Bangladesh J. Zool. **49**(3): 355-367, 2021 ISSN: 0304-9027
eISSN: 2408-8455

A SOCIAL MEDIA-BASED ASSESSMENT ON THE PREVALENCE OF DENGUE FEVER AND KNOWLEDGE, ATTITUDE, AND PRACTICES (KAP) ON DENGUE TRANSMISSION IN DHAKA CITY DURING 2020 COVID-19 OUTBREAK.

Sayeda Mahjuba, Fahad Zamil and Priyanka Barua*

Faculty of Biological Sciences, Department of Zoology, University of Dhaka Dhaka 1000, Bangladesh

Abstract: Dengue is one of the most prevalent mosquito-borne viral disease worldwide which is transmitted to humans by infected female *Aedes* mosquitoes. Bangladesh has become a suitable habitat for the vector of dengue and is struggling with dreadful outbreaks in recent years. This study used social media as a tool to conduct a survey with a detailed questionnaire on the prevalence of Dengue and knowledge, attitude, and practices (KAP) on Dengue transmission during 2020 COVID-19 outbreak. Out of 234 participants, prevalence of dengue was 21.37% with high prevalence of dengue fever (18.80%) followed by dengue hemorrhagic fever (2.14%) and dengue shock syndrome (0.43%). The highest prevalence was observed in people aged 21 to 30 years (11.54%). Male participants had higher prevalence (11.97%) compared to female (9.4%). Prevalence was 5.13% in Dhaka North City Corporation compared to 14.10% in Dhaka South City Corporation. The prevalence was highest in people with monthly income above 30000 BDT (9.40%). Prevalence of dengue was 18.38% for those who used mosquito repellents vs 2.99% those who didn't use. Prevalence was 6.84% in those who had plants in tub, 3.85% with an indoor garden and 0.85% with bush. Only 11.97% remembered seeing any awareness campaigns, 94.44% knew how dengue was transmitted, 97.86% correctly mentioned the name of the vector. Alarmingly, only 65.81% answered correctly about the diurnal nature of *Aedes* and 53.42% responded that COVID-19 has affected the diagnosis and treatment of Dengue.

Key words: Dengue, Prevalence, COVID-19, social media, knowledge, attitude, practices

INTRODUCTION

Dengue fever is a febrile illness caused by a viral infection and a major public health issue worldwide. It's a tropical arbovirus infection that's becoming more common and has high morbidity and death rates. It also exerts a major economic burden on people and affected nations, together with high morbidity and mortality (Islam and Huq, 2021). It is an endemic disease in tropical and subtropical regions of the world including more than one hundred countries in

*Author for corresponding: <baruap7@gmail.com>
 DOI: https://doi.org/10.3329/bjz.v49i3.58510

Africa, the Americas, Asia, the Caribbean, and the Pacific (WHO, 2021). Roughly 3.9 billion people in the world are at risk (Bhatt *et al.,* 2013), between 100 and 400 million cases are reported annually (WHO, 2021) and approximately 22,000 die from severe dengue (CDC, 2021). The worldwide prevalence has increased 30-fold during the previous 5 decades (WHO, 2021). With a continuous growth in the number of nations reporting the disease, dengue has become a global concern.

Dynamic clinical spectrums of dengue infection ranges from asymptomatic illness in DF (dengue fever) to severe illness of DHF (dengue hemorrhagic fever) or DSS (dengue shock syndrome) (Low *et al.,* 2011). Dengue infection is caused by one of the four closely related serotypes of dengue virus (DENV) carried by mostly female *Aedes aegypti* and *Aedes albopictus* mosquitoes. The four serotypes of the virus (DENV-1, DENV-2, DENV-3 and DENV-4) are antigenically different (WHO, 2021). Infection by one serotype causes long-term protection from the infecting serotype but gives the other types only a brief duration cross-protective immunity. The risk of severe dengue and mortality increases for a person in subsequent infections with a different serotype (NATURE, 2021). A high fever with non-specific signs and symptoms such as headache, retro-orbital pain, malaise, nausea/vomiting, abdominal pain, myalgia, arthralgia, and rash are common symptoms of DF. In DHF, severe infection can lead to bleeding manifestation such as petechiae, epistaxis, gum bleeding, hematemesis, and melena (Kalayanarooj, 2011).

Dengue can cause as much or more human misery than other infectious illnesses in some of the places most afflicted. The rising frequency and rapid geographical expansion of dengue might be due to various environmental, biological, social, economic and cultural reasons (Dhar-Chowdhury *et al.,* 2017). Bangladesh has been plagued by dreadful dengue epidemics in recent years (Mamun *et al.,* 2019). The first official outbreak in Bangladesh was identified in 2000, when 5551 dengue cases were reported from Dhaka, Chittagong and Khulna (Yunus *et al.,* 2001). From then on, until 2018, about 50,000 people suffered from dengue (Mutsuddy *et al.,* 2019) and among them nearly 300 died (Abir *et al.,* 2021). In 2019, the situation became worse reaching 101,354 cases and the government's Institute of Epidemiology, Disease Control and Research (IEDCR) confirmed 164 dengue deaths (DGHS, 2021). Because of the wide range of illness signs and symptoms and the absence of adequate case definitions, many dengue cases are misclassified (Ahsan *et al.,* 2021). All the significant dengue epidemics in Bangladesh have tended to be limited mostly to Dhaka. The most attributable factors for the continued increase in dengue infections are widespread expansion of mosquito vectors, fast and uncontrolled urbanization, increased international travel, and lack of appropriate measures (Abir *et al.,* 2021).

Both the vectors of dengue (*A. aegypti* and *A. albopictus*) are predominantly diurnal i.e., they feed on blood rarely during night (Lima-Camara, 2010). Despite the fact that, in comparison to *A. aegypti, A. albopictus* is less common, larvae and adults of both of these vectors were discovered in significant quantities in Bangladeshi cities (Sharmin *et al.,* 2015). Poor city management and the usage of unprotected water reservoirs have provided adequate habitat for vectors throughout the country, as have the absence of adequate disposal, sanitation, drainage system and water supply. Insecticide-based vector management either in the form of space sprays or thermal fogging is the cornerstone of dengue preventive efforts and has been carried out in Bangladesh for many years. But significant levels of resistance to these insecticides have been found in all *A. aegypti* populations (Al-Amin *et al.,* 2020). As a result, people (especially in Dhaka city) are facing dengue outbreaks almost in every year. Bangladesh government has been trying to prevent this kind of situation by launching public health initiatives including the media and volunteer organizations, with the goal of boosting community knowledge of dengue and their participation in mosquito control (Sharmin *et al.,* 2015). Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) has also undertaken efforts to raise public awareness about how to manage stagnant water near homes (Sharmin *et al.,* 2015). Directorate General of Health Services (DGHS) also conducts survey to find and destroy the *Aedes* larva in the capital particularly during the monsoon (Akram, 2019). But despite of having 19 years of experience with dengue management, the tragically massive range of death in 2019 suggests that current control activities are insufficient to identify future risk and urgent awareness is needed to emphasize the early detection of dengue at all healthcare facilities (Akram, 2019; Sharmin *et al.,* 2015). Also, strengthening the surveillance system (all entomological, seroprevalence surveillance and KAP assessment), vector control programs and monitoring systems, and better understanding of changes in risk with societal and environmental changes are extremely necessary if the dengue outbreak is to be contained (Sharmin *et al.,* 2015).

During the year 2020, COVID-19 outbreak has hindered the effort to eradicate many other infectious diseases such as Dengue. To reduce transmission of COVID-19, rigorous lockdown and social distancing measurements were imposed which affected the public health surveillance and monitoring efforts. This study was performed in 2020 in the wake of COVID-19 transmission using social media when people were reluctant to do face to face interviews. The respondents rather preferred to use online platforms and were asked to answer a pre-tested questionnaire which included socio Demographic status of the respondents as well as knowledge, attitude, and practice (KAP)

information on dengue transmission. This study was aimed to identify the risk factors of the disease including demographic characteristics of infected patients, socio-economic status of the risk group and common knowledge regarding the spread of the disease. It was also attempted to test whether social media can be used as an alternative tool to do epidemiological surveys and to raise awareness.

MATERIAL AND METHODS

Study period: The current study was a quantitative study carried out among the interested participants through a detailed questionnaire in both English and Bengali from January 2020 to December 2020.

Development of questionnaire for data collection: A structured questionnaire was developed according to the objectives, contents, and variables of the study. Extensive literature review was done before the development of the primary data collection.

Study participants: Total 234 interested participants participated in an online survey which included information on participants socioeconomic status (age, gender, monthly income, household type etc.), as well as KAP information on dengue transmission. Dengue infected patients also provided their necessary clinical information.

Data collection: Due to COVID-19 outbreak, instead of face-to-face interview, an online questionnaire was prepared through google form and distributed through social media. Informant's consent was taken before starting the interview. Raw data was collected, extracted and checked for missing value.

Data calculation: Prevalence was reported according to the following equation:

$$\text{Prevalence} = \frac{\text{Number of people with the disease}}{\text{Number of people examined}} \times 100$$

Data analyses: Data processing and analyses was done using MS Excel 2010. Chi square test was performed to assess the relationship between categorical variables and $P<0.05$ was termed as statistically significant and mentioned when significant.

RESULTS AND DISCUSSION

In a total of 234 participants, 81 (34.61%) were male and 153 (65.38%) were female. When divided into separate age groups, 25.64% participants were within age group 10 to 20 years, 64.10% were 21 to 30 years, 5.56% were 31 to 40 years and 4.70% respondents were 40 years and above (Table 1). Out of 234 participants, 50 people were infected by Dengue (total prevalence 21.37%). Among them, 44 had DF, 5 had DHF and 1 reported DSS. The highest

percentage of dengue was observed for those who had DF (88% of the dengue infected patients) and followed by DHF (10%) and DSS (2%) (Table 2). Similar observation was reported by Sharmin *et al.* (2013) where in clinically suspected dengue patients from different hospitals of Dhaka city, 70 (87.5%) were DF and 10 (12.5%) were DHF cases among primary cases.

Among 50 confirmed dengue patients, 94% reported high fever, 92% reported headache, 74% reported vomiting/ nausea, 28% reported skin rash, 20% reported gum bleeding (Table 3). The findings regarding fever and skin rash are similar to a recent study (Mahmood *et al.,* 2021) where fever and skin rash was found among 93.1% and 25.3% infected participants respectively. The finding concerning vomiting/nausea is similar to another study (Khan *et al.* 2021) where 80.4% patients reported vomiting.

When divided into 4 separate age groups, the highest prevalence was observed in people aged 21 to 30 years (11.54%). The lowest prevalence was observed in people aged 10 to 20 years (2.56%) and the difference was statistically significant ($P<0.05$) (Table 4). Within the 50 infected patients, the highest percentage of infection was observed in people aged 21 to 30 years (54%). This is similar to a study of 2019 (Mahmood *et al.* 2021) where about 50% of patients belonged to the age group of 20–40 years. Another study (Abedin *et al.* 2021) also reported that dengue infection was found mostly in 21 to 30 years age group followed by above 40 years and 16 to 20 years. The possible reason for the higher prevalence in adult people could be the movement of people due to study and work and their higher chance of exposure to vector containing breeding sites.

According to gender, the percentage of infection was comparatively higher in male participants (56% of the infected patients) compared to female (44%) (Table 5). This is similar to the study conducted by Mahmood *et al.* (Mahmood *et al.* 2021) from August to December 2019 where 60.5% patients were male and 39.5% were female. Another study (Abedin *et al.* 2021) showed that out of 67 positive dengue patients, 41 (61.2 %) were male and 26 (38.8 %) were female. The higher rate of dengue infection in male could be due to the higher exposure to dengue vectors as they go out more often than women for work related purposes.

Respondents were categorized into the following groups depending on their area of residence: people living in DNCC, those in DSCC or those who came to Dhaka for treatment from other districts. Among the dengue patients, 24% lived in DNCC while 66% in DSCC and the rest 10% came from outside of Dhaka. (Table 6). Another study conducted in the same year showed 37.6% patients came from DNCC and 62.4% were from DSCC (Abir *et al.* 2021). The high

percentage of dengue patients from DSCC may have been due to the absence of proper drainage system in DSCC with aged infrastructure and narrow roads leading to the flooding during rainy seasons (Amin *et al.* 2019). A previous study in Singapore (Seidahmed *et al.* 2018) concluded that poor urban planning with dense drainage networks may pose as outdoor breeding grounds for dengue vectors as clogging is common during heavy rain.

In terms of monthly income, the highest percentage of dengue patients was observed in those who had monthly income above 30,000 BDT (44% among infected patients) (Table 7). In an earlier study with Dengue patients from a local hospital of Dhaka city in 2009, it was observed that the highest number of patients had monthly income of more than Taka 10,000 (which was the highest income group) (Farhana *et al.* 2014).

Among the dengue infected participants, (n=50), 32% reported their family members also had dengue before they were infected pointing out the probability that they were infected at home. No family member of 68% responded was infected, meaning proper precautions were taken to manage the disease transmission within family (Fig. 1).

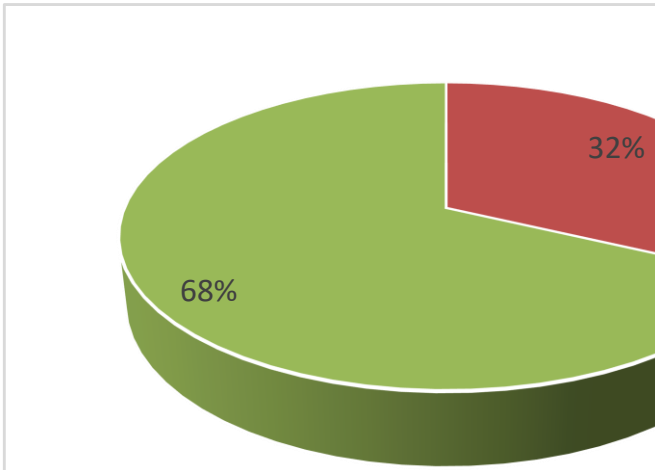

Fig. 1: Percentage of family members of dengue patients infected with dengue (n=50)

Out of 234 participants, 151 used bed-net and 83 people didn't use any bed-net. Prevalence of dengue was 13.25% for those who used bed-nets while 8.12% prevalence was observed for those who didn't use bed-net. However, questionnaire didn't mention the time of using bed-net or whether they used bed nets after infection so possible case scenario they were using bed-nets during night which didn't affect dengue transmission as *Aedes* mostly bites during day

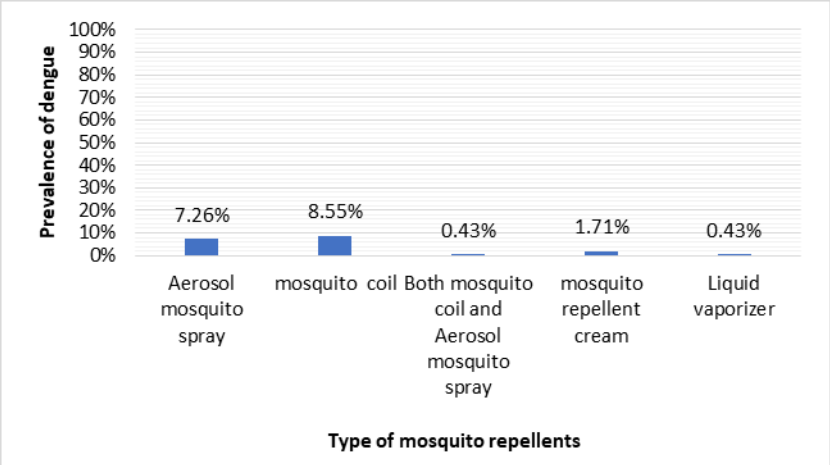

Fig. 2: Prevalence of dengue infection according to types of mosquito repellents

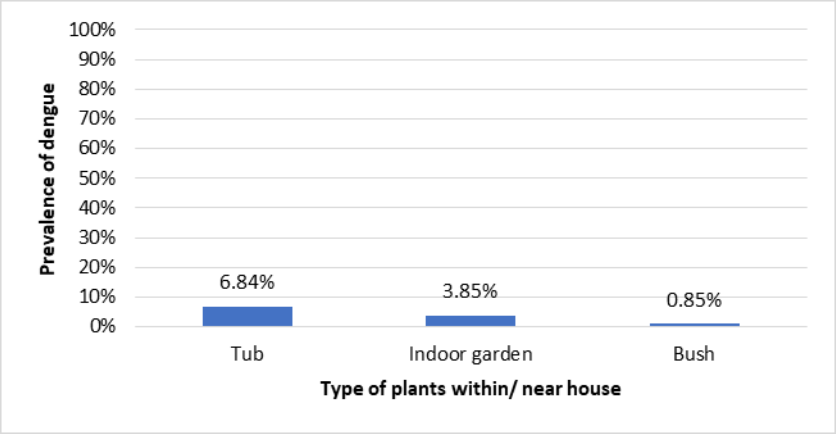

Fig. 3: Prevalence of dengue infection according to type of plants within/ near house

(Lima-Camara, 2010). 178 respondents used mosquito repellents and among them prevalence of dengue was 18.38% while prevalence was 2.99% for those who didn't use mosquito repellents (Table 8). That could mean that the current commercially available repellents used by the participants may not be effective against *Aedes* bites. Among the 50 dengue patients, 8.55% prevalence was observed for those who used coils, 7.26% for those who used aerosol spray and 1.71% for those who used repellent creams. Only 0.43% prevalence was found in those who used both coil and spray or used liquid vaporizer (Fig. 2). Prevalence of dengue was 6.84% in those who had plants in tub, 3.85% in those who had

an indoor garden and 0.85% who had bush near their house (Fig. 3). As female *Aedes* mosquitoes lays eggs in water containers having organic materials (CDC, 2021), tubs and indoor gardens are ideal places for their

Table 1: Baseline characteristics of the participants

Participant characteristics		Number (n)	Percentage (%)
Total respondents		234	100
Gender	Male	81	34.61
	Female	153	65.38
Age groups	10-20 years	60	25.64
	21-30 years	150	64.10
	31-40 years	13	5.56
	40 years and above	11	4.70

Table 2: Type of Clinical features in dengue patients

Form of disease	Number of infected patients	Prevalence (n=234)	Percentage among infected patients (n=50)
Any form of Dengue	50	21.37	100%
Dengue Fever	44	18.80	88%
Dengue Haemorrhagic Fever (DHF)	5	2.14	10%
Dengue shock syndrome (DSS)	1	0.43	2%

Table 3: Clinical Symptoms in dengue patients (n=50)

Symptoms	Yes	No
High fever	47 (94%)	3 (6%)
Headache	46 (92%)	4 (8%)
Vomiting / nausea	37 (74%)	13 (26%)
Skin rash	14 (28%)	36 (72%)
Gum bleeding	10 (20%)	40 (80%)
Eye lesion	2 (4%)	48 (96%)
Hematuria	8 (16%)	42 (84%)
Melena	7 (14%)	43 (86%)
Mucosal bleeding	2 (4%)	48 (96%)

Table 4: Prevalence of Dengue according to age groups

Age group	Number of respondents (n=234)	Number of dengue infected person (n=50)	Prevalence (%)	Percentage among infected patients(n=50)
10-20 years	60	6	2.56	12%
21-30 years	150	27	11.54	54%
31-40 years	13	8	3.42	16%
40 years and above	11	9	3.85	18%

Table 5: Prevalence of Dengue according to gender

Gender	Number of respondents (n=234)	Number of dengue infected person (n=50)	Prevalence (%)	Percentage among infected patients (n=50)
Male	81	28	11.97	56%
Female	153	22	9.4	44%

Table 6: Prevalence of dengue infection according to areas

Area	Number of respondents	Number of dengue infected person	Prevalence	Percentage among infected patients (n=50)
Dhaka North City Corporation	80	12	5.13	24%
Dhaka South City Corporation	106	33	14.10	66%
Others	48	5	2.13	10%

Table 7: Prevalence of Dengue infection according to monthly income

Monthly income	Total number of respondents (n=234)	Number of dengue infected person (n=50)	Prevalence (%)	Percentage among infected patients (n=50)
0-10000	141	19	8.12	38%
10001-20000	24	3	1.28	6%
20001-30000	24	6	2.56	12%
above 30000	45	22	9.40	44%

Table 8: Prevalence of Dengue infection according to use of bed nets and mosquito repellents

Bed nets	Number of respondents	Number of dengue infected person	Prevalence	Mosquito repellent	Number of respondents	Number of dengue infected person	Prevalence
Yes	151	31	13.25%	Yes	178	43	18.38 %
No	83	19	8.12%	No	56	7	2.99%

breeding. While watering the plants, if proper precaution is not taken, water may accumulate in the tub and may pose a threat for transmitting the disease by providing food and shelter for the eggs and growing larvae. Several questions covered the KAP information on dengue by the respondents and are listed in Table 9. Although many awareness campaigns, promotional activities or advertisements on dengue/ chikungunya/ vector borne diseases were arranged by the government, only 11.97% remembered seeing any of these contents. 94.44% respondents knew how dengue is transmitted and 5.56% incorrectly mentioned dengue as either waterborne or foodborne disease or they didn't know how it is transmitted. 97.86% correctly mentioned the name of the vector (*Aedes*) while 2.14% couldn't reply with the correct name. Alarmingly, only

65.81% answered correctly about the diurnal nature of *Aedes* which can be directly related to the risk of the disease as this ignorance can influence their precaution against the disease. 53.42% responded correctly that COVID-19 has affected the diagnosis and treatment of Dengue while 46.58% were either not sure or responded that COVID-19 didn't affect dengue diagnosis and treatment.

Table 9: KAP information on dengue by the respondents

Knowledge about Dengue	Correct answer/ yes	Percentage (n=234)	Incorrect answer/ No	Percentage (n=234)
Seen any health promotional activities or workshop on prevention of dengue/ vector-borne diseases	28	11.97	206	88.03
How dengue is transmitted	221	94.44	13	5.56
Which mosquito transmits the disease	229	97.86	5	2.14
When do they bite	154	65.81	80	34.19
Whether COVID-19 has affected the diagnosis and treatment of Dengue	125	53.42	109	46.58

In a very recent hospital-based cross-sectional study (Abir *et al.* 2021) of 242 fever patients from two city-corporations in Dhaka DNCC (n = 91, 37.6%) and DSCC (n = 151, 62.4%), interview was conducted using pre-tested KAP items. The study found that more than half of the study population knew about dengue (mean percentage scores 52%), and about 71.4% engaged in practices towards its prevention. The results are similar to the current study as most respondents were aware that it is a vector borne disease and name of mosquitoes that transmit dengue. But the alarming fact was that despite being properly educated, only 65.81% answered correctly about the diurnal nature of *Aedes.* So, awareness campaigns should focus on this particular behaviour of the dengue vector to prevent the spread of the disease.

Limitation of this study includes the potential information bias due to the sampling strategy. As it was a social media- based study and was open to all interested participants, we had no control over the number of respondents or the sample sizes of particular age group/gender.

The current study was performed when COVID-19 wreaked havoc throughout the globe and healthcare providers were more focused on COVID-19 than other communicable diseases. However, dengue and COVID-19 can present with similar symptoms during its early days (Joob *et al.*, 2020) and misdiagnosis or late diagnosis in either cases may present with severe consequences. Moreover, coinfection with COVID-19 and dengue is clinically challenging and proper treatment and disease management is necessary to save the lives of the

affected (Bicudo *et al.*, 2020). For this reason, it is necessary to create mass awareness about possible causes of dengue transmission as well as the dangers related to Dengue-COVID coinfection to reduce the morbidity and mortality of Bangladeshi people.

CONCLUSION

Due to lack of effective vaccine or drug, controlling dengue mostly relies on awareness of common people. In epidemiological surveys, a highly effective alternative tool face face interview could be the use of social media as a lot of people in Bangladesh uses social media due to the availability of the digital devices and a recent surge of internet usages during COVID pandemic. If properly utilized, this can be used to create awareness among common people as the survey can be distributed to a lot of people covering wide regions in a short time. Moreover, the results from this survey will have the potential to play an important role in expanding and adapting dengue surveillance practices in Bangladesh.

LITERATURE CITED

ABEDIN, M.Z., ZAMAN, M., UZ, S., AHMAD, T., MARUF, M., AL, A., AKTAR, M.B., AHMED, M., IMRAN, M., SAYEED, A. and HASAN, R. 2021. Analysis of the Dengue Infection, Occurrence and Hematological Profile of Dengue Patients in Dhaka City. *Eur. J. Mol. Clin. Med.* **8**(3): 1572-1578.

ABIR, T., EKWUDU, O., KALIMULLAH, N.A., NUR-A YAZDANI, D.M., AL MAMUN, A., BASAK, P., OSUAGWU, U.L., PERMARUPAN, P.Y., MILTON, A.H., TALUKDER, S.H. and AGHO, K.E. 2021. Dengue in Dhaka, Bangladesh: Hospital-based cross-sectional KAP assessment at Dhaka North and Dhaka South City Corporation area. *PLoS ONE*. **16**(3): 1–17.

AHSAN, A., HAIDER, N., KOCK, R., and BENFIELD, C. 2021. Possible drivers of the 2019 dengue outbreak in Bangladesh: The need for a robust community-level surveillance system. *J. Med. Entomol*. **58**(1): 37–39.

AKRAM, A. 2019. Alarming Turn of Dengue Fever in Dhaka City in 2019. *Bangladesh J. Infect. Dis*. **6**(1): 1–2.

AL-AMIN, H.M., JOHORA, F.T., IRISH, S.R., HOSSAINEY, M.R.H., VIZCAINO, L., PAUL, K.K., KHAN, W.A., HAQUE, R., ALAM, M.S., and LENHART, A. 2020. Insecticide resistance status of *Aedes aegypti* in Bangladesh. *Parasites Vectors***. 13**(1): 1–15.

AMIN, N., RAHMAN, M., RAJ, S., ALI, S., GREEN, J., DAS, S., DOZA, S., MONDOL, M.H., WANG, Y., ISLAM, M.A., and ALAM, M.U. 2019. Quantitative assessment of fecal contamination in multiple environmental sample types in urban communities in Dhaka, Bangladesh using SaniPath microbial approach. *PloS one*, **14**(12), p.e0221193.

BHATT, S., GETHING, P.W., BRADY, O.J., MESSINA, J.P., FARLOW, A.W., MOYES, C.L., DRAKE, J.M., BROWNSTEIN, J.S., HOEN, A.G., SANKOH, O., MYERS, M.F., GEORGE, D.B.,

JAENISCH, T., Wint, W.G.R., SIMMONS, C.P., SCOTT, T.W., FARRAR, J.J. and HAY, S.I. 2013. The global distribution and burden of dengue. *Nature*. **496** (7446): 504–507.

BICUDO, N., BICUDO, E., COSTA, J. D., CASTRO, J. A. L. P. and BARRA, G. B. 2020. Co-infection of SARS-CoV-2 and dengue virus: a clinical challenge. *Brazilian J. Infect. Dis.* **24**: 452-454.

CDC. 2021 About Dengue: What You Need to Know. https://www.cdc.gov/dengue/about/index.html. Centers for Disease Control and Prevention.

DGHS. 2021. Daily Dengue Status Report. https://dghs.gov.bd/index.php/bd/home/5200-daily-dengue-status-report. Directorate General of Health Services.

DHAR-CHOWDHURY, P., PAUL, K.K., HAQUE, C.E., HOSSAIN, S., LINDSAY, L.R., DIBERNARDO, A., BROOKS, W.A., and DREBOT, M.A. 2017. Dengue seroprevalence, seroconversion and risk factors in Dhaka, Bangladesh. *PLoS Negl. Trop. Dis.* **11**(3): 1–24.

FARHANA, R., AWATEF, K.F., KHANUM, H. and AKTER, T. 2014. Prevalence of dengue fevers among the patients of different economic status attended at local hospital in Dhaka. *Bangladesh Journal of Zoology*, **42**(2):161-168.

ISLAM, S. and HUQ, I. 2021. Economic cost of dengue; a selective case in Bangladesh. *The Int, J. Applied Economics and Finance,* **15**; 1-10.

JOOB, B. and WIWANITKIT, V. 2020. COVID-19 can present with a rash and be mistaken for dengue. *J Am Acad Dermatol.* **82**(5): e177.

KALAYANAROOJ, S. 2011. Clinical manifestations and management of dengue/DHF/DSS. *Trop. Med. Health.* **39**(4Suppl): 83-87.

KHAN, M.A.S., AL MOSABBIR, A., RAHEEM, E., AHMED, A., ROUF, R.R., HASAN, M., ALAM, F.B., HANNAN, N., YESMIN, S., AMIN, R., AHSAN, N., ANWAR, S., AFROZA, S., AND HOSSAIN, M.S. 2021. Clinical spectrum and predictors of severity of dengue among children in 2019 outbreak: a multicenter hospital-based study in Bangladesh. *BMC Pediatr.* **21**: 478.

LIMA-CAMARA, T. 2010. Activity patterns of Aedes aegypti and Aedes albopictus (Diptera: Culicidae) under natural and artificial conditions. *Oecologia Australis.* **14**.

LOW, J.G.H., ONG, A., TAN, L.K., CHATERJI, S., CHOW, A., LIM, W.Y., LEE, K.W., CHUA, R., CHUA, C.R., TAN, S.W.S., CHEUNG, Y.B., HIBBERD, M.L., VASUDEVAN, S.G., NG, L.C., LEO, Y.S. and OOI, E.E. 2011. The early clinical features of dengue in adults; challenges and early clinical diagnosis. *PLoS Negl. Trop. Dis.* **5**(5); e1191.

MAMUN, M.A., MISTI, J.M., GRIFFITHS, M.D., and GOZAL, D. 2019. The dengue epidemic in Bangladesh: risk factors and actionable items. *The Lancet.* **394**.

MAHMOOD, R., BENZADID, M.S., WESTON, S., HOSSAIN, A., AHMED, T., MITRA, D.K. AND AHMED, S. 2021. Dengue Outbreak 2019: Clinical and Laboratory Profiles of Dengue Virus Infection in Dhaka City. *Heliyon*, p.e07183.

MUTSUDDY, P., TAHMINA JHORA, S., SHAMSUZZAMAN, A.K.M., KAISAR, S.M.G., KHAN, M.N.A., and DHIMAN, S. 2019. Dengue Situation in Bangladesh: An Epidemiological Shift in terms of Morbidity and Mortality. *Canadian J. Infect. Dis. and Med. Microbiol.* **2019.**

NATURE. 2021. Dengue viruses. https://www.nature.com/scitable/topicpage/dengue-viruses 22400925/

SEIDAHMED, O.M., LU, D., CHONG, C.S., NG, L.C. and ELTAHIR, E.A. 2018. Patterns of urban housing shape dengue distribution in Singapore at neighborhood and country scales. *GeoHealth*, **2**(1):54-67

SHARMIN R, TABASSUM S, MAMUN KZ, NESSA A. and JAHAN M. 2013. Dengue infection in Dhaka City, Bangladesh. *Mymensingh Med J:MMJ.* **22**(4): 781-786.

SHARMIN, S., VIENNET, E., GLASS, K., and HARLEY, D. 2015. The emergence of dengue in Bangladesh: Epidemiology, challenges and future disease risk. *Trans. R. Soc. Trop.* **109**(10): 619–627.

WHO. 2021. Dengue and severe dengue. https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue. World Health Organization, Geneva.

YUNUS, E.B., BANGALI, A.M., MAHMOOD, M.A.H., RAHMAN, M.M., CHOWDHURY, A.R., and TALUKDER, K.R. 2001. Dengue outbreak 2000 in Bangladesh: From speculation to reality and exercises. *Dengue Bull.* **25**: 15–20.

(Manuscript received on 2 September, 2021 revised on 20 December, 2021)