



Review Article

Symptomatic pattern changes and climatic factors in dengue outbreaks in Bangladesh

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ABSTRACT

Public health in Bangladesh, especially in the last several years, has been greatly affected by dengue fever, caused by a virus spread by mosquitoes. The illness, which was first recorded in Dhaka in 1964, under the name “Dhaka Fever”, has continued to rise in both incidence and fatality rates despite the attempts to control it. With 96,228 cases and 531 fatalities recorded in 2024, Bangladesh is among the top nations for dengue mortality. Environmental changes, unplanned urbanization, and the adaptive behavior of mosquito species *Aedes aegypti* and *Aedes albopictus* are the causes of this dramatic increase. Due to increased temperatures and prolonged humidity caused by climate change, the breeding season is now longer than in the typical monsoon months, resulting in outbreaks that happen all year round. Expanded dengue syndrome and other new infection patterns and symptoms make diagnosis and treatment more challenging. The illness is more common in men of working age, yet it kills more women than men. There has been an uptick in cases and deaths in areas outside big cities as well, including Chittagong and Barisal. Identifying worrisome hotspots, controlling mosquito populations, and raising public awareness about unusual dengue symptoms are all necessary to combat this growing epidemic. This research highlights the critical need for implementing comprehensive plans to fight dengue and lessen its social and economic effects in Bangladesh.

Keywords: *Aedes aegypti*; *Aedes albopictus*; Bangladesh; Dengue fever; Public Awareness

INTRODUCTION

Although dengue has been a problem in Bangladesh for many years, it broke all statistical records in 2023. This year, as the number of infected people has increased, the number of deaths has reached its highest. In the last 23 years, a total of 868 people have died from dengue in the country. But in 2023, a total of 1,705 people died from the disease. This means that in 2023 alone, this disease claimed more lives than dengue has in the past 23 years combined in Bangladesh. And in 2023, 321,179 people were hospitalized with dengue. In 2024, 96,228 patients have been hospitalized with dengue in the country, including Dhaka.¹ The highest number of dengue deaths in the country were recorded in November at 173. Experts say that there are several reasons behind this tragedy, including the last few years of unplanned urbanization, failure of the authorities to control mosquitoes, and poor state of the health sector.

Dengue was first transmitted in Bangladesh in 1960. Four decades have passed since then. It was in June 2000, that dengue first became an epidemic in the country. That year, a total of 5,551 dengue cases were reported, of whom 93 died. Since then, dengue has been a prevalent disease

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with people being infected with and dying of dengue every year. This number peaked in 2023. The next highest number of dengue patients was found in 2019. In 2023, a total of 101,354 people were infected with dengue across the country, and 164 people died. If we compare this statistic with that of 2019, the number of deaths from dengue had increased tenfold during this period. At the same time, the number of infected people had increased threefold.² According to experts, dengue did not become as prevalent in the 2020-2021 due to the limited or controlled lifestyle of people during the COVID-19 pandemic.³

Although Dhaka is usually at higher risk of a dengue outbreak, dengue has now spread equally to rural areas. According to experts, the 'semi-urban condition' of villages outside Dhaka contribute to the high number of dengue cases there.⁴ Earlier, urbanization was limited to cities, especially Dhaka. However, in the past decade, there have been major changes in the infrastructure outside Dhaka. As urbanization increases, so does the level of uncleanliness. Because of this, clean water accumulates in various places and serves as a breeding ground for *Aedes* mosquitoes. Cleanliness is the main requirement for dengue control.⁵ Dengue has been spreading in rural areas since last year. But one of the reasons for its increased prevalence is the difference in serotypes. Those who were previously infected with one serotype are now infected with another. As a result, there are more serious patients in villages.⁵ In this article, we review the symptomatic patterns of the dengue virus with respect to climate change between 2023 to 2024.

Epidemiology of the outbreak in Bangladesh

Dengue first appeared in the world in 1780. In 1950, the dengue virus spread to Thailand and the Philippines extending to Kolkata, India in 1963 and finally spreading to Dhaka, Bangladesh in 1964. At the time, dengue was called the Dhaka Fever.⁶ The presence of dengue was officially acknowledged in Bangladesh in 2000. That year, 5,500 patients infected with the dengue virus were admitted to hospitals, 93 of whom died. For two decades, the Bangladeshi government has been working on dengue control, patient management and eradication of *Aedes* mosquitoes.⁷ However, due to lapses in mosquito control and lack of patient management, the disease could not be brought under control. In 2000, globally, 500,000 people were infected with dengue, and in 2019, that number increased ten times to 5.2 million. According to the Pan American Health Organization (PAHO) under the WHO, 9,569,467 people were infected with dengue in Brazil in 2024, of these, 5,303 died. This was the highest death record due to dengue in a single year in any country in the world.⁸ The mortality, as compared to the infection, is 0.05

per cent. Argentina held the second place. In 2024, 574,620 people were infected with dengue in the country, of these, 408 people died. The mortality, as compared to the infection, was 0.07 per cent. 284,173 people were infected with dengue in Paraguay. The number of deaths from dengue in the country was 121, which was 0.04 per cent of the total infected people. In Colombia, 262,440 people were infected with dengue,⁹ of these, 131 people died. The mortality rate in the country was 0.05 per cent. In Peru, the mortality rate was 0.09 percent. 234 out of 261,415 people died in the country.¹⁰

In 2024, the number of dengue infections detected worldwide exceeded 13 million. According to data from the WHO and the European Center for Disease Prevention and Control (ECDC), most of these infections occurred in a few countries in North and South America.¹¹ The highest number of infections was seen in Brazil, Argentina, Peru, Colombia and Paraguay. More than 9.5 million infections were detected in Brazil alone. The number of infections in Argentina, Peru, Colombia and Paraguay was between 200,000 and 600,000. Although the number of infections detected in these countries was high, Bangladesh had already risen to the top of the list in terms of the number of deaths.¹² According to the data of the Directorate General of Health Services, as of December 9, 2024, the number of dengue infections detected in Bangladesh was 96,062, of which 531 people had died [Figure 1]. Accordingly, Bangladesh was second to Brazil and Argentina in the number of dengue deaths.¹³ In 2019, a total of 101,354 people were infected with dengue across the country, and 164 people died.¹⁴ Whereas, in 2022, 62,382 people were infected in Bangladesh, and 281 people died [Figure 2]. The mortality rate was 0.45 percent.¹⁵

In 2023, 321,179 dengue patients were identified. Due to the sudden increase in dengue patients, there was a saline crisis in some places [Figure 3]. At that time, the price of saline had also increased. Meanwhile, it was that 60 per cent of the total dengue cases this year were men. Men in Bangladesh wear scantier clothing than women,¹⁶ so they had more risk of being bitten by mosquitoes.¹⁷ Moreover, there are fewer working women in Bangladesh. This would directly reduce the exposure of women to the outdoors.¹⁸ Although more men were infected with dengue, mortality in women was higher.¹⁹ From January 1 to December 7 of this year, 60,393 or 63.20 per cent of those infected with dengue were men and 35,239 or 36.80 per cent were women. But of those who died from dengue, 270 or 51.70 per cent were women, and 252 or 48.30 per cent were men.²⁰ An analysis of age-based data on dengue-infected men and women showed that people aged 16 to 40 were the most affected. A total of 95,632 people were infected between January 1 and December 7. Of these, 57,724 or 60.36 per cent were aged 16 to 40. Of the infected in this age group, 37,756 or 65.41 per cent were men

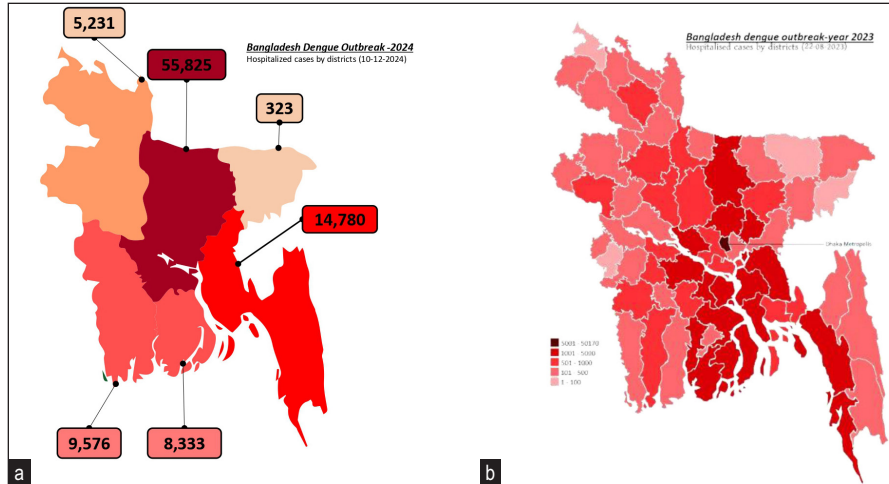


Figure 1: Comparison between dengue outbreak in (a) 2024 and (b) 2023. Source: <https://dashboard.dghs.gov.bd/>.

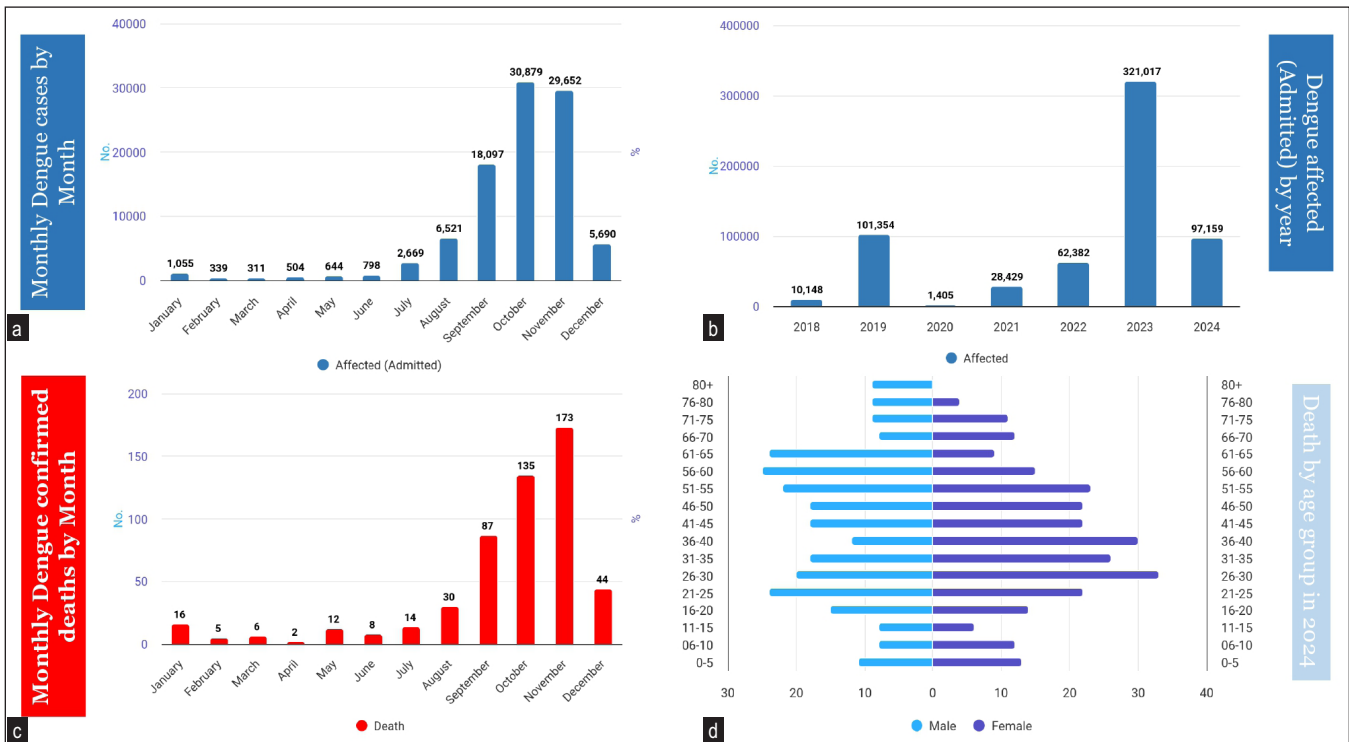


Figure 2: Current epidemiology of dengue in Bangladesh (2024). (a) Month dengue cases by Month, (b) Monthly dengue confirmed death by Month, (c) Dengue affected (Admitted) by year, (d) Death by age group in 2024. Source: <https://dashboard.dghs.gov.bd/>.

and 19,968 or 34.59 percent are women. 55 per cent of the patients admitted to hospitals due to dengue were outside Dhaka. Although there were more adult dengue patients, the number of children s also relatively high 30 per cent. of the total patients are children.²¹ Outside the City Corporation area, Chittagong division recorded 14,703 infections and 50 deaths, Barisal division recorded 8276 infections and 57 deaths, Khulna division recorded 9401 infections and

30 deaths, Mymensingh division recorded 3194 infections and 13 deaths. In addition to these, Rangpur division had 1474 cases, Rajshahi division had 3604 cases and Sylhet division had 318 cases. 8, ²² Nine people died in Rajshahi and Rangpur. Currently, more people between 20 and 40 years of age are dying from dengue in Dhaka. However, the mortality rate for the children and elderly is relatively high in Chittagong.²³

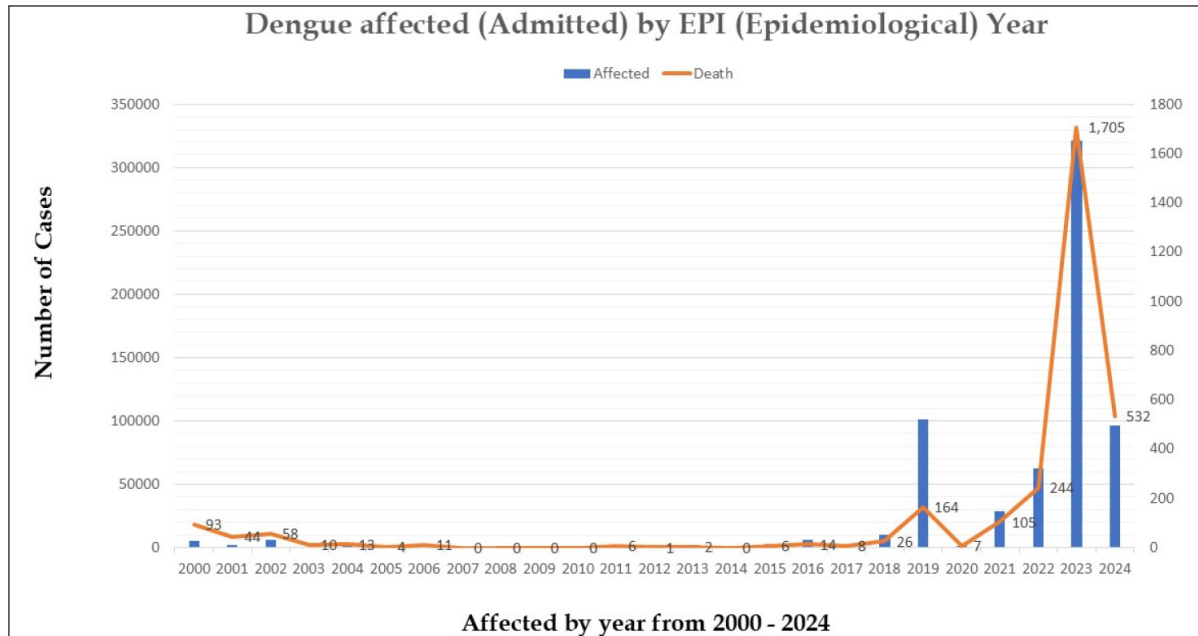


Figure 3: Number of dengue cases and deaths in Bangladesh by year. Source: <https://dashboard.dghs.gov.bd/>.

Environment involvement in dengue outbreak

Climate change and unplanned urbanization has increased the number of mosquitoes carrying dengue and chikungunya viruses in Bangladesh. This has been compounded by the weakness of the mosquito eradication system.²⁴ So far, some mosquito-borne diseases have been identified in Bangladesh, apart from Japanese encephalitis, dengue, chikungunya, malaria and Zika virus. Among them, the increasing number has made it difficult to control dengue cases and deaths. Overall, the outbreak of these mosquito-borne diseases has become a cause of extreme concern for the overall public health of the country. There was a time when it was believed that the rainy season meant dengue season.²⁵ Experts say that now is the time to change that belief. Because now the disease is not only prevalent in the monsoon, but also in the winter and summer seasons.^{26,27} In Bangladesh, the post-monsoon period, i.e., August to October, is usually the 'peak season' of dengue. But although the number of dengue infections and deaths has decreased since October this year, it is not completely under control. This December as well, deaths due to dengue have been recorded almost every day. Between 2019 and 2022, a total of 34 people died in December alone. But in the December, 2023, 76 people have died of dengue, which is twice the total number of deaths in December of the last 5 years and in 2024, 43 people have died until December 9, 2024.

Mosquitoes survive by adapting to various hostile environments.²⁸ Earlier, *Aedes* mosquitoes laid eggs exclusively in clean water. They fed only in the mornings and

evenings. *Aedes albopictus* mosquitoes now breed in polluted and dirty water. They also feed irrespective of the time of day. Many homes in cities remain dark even during the day because sunlight can't reach them. Light pollution occurs due to excessive artificial lighting in the evening and at night. As a result, mosquitoes have also changed their behavior.²⁹ Pesticides are not working. Earlier, although the *Culex* mosquito infestation increased in the winter seasons, it was not seen for *Aedes* mosquitoes. But for the past few years, climate change has caused an increase in the population of *Aedes* mosquitoes in winter.³⁰ This is because of increase in temperatures. If the temperature drops below 13°C, then the larvae do not hatch from mosquito eggs. But this winter in Bangladesh, the temperature did not drop below 13°C. It may have dropped in Panchagarh and Dinajpur; but not across the country.³¹ The reason for widespread dengue in 2023 - 2024 was the favorable weather for mosquitoes all year round. There was high temperature and humidity for a long period. Along with this, there was intermittent rain.³² The temperature in the areas with prevalent dengue was found to be relatively high during winter. For example, in Old Dhaka *Aedes* mosquitoes could breed because the minimum temperature for mosquito breeding is 18 degrees Celsius. But *Aedes* mosquitoes do not breed in Ramna Park, because the temperature there is low due to the presence of many trees.³³

The dengue situation is constantly changing. Dengue outbreaks are seen to be confined to small pockets in different areas or neighborhoods.³⁴ It is very important to identify these pockets first. When it rains, the breeding ground for mosquitoes is not limited to any pocket. Wherever it rains,

water accumulates and becomes a breeding ground. In the absence of rain, pockets where water accumulates contain dengue-carrying mosquitoes or patients. To identify these pockets, it is necessary to talk to dengue patients and find out their exact addresses.³⁵ Generally, dengue is more likely to be contracted from someone's home or workplace. It is necessary to identify these and find dengue patients from there as well. In this way, the control system should be strengthened by identifying pockets. If hotspot management is done properly, good results can be achieved with minimal effort.

Changes pattern in Bangladesh

Due to climate change, dengue infection no longer stays limited winter and summer seasons, resulting in constant outbreaks of dengue disease. Especially in the last few years, more and more dengue patients have been found. Dengue outbreaks have continued throughout 2024.³⁶ The number of patients and deaths from dengue fever is increasing every day. Although the dengue outbreak was not high in the district cities, the situation in Dhaka and Chittagong was dire. This time, the mortality rate was increasing in 'expanded dengue syndrome'. Usually, dengue outbreaks in the country start before the monsoon. The period from May to September is considered the dengue season.³⁷ However, due to climate change, dengue virus-carrying mosquitoes have been breeding and spreading throughout the year. One way to track the spread of infectious diseases is to determine the monthly 'growth factor' or growth rate. This shows how many people will be infected or will die in the current month compared to the previous month, or the next month compared to the current month. In Bangladesh, the dengue growth rate (2.42) was at its highest in June 2024—, meaning that the infection rate may increase by about two and a half times by July. The number of patients infected in October was half of the number of those in September. The growth rate decreased from 0.82 to 0.45 in October. According to data from the last 23 years, mortality rate among dengue patients in Bangladesh risen from 0.45 to 0.53. Considering the number of dengue patients in August 2024 (6,521), the number of patients in September was expected to be around 8,000. But in reality, the number of patients in September was more than 18,000. This is more than double the expected number.³⁸

Dengue fever is spread by the bite of a dengue mosquito. When a mosquito bites a person infected with the dengue virus, the virus enters the mosquito. Then, when the infected mosquito bites another person, the virus enters that person's bloodstream and causes the infection. Symptoms usually appear 3 to 8 days after infection. These include a high temperature (40°C/104°F), severe headache, pain behind the eyes, muscle and joint pain, nausea, vomiting, and a distinctive rash.³⁹ Additionally, platelet counts usually begin

Table 1: Classification and symptoms of dengue fever.

| Dengue category | Sign & symptoms |
|-------------------|---|
| Dengue category A | Patients in the first category are normal. They only have fever. Most dengue patients are in category 'A'. They do not need to be hospitalized. |
| Dengue category B | Patients with dengue in category 'B' are normal, but some symptoms appear in the body. For example, they may have stomach pain, they may vomit a lot or they are not able to eat anything. Many times, after two days of fever, the body becomes cold. In this case, it is better to be hospitalized. |
| Dengue category C | Dengue fever in category 'C' is the worst. In some cases, intensive care unit or ICU may be required. |

to fall from the fourth day of dengue fever. They continue to fall until the seventh day, reaching their lowest point. Recovery begins on day seven, with platelet counts usually returning to normal within ten days [Table 1]. According to the Centers for Disease Control and Prevention (CDC), there are three stages of dengue. The first is the febrile phase, the second is the critical phase, and the third is the convalescent phase. This year, dengue patients in Bangladesh were showing atypical symptoms. Among those being admitted to the hospital, the number of patients who were infected with dengue for the second or third time was high.⁴⁰ Previously, they were infected with a different variant, so the symptoms were not typical. This is called "complicated dengue syndrome or extended dengue syndrome." The symptoms are:

1. Prolonged diarrhea: Diarrhea that has been present for three or four days without improvement. This is one of the new symptoms of dengue that was seen.
2. Absence of fever: Dengue patients were being admitted to the hospital without a fever. That is, even though they did not have a fever, they were diagnosed with dengue after the test. In addition, many people may have suffered from a mild fever for a couple of days due to the heat but did not pay attention to it. But it later progressed to severe dengue.
3. Persistent vomiting: Vomiting starts after a few days of fever, and does not subside. Also, vomiting may contain blood that looks like coffee grounds.
4. Severe brain inflammation: This symptom is very similar to those of meningitis. It causes severe headaches. After a slight fever, there is a severe headache, stiff neck, stiff hands and feet or severe convulsions.
5. Swelling of hands and feet.
6. Water accumulation in different parts of the body - especially in the chest and abdomen.
7. Unbearable stomach pain.

8. Multiple organ failure: Multiple organ failure was slightly more common in children with dengue when compared to adults. Dengue also affects the liver and kidneys. That is why multi-organ failure was more common in children.
9. Even after dengue fever had subsided, some patients were found to have chest pain, shortness of breath, and even irregular heartbeat. In medical terms, this is called 'myocarditis'.
10. A serious aspect of dengue is 'macrophage activation syndrome'. In this case, liver enzymes increase. Again, the levels of LDH and triglycerides also increase. Similarly, the levels of ferritin in the blood also increase significantly. As a result, a 'cytokine storm' is created in the body. In such cases, the patient has to be given steroids.

Moreover, there are four types of dengue. After recovering from the type of dengue virus that infected you, you will develop long-term immunity. However, if you are infected with any of the other three types again, there is no immunity. This means that you can be infected again by one of the other three viruses in the future. If you get dengue fever a second, third, or fourth time, your risk of death is much higher.⁴¹

CONCLUSION

The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B) says climate change will have a major impact on global health and will worsen the situation in densely populated, low-lying countries like Bangladesh. Noting that Bangladesh is highly vulnerable to climate change, the organization says that, the scope of vector-borne diseases such as malaria, dengue, kala-azar and Japanese encephalitis virus infection may increase. Changing weather patterns may change the pathogens that cause the diseases. The WHO has said that 400 million people are infected with the dengue virus every year. According to the organization, almost half of the world's population is now at risk of dengue. Dengue outbreaks are more common in tropical and subtropical climates worldwide. Most of these regions are urban and suburban. Many infections are asymptomatic or cause only mild illness. However, the fever caused by this virus often leads to death. There is no specific treatment for dengue. Early identification and treatment for symptoms can cure the patient and reduce the mortality rate. Public health considerations have been neglected in the eradication of dengue vector and patient management in the country. There has been a lack of coordinated initiatives from the beginning. The local government department and the health care department are at conflict with each other. Mosquito control is being done by seeing the disease but, this activity is carried out throughout the year. The accounts of patients provided by the Department of Health are only based on hospital admissions. Apart from this, patients dying from the disease

at home are not accounted for. The Department of Health also does not have records for patients in private hospitals. As a result, the official accounts of dengue are incomplete. The main way to prevent dengue is to control Aedes mosquito population. For this, public awareness needs to be increased because the origin of Aedes mosquitoes is from inside houses, courtyards, roofs, and stagnant water in various places. We should always keep the courtyard of the house clean, and throw unnecessary containers accumulated in the dustbins. Do not let water accumulate anywhere for more than three days. If you are infected, you should go to the hospital as soon as possible, and drink more liquids.

Author contributions

RAM & SA: Web-analysis design, supervised the data collection process, checked writing, approved methodology, manuscript editing and supervised all steps; PR: Researched literature, questionnaire design, coordinated and monitored the process, wrote the first draft of The manuscript; AAR: Organizing and data arrangement, checked writing; MFA: Organizing and data arrangement, checked writing; NS: Final paper revision.

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