengue infections. [16]

In this study, out of the total positive cases, 263 were males and the remaining (135) were females. The lower rates of disease detection in women may be attributed to under reporting and lower healthcare-seeking behaviour among women, emphasizing the need for well-designed studies to understand sex differences. [17] The higher infection rates in males compared to females could be linked to increased exposure at workplaces or outdoor activities. Halstead SB et al. suggested that females may exhibit more competent immune responses than males, leading to greater cytokine production and increased immunity to dengue infection. [18]

In the present study, we found 88 patients (22.1%) belonging to the age group of less than 15 years. However, in a study by Pandey N et al. in Lucknow, North India (2008-2010), it was reported that 853 (54.43%) patients of their study group were under the age of 15 years, which is a higher figure as compared to our study. [19]

As regards cases according to seasonal variations, Pandey N in Lucknow, North India (2008-2010), reported findings similar to those found in the present study. The majority of positive cases in that study also occurred from August to late October. [19] In the present study also, a predominant dengue epidemic was likewise observed from August to November. This temporal correlation may be attributed to the onset of the rainy season around late June, persisting until October. Rain, temperature, and relative humidity have been identified as major climatic factors, either individually or collectively, contributing to the conditions conducive for an epidemic. [20] In North India, the highest proportion of serologically positive cases has been documented during the post-monsoon period. [20] A study in Bangladesh also revealed that the post-monsoon period is the most affected time frame for dengue cases. [21] It has been proposed in various studies that ecological and climatic factors play a crucial role in influencing the seasonal prevalence of the vector *Aedes aegypti* and the Dengue virus (DENV). [22]

CONCLUSION

The findings of this study lead to the conclusion that dengue infection cases are more prevalent during the rainy and post-rainy seasons in the eastern part of India. For diagnostic purposes, the NS1 antigen serves as the most reliable marker in the early phase of infection. Additionally, IgM and IgG are identified as confirmatory indicators in the later stages of infection.

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