An epidemiological study of dengue Virus and Surveillance Outbreak in Dimapur, Northeast India.

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Abstract

Across the world, dengue fever has emerged as a major health concern. It is a seasonal and is caused by the bite of Aedes mosquido found in swampy areas, and water logging. Infection with the dengue virus has a very complicated and dynamic epidemiology. From August 2022 to January 2023, a thorough epidermilogical survey was carried out in Dimapur. The first outbreak was recorded in urban area dimapur, Nagaland. In this study, serum samples were collected from IPD, OPD and other source from privates Hospital and Laboratories to detect the presence of IgM ELISA in patients with positive dengue NS1 antigen and IgG/IgM antibodies of RAT.

Key: Complement System, Dengue, Aedes aegypti, Aedes albopictus.

1.Introduction:

The flavivirus-driven disease dengue spreads the fastest among mosquito-borne illnesses. In 1946 [1], there were possibly the first reports of it in India. Around the world, it is a widespread vector-borne disease. It breeds in man-made containers and is a major vector [2]. The disease is spread by mosquitoes. The flavivirus that causes the serotypes of dengue virus (DEN 1, 2, 3, and 4) has the highest rate of dissemination.[3- 7]. In nearly all of India's states, dengue is the most prevalent sickness that necessitates hospitalization. Although reports are currently coming from both urban and rural areas [8], the National Vector Borne Disease Control Programme (NVBDCP), the Integrated Disease Surveillance Programme (IDSP), and other organisations work together in a network of 52 Virus Research and Diagnostic Laboratories (VRDL) to monitor dengue fever. This network was set up by the Department of Health Research.

The proliferation of the dengue virus infection is significantly impacted by weather variables such as temperature, rainfall, and other variables. Rash, nausea, vomiting, sore throat, and a sudden onset of a high-grade fever are some of the signs and symptoms of dengue fever (DF). [6-7] Hypovolemic shock, also referred to as Dengue Shock Syndrome (DSS), is the cause of circulatory collapse in DF[3]. In an immunosuppressed person, a primary infection frequently leads to DF. [5,9]

The goal of the current study was to determine the seroprevalence of dengue virus infection in Nagaland by identifying IgG, IgM, and NS1 antibodies against the virus in all clinically suspected cases of dengue infection, depending on whether the fever lasted longer than or less than 5 days at the time of presentation in an outpatient and inpatient department of a tertiary care hospital.

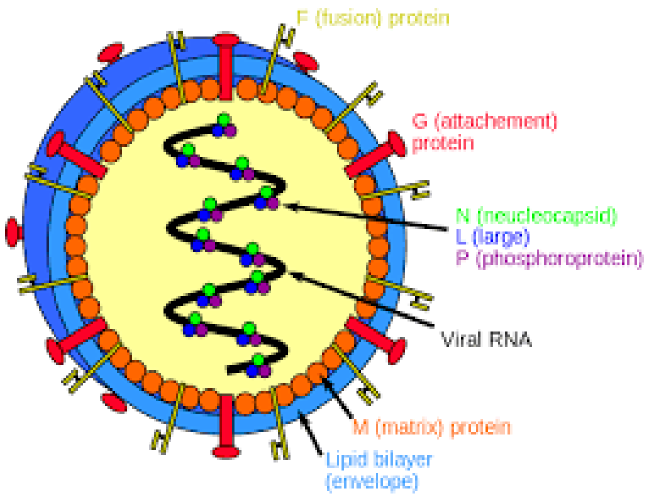

Fig: Dingue virus

2.The immune system's cells

DENV is thought to enter the bloodstream when mosquitoes feed on people, infecting young Langerhans cells (epidermal dendritic cells [DC] (10,11) and keratinocytes). Infected cells go from the infection site to the lymph nodes, where they attract monocytes and macrophages, which serve as the infection's targets. Blood-derived monocytes (12), myeloid DC (13), splenic and hepatic macrophages (14-15), and other mononuclear cells are all infected. According to the virus virulence hypothesis, nucleotide differences DENV strains are assumed to be responsible for more severe sickness. DENV serotypes can be further subdivided into different genotypes, and changes in viral genetics are connected to virulence (16,17).

When defending against infections, the hemostatic system and complement system work closely together. It is a key humoral element of innate immunity. The host can fully initiate the more slowly emerging adaptive immunity with the aid of innate immune systems. When plasma leakage might be found, high plasma levels of the activation products C3a and C5a are evaluated (18-20). Complement activation is essential for understanding the pathophysiology of dengue. (21). An important part of NS1's function in complement activation has been hypothesized.

Additionally, the NS1 produced by infected cells has the power to instantly activate complement components that are present in the fluid phase (22).

3.Structure and non-structure Proteins:

The DENV's shape revealed that its surface was icosahedra and flat. The genome codes for three structural proteins: a capsid (C, 100 amino acids), a premembrane/membrane (PrM/M, 75 amino acids), and an envelope (E, 495 amino acids). Seven non-structural (NS) proteins are also present: NS1, NS2A, NS2B, NS3, NS4A, NS4B, and NS5. Proteins with the N word include structural proteins. Non-structural proteins are responsible for virus replication, whereas structural proteins support the assembly of the DENV virion's constituent parts. [23]

Protein (E) Envelope:

The viral envelope glycoprotein allows the virus to enter the target cell through viral endocytosis, which is mediated by clathrin. The virus enters the cell and a cross-bridge connects it to the host [24-25]. The primary role of the E protein is to bind to and associate with the host cell membrane. DENV cannot assault early stages of infection because of the E protein inhibitors. Each monomer is made up of numerous domains, including the stem domain, soluble ectodomain, and C-terminal transmembrane anchor domain.

Membrane protein/PrM (M) :

The PrM/M protein is composed of 175 amino acids, two transmembrane helices, an N-terminal region, and a M domain. The prM protein is broken down by a cellular protease, which also preserves 180 copies of the 75 residues of the core protein while releasing 91 amino acids at the N-terminus [26]. The N and M domains of the Golgi apparatus break, resulting in the conversion of PrM into M-protein and the maturation of the virus [27].

Capsid Protein (C):

This homodimeric protein has 100 amino acids, four _-helical regions, an unorganised N-terminal domain, and a molecular mass of 12 kDa [27,29-31]. The interaction of the positively charged N-terminal domain with negatively charged lipid droplets is a step in the formation of viral particles [32]. The C protein is essential for the formation of nucleocapsids in the initial stages of dengue virion assembly. It is a favourable target for vaccines and antivirals because to the lack of an adverse drug-enhancing response (ADE), and it is also required for prM maturation [33-37,28].

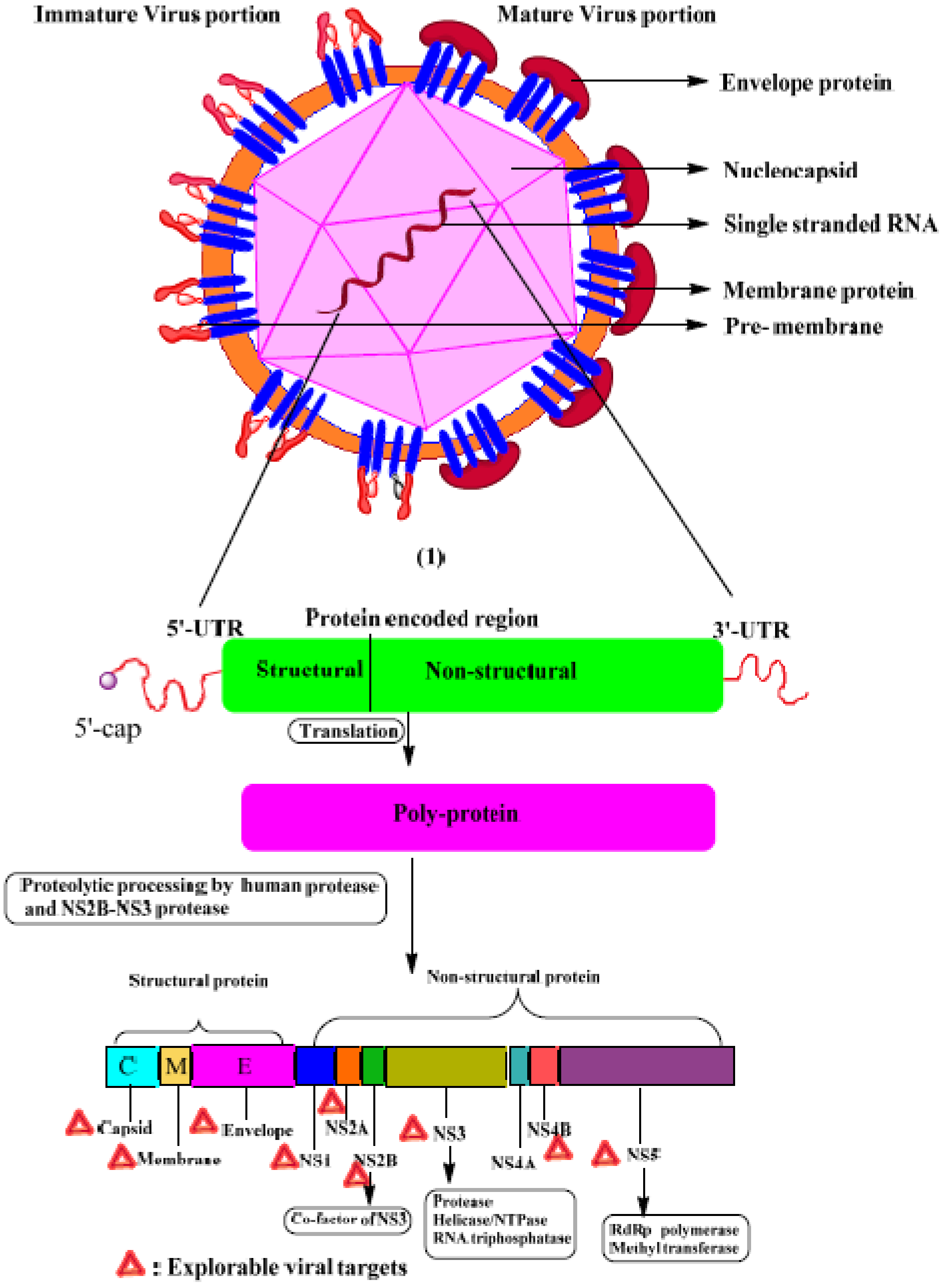

Figure: Schematic diagram showing (**1**) structure of dengue virus, mature, and immature viral portion difference. (**2**) DENV RNA genome and polyprotein processing to form three structural and seven non-structural proteins. UTR—untranslated region

4.Materials & methods

This epidemiological study was carried out at the District Hospital Dimapur sentinel monitoring unit over a 6-month period, from august 2022 to January 2023.The study comprised patients with clinic histories of fever. The present symptoms and demographic characteristics were noted. The standard laboratory tests that were run between 2 to 5 day served as the foundation for this investigation using patient serum.

Serology and Processing

Blood was obtained from patients with a history and duration of fever who had clinical suspicion of dengue viral infection on the day they reported to the hospital. The separated serum samples were then tested using serology for the illness. NS1 antigen and IgG/IgM antibody detection using the qualitative membrane-based immunoassay known as the Dengue Combo NS1 Ag and IgG/IgM Ab Rapid Test requires sample preparation. NS1 Ag and IgG/IgM Ab Rapid test positive samples were transferred to the sentinel monitoring unit for confirmation using an IgM ELISA. Private hospitals, clinics, and labs sent positive samples to the sentinel monitoring unit for confirmation after getting informed consent.

5.Clinical features

Every dengue patient had a history of fever, and other symptoms included myalgia, headache, nausea, vomiting, itching, abdominal pain, rash, and bleeding from the mouth and nose. Swampy areas and water logging, which are spread by mosquito bites, are the outbreak's sources.

6. Phase of life

The infection is spread to non-human primates by the bite of an infected female Aedes mosquito, with sporadic outbreaks in the human population [38]. The dengue virus has spread throughout the entire world since it emerged from sylvatic cycles and the basic life cycle. India has an epidemic or endemic dengue fever, a severe viral infection [39].The female will search for a suitable location to lay her eggs after a blood meal. The eggs can withstand dry spells and will begin to hatch following rain or flooding. Both Aedes species frequently lay their eggs in bodies of open water. In marshy and wet areas, people frequently use empty bottles, vases, flower pot dishes, and even little plastic containers.

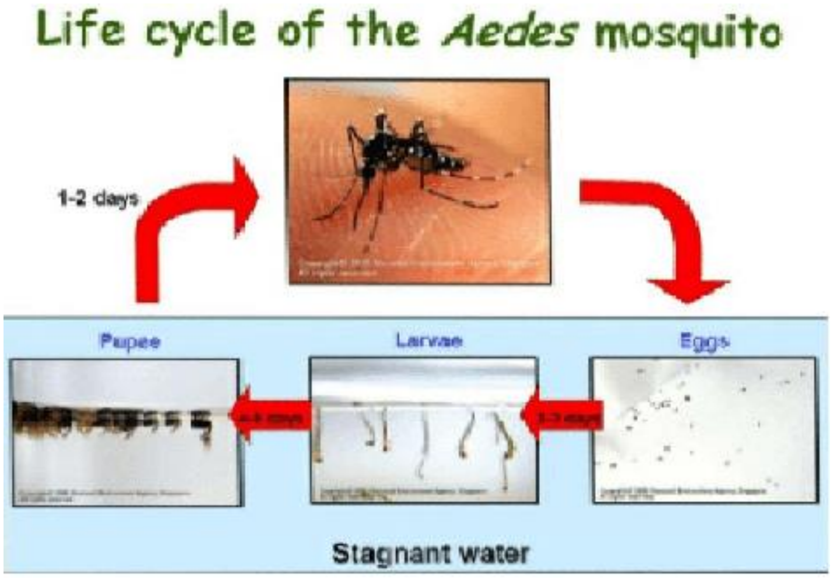

Fig: Mosquito life cycle.

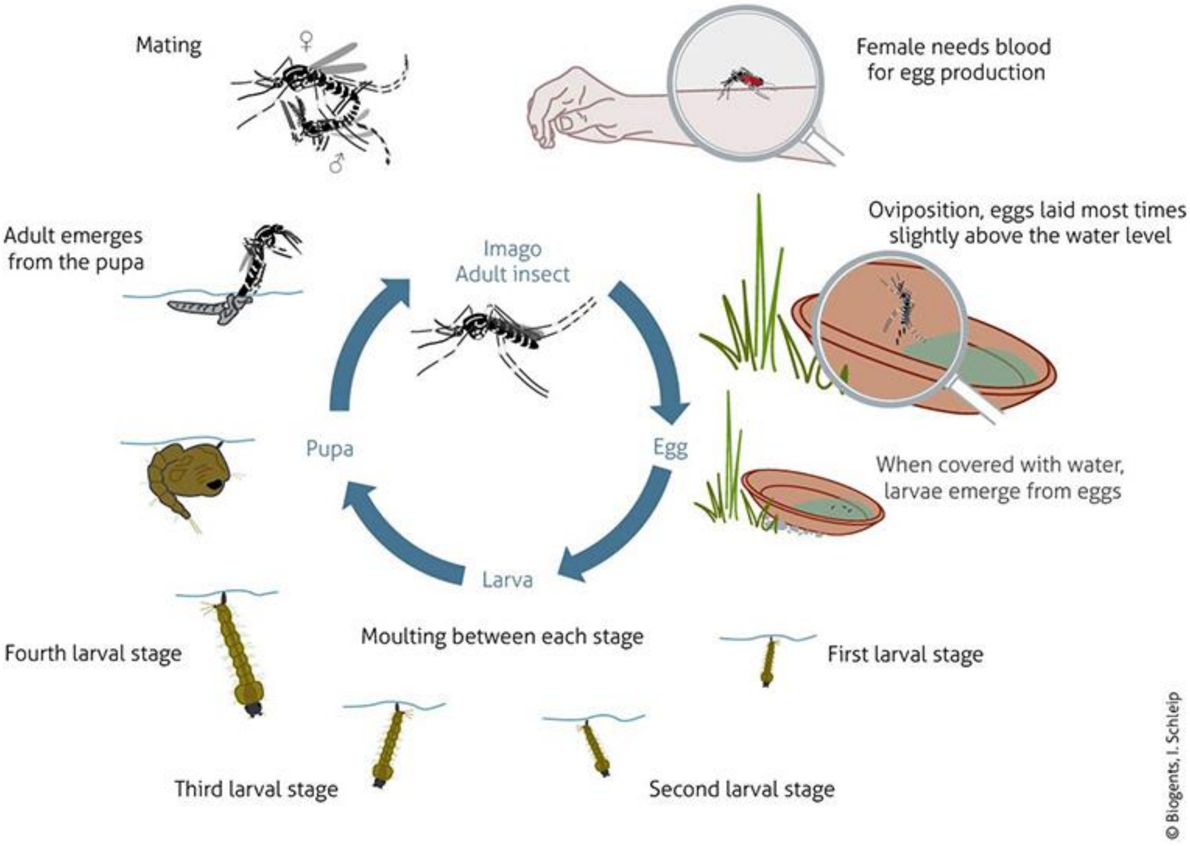

Fig:The dengue life cycle

7.Result

The current study was carried out during a 6-month period, from August 2022 to January 2023, at the District Hospital in Dimapur, Nagaland. In this investigation, a serum sample from 705 samples was used to confirm the presence of IgM ELISA in patients with positive dengue NS1 antigen and IgG/IgM antibodies of RAT. 151 were positive, while 554 were negative . 77 female and 74 male respondents were among the 151 who tested positive. The most frequently impacted age group was that of 15 to 45 years old with 63percentages. There were noticeable differences in the incidence of infection, according to the study's distribution of dengue cases between the monsoon and post-monsoon seasons. The pre-monsoon season, which ran from January to June, saw no favorable examples. The maximum occurrences occurred between September and December of previous year during the post-monsoon period. Males were less likely to get an infection than females were.97 instances were from urban Dimapur, with 52 male and 45 female, 44 from rural Dimapur, with 18 male and 26 female, and 10 from other districts in Nagaland, with 4 male and 6 female.

Table 1.1 Dengue cases analysis from Aug 2022 to Jan 2023 in Dimapur Nagaland

Gender wise breakup of all cases detected

Row Labels	September	October	November	December	Grand Total
F	11	25	29	12	77
M	8	21	33	12	74
Grand Total	19	46	62	24	151

Table 1.2 Infection Month Wise

Row Labels	Count of Month
September	19
October	46
November	62
December	24
Grand Total	151

Age Wise Breakup	positive	Percentage
0-4 yrs	1	1%
5 - 14 yrs	13	9%
15-45 yrs	89	63%
46-60 yrs	24	17%
60 above	14	10%
	141	100%

Table 1.3 Urban -rural breakup

Gender Wise breakup only for Dimapur District

Row Labels	Count of Name of the Patient
others	10
rural	44
Urban	96
Urban	1
Grand Total	151

Gender	Cases	percentage
Male	70	49.65%
Female	71	50.35%
Total	141	100.00%

Total tested	705
total Positive	151
Positivity	21.42%

Table 2.1

Travel History

Count of Name of the Patient	Column Labels				
Row Labels	others	rural	Urban	Urban	Grand Total
No	8	43	96	1	148
Yes	2	1			3
Grand Total	10	44	96	1	151

8.Conclusions:

The current study documents a dengue outbreak that occurred in Nagaland from August 2022 to January 2023. In contrast to IgM antibodies, it was shown that the majority of dengue cases were identified in patient sera by the presence of viral NS1 antigen. Consequently, it is understood that NS1 test early detection of Dengue cases aids in diagnostic detection and case confirmation. With NS1 assays that are noticeably more sensitive for primary than secondary Dengue infection, viral antigen identification is especially helpful during the first five days of sickness. Fever was the most prevalent presenting symptom in clinical presentations of Dengue-positive. The distribution of dengue cases between the monsoon and post-monsoon seasons revealed observable variations in the prevalence of infection. Males had a lower infection risk than females did Epidermologists conducted surveys in the area during the outbreak, which confirmed the presence of mosquito populations there. Swamps, waterlogging, and mosquito bites from Aedes (Stegomyia) aegypti and Aedes (Stegomyia) albopictus were all identified as potential causes of infection.

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