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RECENT TRENDS OF DENGUE VIRUS INFECTION IN DHAKA, BANGLADESH

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The disease caused by the Dengue virus (DENV), belongs to the Flaviviridae family, which is the most common vector for transmission of the virus between humans and arthropods *Aedes aegypti* mosquitoes. In recent years, the number of dengue cases has increased drastically throughout the world, according to a survey around 390 million dengue infection cases are recorded annually, among which one-fourth of cases show clinical manifestations. In Bangladesh, dengue outbreaks are on the increasing trend despite the efforts to control this disease A Hospital-based study of dengue patients in Dhaka city was conducted to check the recent trends of dengue infection among the inhabitants of Dhaka, Bangladesh. 89 blood samples from different patients with appropriate symptoms were tested using the Dengue NS1 Quanticard kit. Among samples, 60 (68%) samples were tested as positive whereas 22 (25%) showed negative results and 6 (7%) showed invalid results in tests. Despite the testing of a low number of samples, it can be clearly stated that a large number of positive results was observed with specific symptoms commonly found in Dengue infection. Among all the positive results some (7%) of the patients did not show any signs and symptoms, but after testing the results were positive against the viral antigen. Attempt to increase awareness about dengue fever through effective management measures from the government and NGOs are very much needed.

Keywords: Dengue, NS1 antigen, IgM, IgG

INTRODUCTION

Dengue is the most common mosquito-based viral disease in developing countries like Bangladesh. Each year the rate of infection and mortality rate is increasing (1, 2). The disease caused by the Dengue virus (DENV), belongs to the Flaviviridae family, which is the most common vector for transmission of the virus between humans and arthropods *Aedes aegypti* mosquitoes. Dengue virus has four serotypes, which are genetically similar but have different antigenic properties thus they are named serotypes 1 to 4 (3, 4). DV (Dengue Virus) is a positive-stranded encapsulated RNA virus that has three structural protein genes, which are a core (C) protein, a membrane-associated (M) protein, an enveloped (E) glycoprotein, and seven nonstructural (NS) proteins. *Aedes aegypti* mosquito is responsible for spreading the virus into the human body (5, 6). All four serotypes of the dengue virus can cause diseases in different ways ranging from subclinical infection to mild self-limiting disease. Dengue fever (DF), and dengue hemorrhagic fever/dengue shock syndrome (DHF/DSS) are severe diseases and also can be fatal if the patients do not get proper treatment at the proper time (7, 8). In recent years, the number of dengue cases has increased drastically throughout the world, according to a survey around 390 million dengue infection cases are recorded annually, among which one-fourth of cases show clinical manifestations (6). The ongoing rise in the number of dengue cases is due to unplanned urbanization, extensive spread of mosquito vectors, increased international travel and the absence of effective interventions practice is also considered a crucial contributor to dengue epidemics. On the other hand, illiteracy, poverty and social inequalities have been associated with poor dengue management (9, 10). Since no effective vaccine is currently available to prevent dengue, the only possible mode of prevention is to control *Aedes aegypti*, based on conventional insecticides and environmental management appears to have limited effect in reducing endemic transmission (11). One needs to look for medical attention instantly if there is a possibility to get bitten by the *Aedes aegypti* mosquito. Early diagnosis and management of symptoms are censorious to reduce the risk of complications and avoid the further spread of the virus (12). Dengue virus is generated by one of four closely related familiar viruses such as DEN-1, DEN-2, DEN-3 and DEN-4. Infection with one type gives lifelong immunity to that particular dengue virus (13, 14). Nevertheless, the infection does not provide immunity to the other three types, so it is possible to get infected with different

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dengue viruses again. A person who had dengue once is at increased risk of experiencing more severe symptoms of dengue infection if they get infected again (15-19).

Dengue infection was first reported in Bangladesh in 1964, but it was not considered a public health concern at that time. After 2000, dengue started to spread out rapidly and become an epidemic. Among the Southeast Asian states, Bangladesh had a lower dengue prevalence, but in recent years the scenario has changed. In 2017, the number of infectious cases was 2769 and it jumped to 10148 cases in 2018. In 2019, the Directorate General of Health Services (DGHS) (9) recorded 87953 cases with 81 deaths, a 9-fold expansion in the occurrence rate of dengue from the previous year (6, 8, 20, 21). After analyzing previous studies, it can be stated that the number of dengue cases and deaths are highest in the warmer months from July to November and that men were doubly as seemingly to become infected as women (12). Many cases of dengue infections were miscategorized because of the wide spectrum of disease signs and symptoms and the lack of effective case definitions. Therefore, it is highly presumptive that dengue cases may be considerably under-reported in Bangladesh given the frail supervision of a struggling healthcare system. Bangladesh is exposed to a continual risk of dengue virus importations from surrounding endemic neighbors like India and Myanmar. Therefore, this study aimed to check the recent trends of dengue infection among the inhabitants of Dhaka, Bangladesh.

MATERIALS AND METHODS

Sample Collection. In this study, blood samples were collected from dengue suspected people along with their signs and symptoms from some popular diagnostic centers in Dhaka, Bangladesh. Samples were taken randomly from different age groups of suspected patients. After collecting the blood samples from patients, serum was separated from cells within 45 minutes to 2 hours by using a centrifuge machine and after that, the serum was used for testing purposes. NS1 is distinguishable during the acute phase of dengue virus infections. NS1 tests can be as sensitive as molecular tests during the first 0-7 days of symptoms (22). Dengue NS1 Ag Quanticard (Zhejiang Orient Gene Biotech Co. Ltd., Zheiang, China) is a sensitive immune-chromatographic test for the qualitative detection of dengue NS1 antigen in human serum or plasma with an iQuant analyzer (From China) and it is an *in vitro* test used for earlier detection of dengue infection.

Antigen-Antibody Reaction. Dengue NS1 Ag iQanticard (Zhejiang Orient Gene Biotech Co. Ltd., Zheiang, China) is a fluorescence immunoassay technique based on the sandwich principle. The test area is coated with specific Anti-dengue NS1 Ag antibodies. When a sample is added to the cartridge, if Dengue NS1 antigen is present, it will form a complex with other specific NS1 antibodies conjugated to fluorochromes. In addition to the assay buffer, this complex migrates along with the nitrocellulose membrane to the test region and forms an antibody-antigen-antibody fluorescence immune complex. The test result was displayed by the iQuant analyzer.

Test Procedure. At first, a dengue rapid antibody device or kit was taken and 3 drops of serum were added into the marked well by using a disposable dropper. 3 drops of dengue NS1 buffer were also added into the well-marked for IgG and IgM right after the addition of the patient's serum. If after 2-5 minutes the colored line of the control region changes from red to blue and a colored line appears in the test line region of IgG and IgM, means the result is positive for dengue viral antibodies. Specific IgM antibodies are indicative of primary dengue infection whereas IgG antibodies are indicative of secondary dengue infection. On the other hand, the control line is still red or partially red, fails to change the color from red to blue, and is considered an invalid result. IgM antibody detection is not handy for dengue virus serotype determination.

RESULTS AND DISCUSSION

Dengue infection was first reported in Bangladesh in 1964, but it was not considered a public health concern at that time. After 2000, dengue started to spread out rapidly and become an epidemic. In this study, recent (2021) test results of patients with severe and mild symptoms were collected, tested and analyzed.

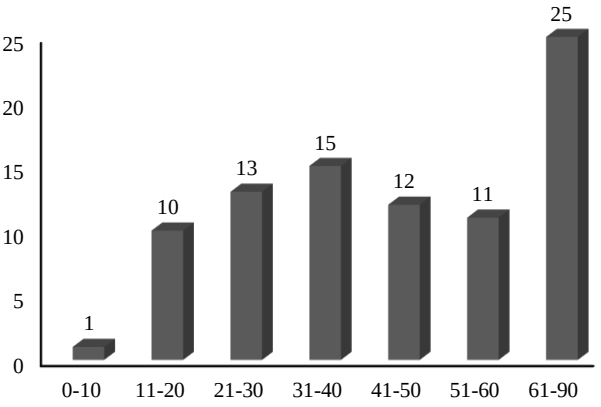

Figure: 1. Distribution of dengue virus infection in the different age groups of patients.

The age group of patients is presented in Figure 1. The highest number of people is between the ages of 61- 90 years whereas the lowest number of patients is between the ages of 0-10 years. On the contrary, an average number of people are simultaneously between the age of 31-40, 41-50, and 51-6. Another survey showed that most of the patients were below the age of fifty years just in case of infectious disease eruption in Dhaka whereas in Barisal it had been unknown to us the average age range of patients (25). When we compare this with global studies, the highest prevalence was observed in the age group of 21-40 years in the case of the dengue outbreak in Peshawar, Pakistan but the dengue outbreak in Odisha, India had dengue positive age group of 21-30 (23, 24). The age group of Dengue-positive patients was so close to each other in the case of global studies. It shows that situations can vary according to an environment such as climate change, urban area population etc.

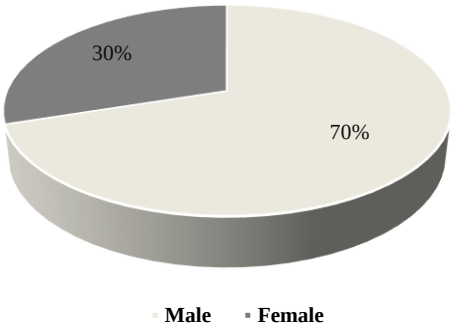

Figure 2: Distribution of dengue in male and female patients.

In this study, the male percentage (70%) was higher

than the female percentage (30%) (Fig: 2). Similarly, the male ratio was higher in Barisal but inhabitant frequency is unknown to us in the case of Dhaka dengue outbreak (25, 26). Global studies also showed male ratio is higher than females. Although there isn't any specific reason about this why the male ratio is higher than female.

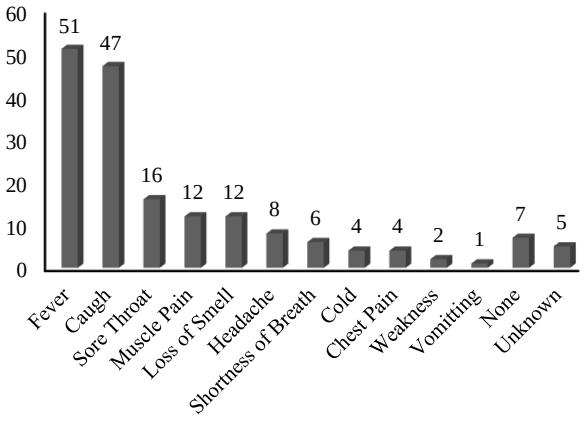

Figure 3. Clinical characteristics of dengue positive patients.

From Fig 3 it can be stated at the maximum number of patients had fever and cough in common while some had a sore throat, muscle pain, and others had chest pain, weakness etc. There were also some cases where we were unable to collect the illness history due to the patient's refusal. There was also a study conducted in Peshawar, Pakistan; where fever and liver abnormalities were the most common types of symptoms (23).

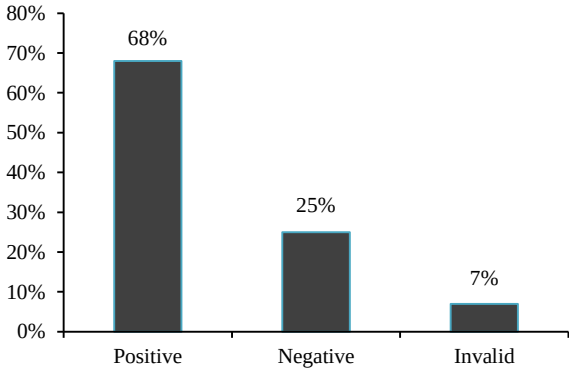

Figure: 4. Frequency of dengue in the suspected patients.

Among the 88 cases, 60 samples (68%) were tested as positive whereas 22 samples (25%) were tested as negative (Figure: 4). The infection rate was higher in males (70%) than in females (30%). Gender differences do not have any effect on the infection ratio but livelihood, awareness, precaution, and demographic area can be major causes which is why males are more prone to the infection. Any positive result in this study among the NS1, IgM and IgG were considered as test positive. Among all the positive cases 29 (48.3%) were tested as only IgM positive, 27 (45%) were tested as only IgG positive and 51 (85%) were tested as only NS1 positive. 24 samples showed positive results for both IgG and IgM, indicating that the infection might be developing or already developed from the primary to the secondary stage. 13 (14.8%) out of 88 cases were screened as IgG, IgM and NS1 positive. These cases indicate that the patients with combo-positive results might be repeatedly exposed to the dengue infection or have lower immunity. 6 samples showed no positive band on the test kits. On the other hand, some cases showed (7%) invalid results as the color line fail to change. Almost 68 percent of patients were dengue positive based on the positivity of IgG (45%) or IgM (48.3%) or NS1 (85%) antigen in the outbreak in Dhaka city but in the case of Barisal survey NS1 (97.2%), IgM (1.9%) and IgG & IgM (0.9%) were observed as positive (25, 26). On the contrary, global studies showed that 50.2% of patients were dengue positive in Odisha, India whereas almost 85% were detected dengue positive in Peshawar, Pakistan during the dengue outbreak (23, 24, 27, 28).

Dengue test should be done within the first five days of the appearance of symptoms because, after five-seven days, the chances of false positive and negative results are high. NS1 Antigen test does not differentiate between different dengue serotypes. It is also found that the sensitivity of the test is higher (more than 90%) in primary infection than in secondary infection according to the information from the manufacturing literature. The dengue RNA PCR test can provide positive results if the test is done within five days after the symptoms start to pop up. It detects the viral genome in the blood but this test can only be performed in certain laboratories where necessary instruments and skilled technicians are available. A positive result not only authenticates the infection but also helps to recognize the different serotypes of the dengue virus by the NAAT Nucleic Acid Amplification Test (29).

CONCLUSION

This study established that patients with symptoms in Dhaka had an understanding of dengue concerning its clinical symptoms, means of transmission and prevention procedure. Climate changes such as average rainfall, humidity, temperature, and rapid unplanned urbanization were strong predictors of an imbalance in the existing ecology that has led to an increase in dengue cases.

Practical, family-oriented and community-based health education movement should be tailored to discourage negative community practices like indiscriminate refuse disposal and deficiency of drain maintenance and inspire healthy family practices that mitigate the risk of spreading of dengue. Government should take proper steps to minimize the ratio of *Aedes aegypti* mosquitoes so that the transmission of dengue viral infections can be reduced.

COMPETING INTERESTS

The authors declare that there are no competing interests.

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