

A CASE CONTROL STUDY TO IDENTIFY THE RISK FACTORS ASSOCIATED WITH DENGUE VIRUS INFECTION IN CHATTOGRAM DISTRICT

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Session: 2018-2019

### A thesis submitted in the partial fulfillment of the requirements for the degree of Masters in Public Health (MPH)

**One Health Institute**

**Chattogram Veterinary and Animal Sciences University Chattogram-4225, Bangladesh**

**February 2021**

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Mustaree Arzu

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### This is to certify that we have examined the above Master’s thesis and have found that is complete and satisfactory in all respects, and that all revisions required by the thesis examination committee have been made

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**February 2021**

## Acknowledgments

All praises to the Almighty Allah, the most gracious and most merciful that by His endless grace, who giving me the opportunity, courage and enough energy to carryout and complete the entire thesis work.

It is my proud privilege to express my intense gratitude, sincere appreciation and deep sense of respect to my honorable teacher and guide, Professor Dr. Paritosh Kumar Biswas, Director (In-charge), Poultry Research and Training Centre, Chattogram Veterinary and Animal Science University, Chattogram, whose keen supervision, constructive criticisms, valuable suggestions, affectionate advice and whole hearted co- operation made this study possible. It would have been difficult on my part to carry out this thesis without his unfailing and stimulating guidance throughout the study. He deserves more than I can express. I consider myself very fortunate in having his as my guide.

I am also thankful to Professor Dr. Sharmin Chowdhury, Chairman, One Health Institute & other faculty members of One Health Institute, Chattogram Veterinary and Animal Science University, Chattogram.

I would like to express my sincere gratitude to the CASR, CVASU for providing funds for implement this research.

I would like to express my deep sense of gratitude and thanks to honorable Vice Chancellor, Professor Dr. Goutom Buddha Das, Chattogram Veterinary and Animal Science University, Chattogram.

My heartiest thanks to my family for their sacrifices they made for me. Certainly those 400 participants who made immense contribution by providing their data. Without their contribution, the writing of this thesis would have never been possible.

Also thankful to staff of Chattogram Medical College Hospital, Chattogram (CMCH), Chattogram Metropolitan Hospital Pvt. Ltd., CSCR etc.

During experimental work for the analysis of data Dr. Mortahina Rashid, Project Officer, Bangladesh Breast Feeding Foundation is gratefully acknowledged.

I would also like to thank all member of the thesis supervision committee.

Last but not least, my heartiest thanks to my family for their sacrifices they made for me.

## Table of Content

|  |  |  |
| --- | --- | --- |
| **Authorization/ Statement of Candidate** | | ii |
| **Signature Page** | | iii |
| **Acknowledgement** | | iv |
| **Table of Content** | | v |
| **List of figure** | | vi |
| **List of table** | | vi |
| **List of Acronyms and Symbols used** | | vii |
| **Abstract** | | ix |
| **1. Introduction** | | **1** |
| **2. Review of literature** | | **3** |
| 2.1 | Bangladesh perspective | 3 |
| 2.2 | India and other country perspective | 5 |
| **3. Materials and methods** | | **9** |
| 3.1 | Study design | 9 |
| 3.2 | Study period | 9 |
| 3.3 | Study area | 9 |
| 3.4 | Study population | 10 |
| 3.5 | Confirmation of cases | 10 |
| 3.6 | Selection of controls | 10 |
| 3.7 | Questionnaire type | 10 |
| 3.8 | Pre-Testing of questionnaire | 11 |
| 3.9 | Data collection method | 11 |
| 3.10 | Data management and analysis | 11 |
| 3.11 | Ethical consideration | 11 |
| **4. Results** | | 12 |
| 4.1 | An overview of the respondents | 12 |
| 4.2 | Univariable analysis | 13 |
| 4.3 | Multivariable logistic regression | 18 |

|  |  |
| --- | --- |
| **5. Discussion** | 19 |
| **6. Conclusion** | 22 |
| **7. References** | 23 |
| **Appendix A: Questionnaire** | 26 |
| **Brief Bio-Data** | 30 |

**List of Figures**

|  |  |  |
| --- | --- | --- |
| **Figure No** | **Figure Name** | **Page** |
| Figure 1 | Map of Bangladesh showing the Study Area,  Chattogram district | 9 |

**List of Tables**

|  |  |  |
| --- | --- | --- |
| **Table No** | **Table Name** | **Page** |
| Table 1 | Frequency distribution of dengue fever among the variables including the indicator variables of a categorical variable and their association with the  occurrence of dengue fever in the study area | **13** |
| Table 2 | Results of Multivariable logistic regression analysis on the risk factors associated with dengue  fever in the study area | **18** |

**List of symbols and abbreviations**

|  |  |
| --- | --- |
| % | : Percent |
| > | : Greater than |
| < | : Less than |
|  | : Greater than equal |
|  | : Less than equal |
| = | : Equal to |
| C | : Degree Celsius |
| CTWC | : Covered tightly all water containers |
| DFFB | : Drain Free from blockage |
| CWIC | : Change water in plant container |
| CWIT | : Change water in Trays under the fridge |
| PGAW | : Place garbages that can accumulate water into closed bin |
| DFSW | : Leveled defective floor surfaces that an collect water. |
| MORE | : Use mosquito Repellent during sleeping. |
| MONT | : Use mosquito Net during sleeping |
| DUUT | : Disposed Unused trays |
| WINS | : Use Window Screen |
| LARW | : Add larvacide in water container |
| WEEP | : regularly remove water from flower pot trays |
| DUCO | : Destroy/ Burn unused containers |
| KMOS | : Know which mosquitoes are responsible for the transmission of dengue  virus |
| VDBO | : Visit Dhaka before the onset of fever. |
| DHF | : Dengue haemorrhagic fever |
| VHBO | : Visit any hospital before the last 21 days of the onset of fever. |
| FMSS | : Any family member suffers from same illness. |
| NSSS | : Any neighbour suffer from similar illness in the last 21 days |
| PLNH | : Any Pond /Drain located nearby of your habitat |

|  |  |
| --- | --- |
| WLSF | : Living in a space where water lodgement is seen frequently after heavy  rains. |
| SDWM | : Sleep in Day time without mosquito net. |
| CAIR | : City Authority regularly sprays mosquitocide in your residential area. |
| VSAC | : Visit any other South-East Asian Countries in the last 21 days on the onset  of clinical illness. |
| DIAB | : Are you Diabetic |
| TDPA | : Are you thyroxin deficient patient? |
| HYPE | : Are you hypertensive patient? |
| n | : None |
| DF | : Dengue Fever |
| IgG | : Immunoglobulin G |
| IgM | : Immunoglobulin M |
| i.e. | : That is |
| Fig. | : Figure |
| CI | : Confidence interval |

### Abstract

Dengue fever (DF) is a mosquito-borne infectious disease, which is now endemic in Bangladesh. Effective preventive measures are critical for controlling DF in Bangladesh. This study aimed to explore the individual risk factors for the dengue virus infection in Chattogram and to provide a scientific basis for the future prevention and control of DF. A case-control study including 200 cases and 200 controls was performed. The data were collected by using a prototype questionnaire. There were 32 variables in the questionnaire. Out of them 25 were dichotomous and 7 were categorical. The association of a variable with DF was initially assessed by χ2 test. The variables with p≤0.25 after the results of univariable analysis were considered for multivariable logistic regress to see the independence of effects of them. Out of the dichotomous or categorical variables only two variables namely, Age (5 indicator variables generated within the categorical variable Age) and number of people living in a family (2 indicator variables generated within the category) had p<0.25. Among the age indicator variables among the variable Age, people of age of <5 years and 6 to 15 years had a higher frequency (67%) of catching dengue fever, although the association was not statistically significant at p<0.05. Density of people, i.e. number of members living in a family was only other variable with the cutoff p value qualified for the multivariable logistic regression analysis, and the results showed that when a household had members >3 the DF frequency was higher (67%) compared with household of having members <3. However, the results of the multivariable logistic regression analysis revealed that the other age indicator variables within the categorical variable Age when compared with the reference indicator variable age 1 to 5 years and household of having >3 members compared with household of having <3 members were neither positively nor negatively associated with DF in the study area. People of all categories, irrespective of age, living area, and socio-economic status were seemingly at an equal risk of catching DF in the study area.

**Keywords:** Dengue fever (DF), endemic, univariable analysis, multivariable logistic regress, χ2 test,

# Introduction

Dengue fever (DF) is an acute viral disease caused by four distinct serotypes of dengue virus, transmitted between humans by *Aedes aegypti*. In endemic countries in Asia and America, the burden of dengue is approximately 1,300 disability-adjusted life years (DALYs) per million populations, which is comparable to the disease burden of other childhood and tropical diseases, including tuberculosis, in these regions. In Asia, epidemic dengue haemorrhagic fever (DHF) has expanded geographically from Southeast Asian countries west to India, Sri Lanka, the Maldives, and Pakistan and then east to China. According to the World Health Organization (WHO) statistics, there were only nine countries experiencing severe dengue epidemics before 1970. However, the number of countries which have experienced the disease now is more than 100, and the actual number of dengue infection is approximately 390 million, of which 500, 000 people require hospital admission because of severe dengue (WHO, 2018).

The first official outbreak of dengue fever in Bangladesh was in 2000, and since then the number of hospitalized patients has exceeded 3000 patients six times—6232 in 2002, 3934 in 2004, 3162 in 2015, 6060 in 2016, 10 148 in 2018, and 100 107 as of Nov 30,

2019, with estimated projections of more than 112 000 cases by the end of 2019. Based on the aforementioned official number of cases in November, 2019, as many as 3–4 million people could have conceivably been infected.

In order to effectively prevent dengue fever, understanding the infection risk factors for dengue fever is necessary. Now, it is clear that the rapid growth of population, urbanization, and convenient modern transportation have greatly increased the spread of dengue fever. The virus is transmitted to humans through the bites of infected female mosquitoes, primarily the *Aedes aegypti* mosquito. Other species within the *Aedes* genus, especially *A. albopictus,* can also act as vectors, but their contribution is secondary to *Aedes aegypti*. The proximity of mosquito vector breeding sites to human habitation is considered a significant risk factor for dengue. At present, the main method to control or prevent the transmission of dengue virus is to combat the mosquito vectors (WHO,

2020). There might be other demographic, living condition, other ethnographical and environmental risk factors in a local setting having influence on the risk of dengue fever that need to assess to identify the risk association to recommend a better control strategy for dengue considering the local resources.

Chattogram is the 2nd largest city in Bangladesh after Dhaka, the capital. Dengue is endemic here like the capital, but its prevalence varies according to different seasons. Despite the known cause of increasing the vector population, there might also be other factors here that influence the survivability of the vectors and their biting frequency that eventually might have a greater change of transmitting the causative virus of dengue. There could be protective factors as well to diminish the vector breeding places in and around living places, eventually preventing the virus from being transmitted to humans through the vectors. However, information on such risk or protective factors is scanty, if not absent. To fill the gap of knowledge, a case-control study could be helpful. With this background, the present study was conducted with the aim to assess the probable demographic, ethnographical and environmental risk factors associated with the occurrence of dengue in Chattogram.

# Review of Literature

## 2.1 Bangladesh perspective

In Bangladesh, all the dengue outbreaks since 2000 were primarily confined to Dhaka city (Hossain et al., 2020). However, it is expected to spread in other areas because of the presence of *Aedes* mosquitoes throughout Bangladesh. Based on a survey conducted in 2014–2015, both *A*. *aegypti* and *A*. *albopictus* were found in Dhaka city and in other urban areas. While the prevalence of *A*. *aegypti* was higher in urban areas, *A*. *albopictus* was more abundant in rural areas across Bangladesh. Climate factors on mosquito breeding were also considered. Previous studies showed that transport vehicles could disperse *Aedes* mosquitoes within a country. Dhaka was due to a large number of infected individuals traveling as asymptomatic carriers. Some major festivals like Eid, Puja, and the Bengali New Year can sometimes be reasons for major concern if their location and timing coincide with major outbreak. Such unexpected coincidence could facilitate outbreaks (especially with highly contagious viruses) morphing into an epidemic or even pandemic (depending on other factors like ease of transmission and favorability of climate factors). The ongoing outbreak of coronavirus in Wuhan, China, can be a recent example of this. This is especially true for the countries that have high population density and have a limited capacity to manage an increasing number of patients beyond the urban areas where the healthcare facilities are relatively well equipped.

Since first dengue outbreak in Bangladesh, then the number of hospitalised patients has exceeded 3000 patients six times—6232 in 2002, 3934 in 2004, 3162 in 2015, 6060 in

2016, 10148 in 2018, and 100107 as of Nov 30, 2019, with estimated projections of more than 112000 cases by the end of 2019 (Mamun et al., 2019). In parallel with the major epidemics in 2018 and this year’s outbreak, 26 deaths and 129 deaths, respectively, have been officially documented by the government surveillance systems with a clear predominance of cases and fatalities during the summer months (July to November), even if the death tally likely to be much higher because of actual under-reporting The geographical spread of the cases reported in 2019 affects all districts of the country,

exhibits a clear predominance in men (64·11% for men vs 35·89% for women), and primarily encompassed younger adults (whereby people aged 15–35 years accounted for 51·42% of 29855 total cases).As national surveillance is passive and only government hospitals are included, it is highly likely that substantial underreporting is taking place. Furthermore, the operational surveillance is not based on appropriate methods, such as the WHO projection done in July, 2019, where an estimated 358 960 people were deemed to be infected compared with only 7179 cases in official reports.8 Based on the aforementioned official number of cases in November, 2019, as many as 3–4 million people could have conceivably been infected (Dhar-Chowdhury et al., 2017). It i**s** likely to be much higher because of actual under-reporting. The geographical spread of the cases reported in 2019 affects all districts of the country, exhibits a clear predominance in men (64·11% for men versus 35·89% for women), and primarily encompassed younger adults (whereby people aged 15–35 years accounted for 51·42% of 29855 total cases). As national surveillance is passive and only government hospitals are included, it is highly likely that substantial underreporting is taking place. Furthermore, the operational surveillance is not based on appropriate methods, such as the WHO projection done in July, 2019, where an estimated 358 960 people were deemed to be infected compared with only 7179 cases in official reports.8 Based on the aforementioned official number of cases in November, 2019, as many as 3–4 million people could have conceivably been infected. We cannot underscore the seriousness of the current epidemic, which is unfortunately being handled with great laxity by the country’s authorities, as shown not only by the marked under-reporting, but also by the absence of health awareness campaigns targeting both the general public and health professionals. Such campaigns that aim for earlier and more consistent recognition and supportive clinical management of dengue cases are a major factor underlying reduced mortality for this highly contagious disease. However, in the contemporary literature, these indices are considered poor methods for predicting vector abundance because of their failure to effectively associate with and explain abundance of adult female mosquitoes and the potential for dengue virus transmission. The prevailing local proverb that “dengue is a disease of the rich” was supported by the findings of the present study. The number of reported dengue cases during the study period (2011–2013) was low, which can be due to

under-reporting and passive nature of the surveillance for human cases of dengue virus infection. Different types of water containers produced variable numbers of *Aedes* immatures during the present study. In all four surveys, plastic drums, plastic buckets, water tanks, clay pots, and flower tubs were observed to producing large number of *Aedes* larvae and pupae. City dwellers use relatively smaller plastic drums, plastic buckets, and larger water tanks to store water from supplied piped water, as municipal water supply is not reliably available. As reported previously, if the water stored within containers is not emptied weekly, they become ideal oviposition sites for *Aedes* mosquitoes. Residents of Dhaka use flower tubs in and around houses to plant relatively small ornamental trees, and refrigerator trays located underneath refrigerator compartment remain out of sight and unnoticed. Tires and clay pots are usually located in outdoor locations where water remains stagnant, become suitable for *Aedes* oviposition. We observed that during the wet seasons, tires and refrigerator trays were mostly responsible for *Aedes* production. These *Aedes* habitats need to be the focus of vector control efforts. In a recent study in Lahore (Pakistan), Malik *et al.,* (2019) also noted a distinct seasonality to vector abundance. Periods of high intensity of vector mosquitoes development (i.e., larval observed in standing water environments) occurred during the wetter periods of the season with large numbers of immatures developing within water tanks, bottles, jugs and pitchers. However, during (or shortly after) substantial rainfall events, the occurrence of larvae was low. The increased vector abundance was correlated with periods when the resident human population was more prone to disease outbreak. Small plastic reservoirs were most abundant and discarded vehicle and construction materials were most efficient immature habitats.

## 2.2. India and other country perspective

Literature showed that activities in the park, outdoor sports and the poor indoor daylight quality significantly increased the 1.70-time, 1.67-time, and 2.27-time risk of developing dengue infection respectively in Guangdong Province (Liu et al., 2018). The result of the study revealed that people with activities in the park have significantly higher risk of contracting dengue fever than those with no activities in the park. This could be related to the high density of the mosquito of *Aedes albopictus* in the park. And when playing in the

park especially in the morning and at dusk, residents were usually casually dressed with more skin exposed, which made it easier to be bitten by mosquitoes and increased the risk of dengue infection. Besides, research showed that the main protocols of mosquito prevention were using mosquito nets, pesticide and mosquito repellent, but less residents tend to use mosquito repellent outdoor. Thus it is necessary for residents to increase the awareness of adopting some approaches to prevent mosquito in their daily lives and reduce the risk of dengue fever. For instance, wearing long-sleeve clothes during activities in the park. Meanwhile, having outdoor sports was another risk factor for dengue virus infection, the explanation for which might be that the forest margin, the holes of trees and the natural reservoirs were the origins of *Aedes albopictus*. They also found that the density of human population was closely associated with dengue transmission. In general, it is believed that the high population density is a risk factor for dengue transmission. But in our study, those sharing a crowded household with 2 persons and 3 persons and above were less likely to have a dengue infection. The explanation could be that most of one room with 3 persons and above were shared by the parents and their young children which was related to Chinese way to raise kids.

A previous study conducted by (Swain et al., 2020) studied the risk factors of dengue transmission, especially the environmental and climatic associations. More advanced researches use the population dynamics of both human and vector to understand the outbreak. However, most of these population-based studies are based on simulative mathematical models. Few in India have researched the epidemiological determinants for dengue. This is the first ever study done to identify the risk factors in the Eastern India. We found the leading associated factors are (i) occupation demanding travel has nearly three times higher risk; (ii) presence of breeding sites increases the risk by nearly two times and (iii) travel during the disease increases the risk by two times as well. The case- control study is matched for age, gender and small extent of area of living; thus, the identified individual and housing level factors making the estimates real and comparable. They found significant association of dengue with occupation and housing type. Which demonstrates a clear difference in the occupation and housing characteristics of cases compared to controls. The positive association with businesspersons and agriculture/daily

worker indicates the jobs demanding travel to other places or nearby towns predisposes them more at risk towards the disease. Housing structure is proved to be linked with dengue outbreak. Studies reported that, staying in sheds/old flats creates higher chances of dengue. Especially, densely and nearly located houses increase the dengue spread chances because of the crowding and environmental conditions.

Educational attainment by household heads and the income status of the households were not closely associated with dengue sero-prevalence (Dhar-Chowdhury et al., 2017). This finding conforms to the results of a Brazilian study by (Vasconcelos et al., 1998). However, numerous studies report that poverty in general (such as, at the local community level) and the low socio-economic status (SES) of residential zone are important risk factors, an incorporation of SES of residential zones, along with individual’s socioeconomic characteristics in future risk factor studies in Bangladesh will help to understand the context of the country better. In a comparative study between Texas, USA and Matamoros, Mexico (Brunkard et al., 2007) inferred that poverty is an effective proxy indicator for numerous risk factors. They reported that the protective effect of air conditioning in the more developed, well-off areas was profound in lower risk exposure. In Taiwan, recorded that patients who resided near markets and/or open sewage or ditches had a risk of contracting infectious diseases 1.8 times higher than those who did not live in such conditions. As several analysts already registered, low socioeconomic residential area risk factor may be attributed to poor settlement and housing structures, high population density, presence of interdomiciliary potential mosquito breeding sites such as, potholes, discarded bottles and cans, vehicle tires in such urban zones.

In a case-control study to investigate the association between hospitalization with a diagnosis of DHF and evidence of diabetes, allergy and hypertension and the results reported here are the initial evidence for this very important association (Figueiredo et al., 2010). They believe the evidence produced in this study when confirmed suggests that screening criteria might be used to identify adult patients at a greater risk of developing DHF with a recommendation that they remain under observation and monitoring in

hospital. Finally, cross immunologic pathophysiologic studies based on the associations between diabetes, allergy and high socio-economic status and DHF, are urgently needed to investigate the intricate mechanism controlling severe form of dengue.

# Materials and Methods

* 1. **Study Design:** This was a case-control type of observational study.
  2. **Study period:** The study was conducted from July 2019 to June 2020. The period thus covered Monsoon, Winter and Summer seasons.
  3. **Study Area:** The study was carried out in urban and rural areas of Chattogram district. Chattogram, also known as the Port City of Bangladesh, is a major coastal city and financial center in southeastern Bangladesh. It is the second largest city in the country with a population of more than 8.6 million in 2017. The city is located on the banks of the Karnaphuli River between the Chittagong Hill Tracts and the Bay of Bengal. The cases and controls for this study were selected from both urban and rural areas of Chattogram (Fig. 1)



Figure 1: Map of Bangladesh showing the study Area, Chattogram District

* 1. **Study Population:** Patients infected with dengue virus in urban and rural areas of Chattogram District were included in this study as the cases. Patients admitted to 20 hospitals in Chattogram district diagnosed positive with a dengue virus were the sample frame for this study. From this frame, a total of 200 patients were randomly selected as the cases.
  2. **Confirmation of cases:** The patients’ laboratory test reports were verified for the positive results of the following tests for the presence of dengue virus or specific antibodies to the virus:

1. Reverse transcription-polymerase chain reaction (RT-PCR) from blood samples collect during the first few days of infection;
2. Rapid-test for a virus-produced protein called NS1; and
3. Serological methods, such as enzyme-linked immunosorbent assays (ELISA), to detect the presence of a recent or past infection, with the detection of IgM and IgG anti-dengue antibodies.

IgM antibodies are detectable ~1 week after infection and are highest at 2 to 4 weeks after the onset of illness. They remain detectable for about 3 months. The presence of IgM was considered for a recent dengue virus infection. IgG antibody levels take longer to develop than IgM, but IgG remain in the body for years. The presence of IgG was indicative for a past infection (https://[www.who.int/news-room/fact-sheets/detail/dengue-](http://www.who.int/news-room/fact-sheets/detail/dengue-) and-severe-dengue).

* 1. **Selection of Controls:** The controls were selected from the patients admitted to the same hospitals, but tested negative for the presence of any dengue virus and/or antibodies (IgM and IgG) to the virus. In total, 200 controls were included in the study.
  2. **Questionnaire:** A prototype questionnaire was designed for the study including 32 variables. The questionnaire is given in annex 1. Among the variables seven were categorical and the other 25 were dichotomous or binary. The categorical variables were Age, Living area, Education, Occupation, Marital status, Number of people living in a family and Household monthly income.
  3. **Pre-Testing of Questionnaire:** Before going to data collection by administering the questionnaire designed, its pretesting was carried out on a small sample comprising 10 respondents to finalize the variables and make it clearly untestable for the participants. During pretesting, the participants were asked any specific words or sentences they failed to understand as well as an unacceptable or offensive word or expression. Participants were also asked about language difficultly or any alternatives that fit better language. After the pretesting the necessary modifications were made to finalize it.
  4. **Data collection method:** Face to face interview was taken for a case or a control selected by using the questionnaire to record the data.

1. **10 Data Management and Analysis:** The data were entered into a spread sheet using MS Excel-2010 for data summary and management, and then transferred to STATA 13 for statistical analysis. Within a categorical variable indicator variables were generated, and association of the indicator variables in a category and also the association of a binary/dichotomous variable were assessed initially by χ2 test. After this analysis, only variables with p<0.25 were entered into the multivariable logistic regression analysis. For multivariable logistic regression analysis, the impacts of other indicator variables were compared with the reference indicator variable set for the category. Either in univariable or in multivariable analysis, an association with p<0.5 was considered statistically significant.

**3.11 Ethical Consideration:** The study was conducted through the collection of data using a questionnaire. No intervention or any other invasive procedure was undertaken. Before initiation of the interview, each respondent was informed about the research, assured and informed consent was taken. Participation in the study was voluntary. The participants were informed that they have the right to refuse at any time during or after completion of interview. They were also informed about the nature, purpose and confidentiality of data handling. A complete assurance was given to them that information provided by them would be kept confidential and their names or anything which can identify them could not be published or exposed anywhere.

## RESULTS

* 1. **An overview of the respondents**

Out of 400 respondents, majority (187) were 41-60 years of age. Among them 247 respondents were male and 153 were female; 263 respondents were from urban area while 213 were educated up to college or university level, and only 47 were illiterate. A total of 142 respondents were unemployed or student. According to marital status, 267 were married. The number of family members was 1 to 3 in case of 388 respondents and the monthly income of 372 respondents was more than 3000 Taka. A total of 240 respondents did not use tight coverings for water containers and 244 respondents didn’t see any blockage in nearby water draining system. Of the respondents, 245 had indoor plants; however, 311 respondents did not change water in plant container, whereas, 366 respondents didn’t remove water from flower pot trays regularly, and 192 respondents noticed water accumulated into closed bin. In total, while sleeping, 388 and 299 respondents, respectively, didn’t use mosquito repellent and mosquito net. A total of 299 respondents didn’t use window screen, and none of the respondents used larvicide in water container, and most of them (390) did not burn container. In total, 358 respondents had knowledge about dengue transmission. Of the respondents, 272 respondents visited Dhaka before the onset of fever and 298 visited any hospital before the last 21 days of the onset of fever. A total of 266 respondents’ family members suffered from similar illness in the last 21 days, and 249 respondents’ neighbors suffered from similar illness in the last 21 days of the onset of their clinical illness. Of the respondents, 374 were not living nearby any pond, but 221 respondents were living in a place where water lodgment was seen frequently after a heavy rain. A total of 301 respondents used to sleep in day time without the cover of mosquito net, while 336 respondents did not have mosquitocide spray in their residents. Most (326) respondents did not visit any other South-East Asian countries in the last 21 days. When comorbidities were assessed, 237 respondents were found to be non-diabetic while 248 were non-hypertensive.

## Univariable analysis

The frequency distribution of cases and controls under different indicator variables generated under a categorical variable and the binary/dichotomous variables are given in Table 1. The univariable association of each variable with the outcome (dengue fever) is also shown. The results of univariable analysis revealed that not a single variable had p<0.05. However, while assessing the association among the indicator variables two categorical variables namely, Age and Number of people living in a family had p<0.25. The frequency distributions of dengue fever in different indicator variables in the Age category suggested that people less than 5 years of age and 6 to 15 years of age had an increasing trend of having dengue fever, with frequency percentage of 66.7% (95% CI 22.3% - 95.7%) and 66.7% (38.4% - 88.2%). Of the two indicator variables generated in the categorical variable Number of people living in a family, the indicator variable family containing 3 or more members had an increase trend of affecting with dengue fever (66.7%; 95% CI 44.0% - 54.6%)

### Table 1. Frequency distribution of dengue fever among the variables including the indicator variables of a categorical variable and their association with the occurrence of dengue fever in the study area

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Co-variable** | **N** | **Frequency**  **of dengue fever** | **% (95% CI)** | **2 -value** | **p-value** |
| Age | less than 5  years | 6 | 4 | 66.67 (22.28-95.67) | 6.78 | 0.13 |
| 6 to 15 years | 15 | 10 | 66.67 (38.38-88.18) |
| 16 to 40  years | 94 | 54 | 57.45 (46.82-67.59) |
| 41 to 40  years | 187 | 83 | 44.39 (37.14-51.81) |
| more than 60  years | 98 | 49 | 50 (39.73-60.27) |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Co-variable** | **N** | **Frequency of dengue**  **fever** | **% (95% CI)** | **2 -value** | **p-value** |
| Sex | Male | 247 | 121 | 48.99 (42.60-55.40) | 0.26 | 0.61 |
| Female | 153 | 79 | 51.63 (43.42-59.78) |
| Living Area | Rural | 50 | 28 | 56 (41.25-70.01) | 0.92 | 0.63 |
| Semi-urban | 87 | 44 | 50.57 (39.64-61.47) |
| Urban | 263 | 128 | 48.67 (42.48-54.89) |
| Education | Illiterate | 47 | 26 | 55.32 (40.11-69.83) | 1.63 | 0.65 |
| Primary  school | 54 | 30 | 55.56 (41.40-69.08) |
| Secondary  school | 86 | 42 | 48.84 (37.90-59.86) |
| University or  college | 213 | 102 | 47.89 (41.04-54.82) |
| Occupation | very young | 27 | 18 | 66.67 (46.04-83.48) | 4.61 | 0.33 |
| unemployed  or student | 142 | 74 | 52.11 (43.58-60.56) |
| full time job | 60 | 26 | 43.33 (30.59-56.76) |
| housewife | 117 | 56 | 47.86 (38.54-57.29) |
| part time job | 54 | 26 | 48.15 (34.34-62.16) |
| Marital Status | Married | 267 | 126 | 47.19 (41.08-53.37) | 3.22 | 0.36 |
| Single | 92 | 52 | 56.52 (45.78-66.83) |
| Divorce | 13 | 8 | 61.54 (31.58-86.14) |
| Widow | 28 | 14 | 50 (30.64-69.36) |
| No. people living  in a family | 1 to 3 | 388 | 192 | 49.48 (34.89-90.08) | 1.37 | 0.24 |
| More than 3 | 12 | 8 | 66.67 (44.04-54.58) |
| Household monthly income in Taka | Less than  3000 | 28 | 15 | 53.57 (33.87-72.49) | 0.15 | 0.70 |
| More than  3000 | 372 | 185 | 49.73 (44.54-54.93) |
| All water  containers covered | Yes | 160 | 79 | 49.38 (41.39-56.91) | 0.04 | 0.84 |
| No | 240 | 121 | 50.42 (43.91-56.91) |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Co-variable** | **N** | **Frequency of dengue**  **fever** | **% (95% CI)** | **2 -value** | **p-value** |
| tightly |  |  |  |  |  |  |
| Free-drainage of  water | Yes | 156 | 77 | 49.36 (41.27-57.47) | 0.04 | 0.84 |
| No | 244 | 123 | 50.41 (43.95-56.85) |
| Indoor potted  plants | Yes | 245 | 120 | 48.98 (42.56-55.42) | 0.26 | 0.61 |
| No | 155 | 80 | 51.61 (43.45-59.70) |
| Changing water in  plant container | Yes | 89 | 44 | 49.44 (38.66-60.25) | 0.01 | 0.90 |
| No | 311 | 156 | 50.16 (44.47-55.58) |
| Regularly removing water from flower pot  trays | Yes | 34 | 17 | 50 (32.42-67.57) | 0.00 | 1.0 |
| No | 366 | 183 | 50 (44.76-55.24) |
| Placing all garbage into closed bin accumulating  water | Yes | 192 | 92 | 47.92 (40.67-55.23) | 0.64 | 0.42 |
| No | 208 | 108 | 51.92 (44.91-58.88) |
| Using of mosquito repellent while  sleeping | Yes | 62 | 29 | 46.77 (33.98-59.88) | 0.31 | 0.58 |
| No | 338 | 171 | 50.59 (45.13-56.44) |
| Using mosquito  net while sleeping | Yes | 171 | 88 | 48.54 (42.27-55.58) | 0.2554 | 0.61 |
| No | 229 | 112 | 51.46 (43.71-59.16) |
| Using window  screen | Yes | 101 | 48 | 47.52 (37.49-57.70) | 0.33 | 0.56 |
| No | 299 | 152 | 50.84 (45.02-56.4) |
| Adding larvicide  to water containers | Yes | - | - | - | - | - |
| No | 400 | 200 | 50 (44.99-55.01) |
| Destroying or burning unused  containers | Yes | 10 | 6 | 60 (26.24-87.85) | 0.41 | 0.52 |
| No | 390 | 194 | 49.74 (44.67-54.82) |
| Knowledge on  mosquitoes that | Yes | 358 | 177 | 49.44 (44.14-54.75) | 0.42 | 0.51 |
| No | 42 | 23 | 54.76 (38.67-70.15) |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Co-variable** | **N** | **Frequency of dengue**  **fever** | **% (95% CI)** | **2 -value** | **p-value** |
| transmit dengue  virus |  |  |  |  |  |  |
| Recent visit to  Dhaka | Yes | 128 | 62 | 48.44 (39.51-57.41) | 0.19 | 0.67 |
| No | 272 | 138 | 50.74 (44.63-56.68) |
| Visiting any hospital in the last 21 days before the  onset of fever | Yes | 102 | 51 | 50 (39.99-60.07) | 0.0 | 1.0 |
| No | 298 | 149 | 50 (44.18-55.82) |
| Any member of family suffered from similar illness in the last 21 days of the onset of your  clinical illness | Yes | 134 | 68 | 50.75 (41.98-59.48) | 0.45 | 0.83 |
| No | 266 | 132 | 49.62 (43.36-55.79) |
| Any neighbours suffered from similar illness in the last 21 days of the onset of  clinical illness | Yes | 249 | 126 | 50.60 (44.21-56.97) | 0.10 | 0.76 |
| No | 151 | 74 | 49.40 (40.79-57.26) |
| Any pond located  nearby habitat | Yes | 26 | 14 | 53.85 (33.37-73.41) | 0.16 | 0.68 |
| No | 374 | 186 | 49.73 (44.55-54.91) |
| Living in a place where water lodgment is seen frequently after a  heavy rain | Yes | 221 | 112 | 50 (43.89-57.45) | 0.09 | 0.76 |
| No | 179 | 88 | 49.1 (41.62-56.73) |
| Sleep in day-time  without the cover | Yes | 301 | 150 | 49.83 (44.05-55.63) | 0.01 | 0.91 |
| No | 99 | 50 | 50.51 (40.27-60.71) |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Co-variable** | **N** | **Frequency of dengue**  **fever** | **% (95% CI)** | **2 -value** | **p-value** |
| of a mosquito net |  |  |  |  |  |  |
| City authority regularly spray mosquitocide in  residential area | Yes | 64 | 32 | 50 (37.23-62.77) | 0.00 | 1.0 |
| No | 336 | 168 | 50 (44.52-55.47) |
| Visit any other South-East Asian countries in the last 21 days on the onset of clinical  illness | Yes | 74 | 36 | 50 (36.85-60.56) | 0.66 | 0.79 |
| No | 326 | 164 | 50.31 (44.74-55.86) |
| Diabetic | Yes | 163 | 78 | 47.85 (39.97-55.81) | 0.51 | 0.48 |
| No | 237 | 122 | 51.48 (44.92-57.99) |
| Thyroxin  deficiency | Yes | 49 | 24 | 48.98 (34.42-63.66) | 0.23 | 0.88 |
| No | 351 | 176 | 48.98 (44.79-55.49) |
| Hypertensive | Yes | 152 | 72 | 47.37 (39,22-55.62) | 0.69 | 0.41 |
| No | 248 | 128 | 51.61 (45.20-57.98) |

**Table2 Results of multivariable logistic regression analysis on the risk factors associated with dengue fever in the study area**

|  |  |  |  |
| --- | --- | --- | --- |
| **Explanatory variable** | **Co-variable** | **Odds ratio (95% CI)** | ***p*-value** |
| Age | Less than 5 years | Reference | - |
| 6 to 15 years | 1.08 (0.14-8.12) | 0.94 |
| 16 to 40 years | 0.70 (0.12-4.01) | 0.62 |
| 41 to 60 years | 0.42 (0.07-2.40) | 0.33 |
| More than 60 years | 0.55 (0.94-3.16) | 0.50 |
| No. people living in a family | One to three person | Reference | - |
| More than three persons | 1.61 (0.34-10.30) | 0.74 |

* 1. **Multivariable logistic regression**

After univariable analysis, two variables had p<0.25, and they were entered for multivariable logistic regression analysis. The results obtained revealed that none of the indicator variables under the Age category was significantly associated with the outcome when compared with the reference indicator variable “Less than 5 years of age” (Table 2). However, the point odds ratio (1.6) was although higher in the indicator variable of >3 persons living in family compared with the reference indicator variable <3 persons in living family of the categorical variable No. of persons living in a family, it was not statistically significant (p=0.74).

## Discussion

The escalating dengue situation in Bangladesh has been emerging as a serious public health problem in terms of mortality and morbidity. Results of analysis of the case- control study by incorporating 200 cases and 200 controls revealed that none of the variables included had any significant positive or negative association with the occurrence of dengue fever in Chattogram district. However, people of less than 15 years of age and crowdy living condition in a family might have had influence in experiencing a higher occurrence of the disease in the area. In a previous study from Brazil (Branco *et al*., 2014), a highest number of dengue cases was found in the 21-35-year-old age group and minimum cases were recorded in less than 4 years of age.

In a previous survey conducted in Dhaka city (Shirin *et al*., 2019), the prevalence of dengue was higher in urban areas compared with other areas. However, we didn’t find such association in Chattogram area. Likewise, other factors, such as education, occupation, marital status and gender, monthly income had no significant association with the occurrence of dengue in Chattogram area.

In this study, the morbidity of dengue seemed to decrease with increasing age, in agreement with another study conducted in china (Lu *et al.*, 2012), A plausible explanation for such age susceptibility to dengue could be the reason that children spend much time in closed confinements, such as at home or in school where frequency of biting from *A. aegypti* could be higher. The other explanation was that older people might have had the virus infection over time, developing life-long immunity to the serotype of the virus circulating in Chattogram district

Overall, practicing hygiene measures helped prevent the disease through eradication of breeding grounds. In a study by (Toan *et al.*, 2014) Hanoi, Vietnam, reported environmental factors positively associated with the development of dengue fever and/or dengue hemorrhagic fever. Also, people having exposed stagnant water within their houses, such as uncovered water tanks were more likely to develop dengue fever when

compared with people who kept their water tanks covered. However, the present study found no statistical association with this kind of factors. Nevertheless, emphasis should be given to nullify any possible breeding pleases of *A. aegypti* mosquitoes in and around living houses to avoid their bites which eventually would protect people from being infected with the virus.

In the present study, comorbidities, such as diabetes, hypertension or hypothyroidism – none had any association with dengue fever. This is similar to a study from Pakistan (Shahid et al., 2017) where no significant difference was found in people having such comorbidities. However, the finding contradicts with few other studies. One meta- analysis in India showed (Kaur et al., 2017) that obesity and overweight, hypertension and diabetes mellitus were the most prevalent commodities associated with dengue.

Dengue virus is transmitted by female mosquitoes mainly of the species *Aedes aegypti* and, to a lesser extent, *A. albopictus*. These mosquitoes are also vectors of chikungunya, yellow fever and Zika viruses. According to WHO, dengue is widespread throughout the tropics, with local variations in risk influenced by rainfall, temperature, relative humidity and unplanned rapid urbanization. In 2020, dengue continues to affect several countries, with reports of increases in the numbers of cases in Bangladesh, Brazil, Cook Islands, Ecuador, India, Indonesia, Maldives, Mauritania, Mayotte (France), Nepal, Singapore, Sri Lanka, Sudan, Thailand, Timor-Leste and Yemen. The largest number of dengue cases ever reported globally was in 2019. High numbers of cases were reported in Bangladesh (101,000), Malaysia (131,000) Philippines (420,000), and Vietnam (320,000) in Asia

(WHO, 2018).

The proximity of mosquito vector breeding sites to human habitation is a significant risk factor for dengue as well as for other diseases that Aedes mosquitoes transmit, according to WHO. Because the vectors of dengue virus live in urban habitats and breed mostly in man-made containers these breeding places need to destroy as a first line of defense to combat dengue, although no specific risk factors were detected from the present study independently associated with the disease. Equal distribution of the risk factors in both case and control groups in the present study in an endemic setting for dengue suggests

that, irrespective of demographic, socio-economic and environmental perspectives people living in Chattogram district are equally susceptible to dengue. In addition to nullify the breeding places in and around a living home and community places people also need to use personal household protection measures, such as mosquito-protecting window screens, repellents, insecticide treated materials, coils and vaporizers. These measures must be observed during the day time because the primary mosquito vectors bite throughout the day. People also need to wear clothing that minimizes skin exposure to mosquitoes (WHO, 2018)

## Conclusion

People below 15 years of age might have an increasing trend of getting affected with dengue fever in Chattogram, and people in overcrowded house might have a similar trend. But there are no risk factors identified that have independent risk association with dengue fever in the area, or have any protective effects from the disease. This means that, people living in Chattogram are seemingly equally susceptible to the disease irrespective of their demographic, socio-economic status and surrounding living environments, suggesting that general household measures need to be practiced in order to destroy the breeding places of the vector mosquitoes, *A. Aegypti*, or not to allow them to lay eggs inside or outside of the houses and community places. Personal protective measures also need to be ensured to prevent mosquito bites.

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## Appendix A Questionnaires of the Research Project

“A Case control study to identify the risk factors associated with dengue virus infection in Bangladesh”

### Set: 1

Case / Control (Put tick mark)

### Case / Control ID:

Part A: Socio demographic profile of the Cases and Controls enrolled for the study.

### Name :

1. **Age** : 1) < syears 
   1. 5-15 years  3) 16-40 years  4) 41-60 years 

5) > 60 years 

### Sex :

* 1. **Living Area (LIVA)**
  2. **Education (Edu):**

1. Male 
2. Female 
3. Rural 
4. Semi urban 
5. Urban 
6. Illiterate 
7. Primary School 
8. Secondary School 
9. University / College 

### Occupation (Occu) :

* 1. Professional / Full time
  2. Professional Part time
  3. House wife
  4. Unemployed / Student

### Marital Status: (MATS)

* 1. Married
  2. Single
  3. Divorce
  4. Widow

### How many people living in the house? (FAMM)

1) < 4 

2) > 4 

### Estimated monthly house hold income? (Income)

* 1. Below 500 Tk

2) Tk 501- Tk 1500

3) Tk 1501- Tk 3000

4) Tk 3001 and above

### Part B: These are the risk factors ?

1. **Have you covered tightly all water containers? (CTWC)** Yes / No
2. **Have you kept drain free from blockage? (DFFB)** Yes / No
3. **Do you change water in plant container? (CWIC)** Yes / No
4. **Do you change water in trays under the fridge? (CWIT)** Yes / No
5. **Do you place all garbage that can accumulate water into closed bin? (PGAW)** Yes / No
6. **Have you leveled defective floor surfaces that can collect water, if any? (DFSW)** Yes / No
7. **Do you use mosquito repellent water sleeping? (MORE)** Yes / No
8. **Do you use mosquito net when sleeping? (MONT)** Yes / No
9. **Do you dispose of unused trays, if any? (DUUT)** Yes / No
10. **Do you use window screen?**

**(WINS)** Yes / No

### Do you odd larvaecide in water containers? (LARW) Yes / No

1. **Do you regularly remove water from flower pot trays? (WEEP)** Yes / No
2. **Do you destroy / burn unused containers? (DUCO)** Yes / No
3. **Do you know which mosquitoes are responsible for the transmission of dengue virus? (KMOS)** Yes / No
4. **Did you visit Dhaka before the onset of fever? (VDBO)** Yes / No
5. **Have you visited any hospital before the last 21 days of the onset of fever?**

**(VHBO)** Yes / No

### Did any member of your family suffer from similar illness in the last 21 days of the onset of your clinical illness?

**(FMSS)** Yes / No

### Did any of your neighbors suffer from similar illness in the last 21 days of the onset of your clinical illness?

**(NSSS)** Yes / No

### Is there any pond located nearby of your habitat? (PLNH) Yes / No

1. **Are you living in a place where water lodgment is seen frequently after a heavy rain?**

**(WLSF)** Yes / No

### Do you sleep in day-time without the cover of a mosquito net? (SDWM) Yes / No

1. **Do the city authority regularly spray mosquitocides in your residential area? (CAIR)** Yes / No
2. **Did you visit any other South-East Asian countries in the last 21 days on the onset of clinical illness?**

**(VSAC)** Yes / No

### Are you diabetic?

**(DIAB)** Yes / No

### Are you thyroxin deficient patient? (TDPA) Yes / No

1. **Are you hypertensive patient?**

**(HYPE)** Yes / No

Interviewer

## Brief bio-data of the Author:

Dr. Mustaree Arzu has passed the Secondary School Certificate Examination in 2000 followed by Higher Secondary Certificate Examination in 2002. She obtained his Bachelor of Medicine and Bachelor of Surgery (MBBS) Degree in 2008 from Chattogram Medical College Hospital (CMCH), Chattogram, Bangladesh. Now, she is a Candidate for the degree of Masters in Public Health (One Health) under the One Health Institute, CVASU. She has immense interest to continue research on infectious disease, Public Health and Epidemiology through One Health approach.