Research Article

Socio-demographic, Environmental and Life Style Factors on the Dengue Epidemic in Noakhali District, Bangladesh: Evidence from Recent Outbreak

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I N F O

A B S T R A C T

Background: Dengue, a mosquito-borne disease predominantly found in tropical and subtropical countries like Bangladesh. This study attempted to look at the influence of various socio-demographic, environmental, and lifestyle factors on the recent dengue outbreak in Noakhali district, Bangladesh.

Methods: The study adopted a mixed-method analysis of information collected from hospital records of dengue patients, and a telephone survey of the same patients to collect background information, their length of stay in the hospital, types of symptoms they had & medicines they took, etc. Descriptive statistics, chi-square test, and logistic regression analysis were used for analysis.

Result: More than 80% of the patients were male, aged <30 years and resided in urban and semi-urban areas; >60% of the patients got bitten by dengue vector at working place or while traveling, >50% of the patients reported that they did not have proper sewage and garbage management at place. Patients living in urban areas were more likely to get infected with dengue than in other areas. Older patients (≥30 years) were more likely to stay longer duration in hospital than younger ones. Moreover, men had higher chances of getting bitten at working place than women and children who were mostly bitten at household and surrounding environment [OR = 14.7; P = 0.01].

Conclusion: Environmental, lifestyle, and socio-demographic factors had effects on dengue patients and their sufferings at the hospital. A safe working environment, proper sewage, and garbage management system, and organized urban development plan can help to reduce larvae development sites to a great extent.

Keywords: Dengue, Dengue Epidemic, Environmental & Lifestyle factors, Noakhali District

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Introduction

Dengue fever, a mosquito-borne tropical disease caused by the dengue virus is a well-known phenomenon in recent era due to its severity across societies. In tropical and sub-tropical areas it is mainly occurred, especially Africa, Latin America, South East Asia and Oceania.[1] Being considered a global health problem, every year it occurs in the world in the rainy season mainly when the environment is conducive for dengue breeding.[2] Aedes type of mosquito transmits the dengue fever that was proved in 1906 and it was the second viral disease after yellow fever that was discovered in 1907.[3] Aedes aegypti and A. albopictus are the two main vectors that are responsible for dengue fever[4]; however, four distinct serotypes of closely related vectors (DEN-1, DEN-2, DEN-3, and DEN-4) are available which causes dengue hemorrhagic fever.[5] Aedes aegypti is an urban vector, it is found mostly in urban area & A. albopictus is found in rural and semi urban and forested area.[6] Dengue virus is a type of RNA virus. Dengue fever has become a most horrible and emerging disease in South East Asian countries recently. Uncontrolled urbanization, lack of proper water and container management system are highly responsible for dengue virus development along with other factors.[7]

As dengue is mosquito-borne, its transmission pattern is strongly influenced by climate. Mostly occurs in cities, dengue virus is rapidly spreading largely due to urbanization, climate change and increased human movements found out by one study. However, dengue cases are not always distributed evenly throughout cities, where climate can be assumed to be homogenous. This suggests that other factors which are heterogeneously distributed in cities could play a role in dengue transmission, such as socioeconomic status and environmental factors.[8] Various studies revealed that dengue has positive association with poor socio-economic status, low income, poor education, lack of concern and knowledge about dengue, unemployment status, household crowding, poor housing which includes inadequate sewage and garbage disposal, type of housing etc.[9,10] But there are some studies which contradicts these finding stressed in one systematic review and these difference could be due to heterogeneity in measurements of socioeconomic indicators.[11]

However when it occurs, early treatment is important for reducing morbidity and mortality.[12] Every year about 500,000 people get infected by dengue hemorrhagic fever and about 12,000 people die each year.[13] Another report of WHO, estimated that 50-100 million people infected annually and 30 fold developed in last 50 years and among them about 20,000 deaths occur annually by dengue infection.[14] Over 3.9 billion people from 128 countries live under the threat of dengue and 390 million infections occur every year, with 96 million people experiencing clinical manifestations of dengue.[15] Plastic containers, tires, refrigerator trays, vehicle parts, discarded construction materials were significant predictors of dengue vector development.[16]

Bangladesh, a developing country with continuous economic development accompanied by rapid urbanization have experienced serious consequences of dengue fever in the last couple of years. According to a report of Directorate General of Health Services of Ministry of Health & Family Welfare, Dhaka, Bangladesh, 16,223 people were infected with dengue in July, 2019 and 9,006 more till 6th August, 2019 and 18 of them died.[17] Being an one of the populous countries in the world there are various changes happening; climate change one of the issues with unusual and heavy rainfall during summer and the unusual rise of temperature has positive relation with the dengue transmission and increased dengue risk.[18]

One study conducted by Mutsuddy P et al. in Bangladesh revealed that most of the dengue cases occurred during monsoon season (May-August) and post monsoon season (September -December); interestingly the study concludes that in the year 2015-17 the dengue cases were reported to be more than seven times higher in pre-monsoon season than the previous 14 years which sums up the danger season as pre to post monsoon for dengue risks in Bangladesh. They also claimed that climate changes, such as average rainfall, humidity, and temperature, after 2014, and rapid unplanned urbanization were the strong predictors which has led to increase in dengue cases.[19] Various environmental, climatic and household factors aggravates dengue epidemics[20]; Containers, plastic bottles, cans and present of organic matters has positive association of dengue fever occurrences.[21] Another study also concludes that environmental, social, economic and biological factors have positive association with dengue diseases.[22] Climate, especially, temperature increases the mosquito bite, development rates and control the reproductive capacity of the virus within the mosquito21 and it also affects human behavior and life style which also accelerate the dengue transmission dynamics in favor of cases development.[23]

Long time hospital stay has possibility to increasing dengue mortality and morbidity rate, dengue management system and inadequate public health infrastructure has positive association of dengue rate increasing.[24] Various chemical, biological controlling method, and spraying have shown better result for preventing dengue larva development and decreasing breeding capacity of dengue; environmental control method also destroy the dengue growth media.[25] However, it requires more in-depth analysis from different area specific and context specific observation and this study attempts to answer effects of all these factors by studying dengue patients who got admitted in Noakhali district, Bangladesh.

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Survey Design & Methodology

The study adopted a mixed method analysis of information collected from hospital records of dengue patients who were reported as dengue patients by Noakhali General Hospital and telephone survey of the same patients to collect socio-demographic, environmental and various lifestyle data. The study considered all the 73 patients records that were available at hospital archives; however only 52 of the patients found available for telephone survey who enthusiastically participated in this study. The patients who were admitted to Noakhali General Hospitals were considered as patients and included in the study; however, patients who admitted to different private/public hospitals were not considered and hence not included in this study. The study material was a standard questionnaire and analysis of hospital records of patients. It included questions on general information of respondent's patients such as age, sex, hospital admission and release date, education, occupation, religion. It also included physical condition of patients, clinical conditions, comorbidities related conditions, environmental conditions, personal and living conditions. The survey had been carried out between January-March 2020. Telephone surveys were conducted in the day time from 10 a.m. to 5 p.m. on working days and from 10 a.m. to 12 p.m. on Friday, as working men and women are likely to be at home at this time. Data was analyzed using SPSS version 23, MS Excel after editing, coding and recoding. Descriptive statistics along with chis-square test and bivariate logistic regression were among the important analysis that have been performed; P-value <0.1 were considered as statistically significance with 90% CI.

Variables Measurement

Categorization of some of the important variables were as follows: age of the patients (<18, >18-29), area of residence (urban, semi-urban and rural), occupation (student/children, professional, labor/farmer, and housewife). In the bivariate logistic regression the categorization follows: where did you get bitten (home/surrounding environment vs. working place/travelling), how long you were admitted to hospitals (<7 days vs. more than 7 days), how long you've waited to visit hospital (within 2 days vs. more than 2 days), did you know sign and symptoms of dengue (yes vs. no).

Result

Socio-demographic Characteristics of the Study Patients

Table 1, represents information about basic socio-demographic characteristics of the study patients. There were 45 male and 07 female patient. Most of the patients were Muslim and most of the patients were in moderate income group 36 (69.2%) and rest of the patients can be considered as poor. From the frequency table of occupation, we came to know that most of the participant were employee or doing business. Only 14.3% of the patients were aged more than 30 years and only 28.8% of them had higher education and most of them were in normal physical state.

Table 1.Basic socio-demographic characteristics

Variables	n= 52		Variables	n= 52	
Sex of the patients	**n**	**%**	**Religion of the patient**	**n**	**%**
Male	45	86.5	Muslim	49	94.2
Female	7	13.5	Hindu	3	5.8
Patient age	**Male**	**Female**	**Occupation of the patients**		
<18 years	15	3	33.3	42.9	Student/ Children	16	30.8
18-29 years	24	3	53.3	42.9	Professional (Employee/ Business)	21	40.8
≥30 years	6	1	13.3	14.3	Labor/ farmer	12	23.1
					Housewife	3	5.8
Education status of the patients					
Illiterate	6	11.5	**Physical condition of the patients**		
Primary	13	25.0	Normal	44	84.6
Secondary	18	34.6	Overweight	4	7.7
Higher Secondary	15	28.8	Underweight	4	7.7
Monthly income the of the family					
<10000	16	30.8			
≥10000	36	69.2			

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Environmental & Living Conditions of the Study Population

Table 2, describes various environmental and living conditions of the study population. Around half of the patients were living in urban areas (48.1%) and more than 55% of the patients did not have any sewage and garbage management system at place where they got bitten by mosquitos. Moreover, 61.5% of the patients reported that there were ponds, canals or rivers around the place where the incident happened. More than 44% of the patients bitten at their working place, 25% of them from their surrounding environment and the rest were got bitten while travelling or while staying at home.

Clinical and Hospital-based Information

Table 3, describes information about the clinical and hospital related information. The figure says around 42% of patients did not know about the sign and symptoms of the dengue and only 55.8% used mosquito nets/coil/aerosol in living place. Hospital admission record says most of the patients got admission in hospital within 2-3 days after they have experienced symptoms. 51.9% of the patients stayed 4-7 days in hospital and all of them had experienced fever and the next symptoms they had was headache; more than 70% of the patients were relied on traditional hospital medicine.

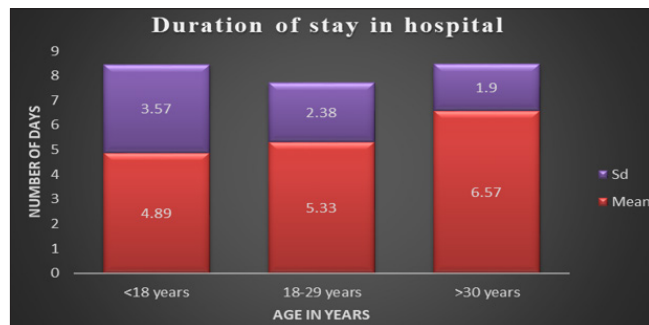Figure 1, depicts hospital admission duration of patients in

Table 2.Environmental & living conditions of the study population

Study variables	n = 52		Study variables	n=52	
Location of the residence	**n**	**%**	**Are there any bushes around?**		
Urban	25	48.1	Yes	7	13.5
Suburb	18	34.6	No	45	86.5
Rural	9	17.3			
Sewage and garbage management system bitten place			**Is there have any ponds, River, Canal beside the area?**		
Yes	23	44.2	Yes	32	61.5
No	29	55.8	No	20	38.5
Is there any construction site around?			**Where did patient get bitten**		
Yes	24	46.2	Working place	23	44.2
No	28	53.8	While Travelling	10	19.2
			At home	6	11.5
			Surrounding Environment	13	25.0

Table 3.Clinical and hospital related information

Study variables	n = 52		Study variables	n=52	
Knowing the sign and symptoms of dengue	**n**	**%**	**Symptoms of the patient**	**n**	**%**
Yes	30	57.7	Fever	52	100.0
No	22	42.3	Severe headache	34	65.4
Using of mosquito net/ coil/ aerosol in living place			**Muscle and joint pains**	18	34.6
Yes	23	44.2	Rash	8	15.4
No	29	55.8	Abdominal pain	7	13.5
How long patient waited to visit hospital			Vomiting/ Nausea	23	44.2
Within 1-2 days	22	42.3	**Type of medicine taken during dengue disease**		
Within 2-3 days	23	44.2	Traditional Medicine	38	73.1
After 5 or more days	7	13.5	Home remedies	14	26.9
How long patient were admitted in hospital					
3 or less days in hospital	14	26.9			
4-7 days in hospital	27	51.9			
More than a week in hospital	11	21.2			

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relation with their ages and the result reveals that patients who aged more than 30 years had to stay longer (6.57 ± 1.9 days) than their younger counterparts (4.89 ± 3.57 days).

(Result derived from ANOVA test; Levene's statistic: 2.6; p-value: 0.079)

Figure 1.Admission duration in hospital in relation with age

Description of Prevalence of Socio-demographic, Environmental and Life Style Factors

From the Table 4, it can be said that there is significant relationship between educational level and the knowledge about sign and symptoms of dengue. It shows that higher educated patients had more knowledge about sign and

symptoms of dengue than lower educated. 93.3% of the HSC/ higher educated patients had knowledge about dengue sign and symptoms whereas the figure was mere 16.7% for patients who didn't have traditional education. Moreover, aged patients stayed long period of time in the hospital than the young patients. 42.9% of the patients above 30 years had stayed more than 7 days in hospital compared to 22.2% of patients of less than 18 years who stayed more than 7 days in the hospital.

From this study it was observed that there was co-relationship between location of the residence and community hygiene maintenance. 72.0% of urban patient did not maintain community hygiene; the figures were much lower for the suburb and rural patients. This study found no significant relationship between sex of the patient and duration of stay in the hospital. There is no significant relationship between knowledge of the sign and symptoms of dengue and longevity of waiting to hospital visit. There was significant relationship between sex of the patient and the visibility of the symptoms of dengue. More number of women had experienced muscle and joint pains, rash than males and almost half of the patients had skin problems as comorbidities, 11 patients had respiratory problems and only few of them had other non-communicable diseases.

Table 4.Prevalence of socio-demographic, environmental and life-style factors

Variables							
Education of the patient	Knowledge about the sign and symptoms of dengue		P-value	Education of the patient	Do you use mosquito net in day time		P-value
	Know	Don't know			Yes	No	
Illiterate/ Children	1 (16.7)	5 (83.3)	0.00	Illiterate/ Children	3 (23.1)	10 (76.9)	0.023
Primary	3 (23.1)	10 (76.9)		Primary	0 (0.0)	6 (100)	
Secondary	12 (66.7)	6 (33.3)		Secondary	0 (0.0)	18 (100)	
HSC/ Higher Education	14 (93.3)	1 (6.7)	0.00	HSC/ Higher Education	0 (0.0)	15 (100)	0.023
Age of the patient	How long you were admitted in a hospital			Location of the residence	Is community hygiene is maintained?		
	≤3 days	4-7 days	>7 days		Yes	No	
<18 years	8 (44.4)	6 (33.3)	4 (22.2)	Urban	7 (28.0)	18 (72.0)	0.066
18-29 years	6 (22.2)	17 (63.0)	4 (14.8)	Suburb	10 (55.5)	8 (45.5)	
≥30 years	0 (0.0)	4 (57.1)	3 (42.9)	Rural	6 (66.6)	3 (33.4)	
Sex of the patient	How long you were admitted in a hospital			Knowledge on sign and symptoms of dengue	How long you waited to visit hospital		
	≤ 3 days	4-7 days	>7 days	0.585		1-2 days	2-3 days	≥ 5 days	0.225

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Male	11 (24.4)	24 (53.3)	10 (22.2)		Know	13 (43.3)	15 (50)	2 (6.7)	
Female	3 (42.9)	3 (42.9)	1 (14.3)		Don't know	9 (40.9)	8 (36.4)	5 (22.7)	

Sex of the patient	Symptoms of dengue						
	Fever	**Severe Headache**	**Muscle and Joint pains**	**Rash**	**Abdominal Pain**	**Vomiting /Nausea**	
Male	45(100)	29 (64.4)	14 (31.1)	6 (13.3)	6 (13.3)	19 (42.2)	0.000
Female	7 (100)	5 (71.4)	4 (57.1)	2(28.6)	1(14.3)	4 (57.1)	
Co morbidities response	Ischemic heart disease	Obesity	Hematocrit	Respiratory problems	Diabetes	Infection (skin allergy)	Chronic bronchial asthma
Yes	4	2	1	11	2	20	1
Percentage	9.8%	4.9%	2.4%	26.8%	4.9%	48.8%	2.4%

(P-value derived from chi-square test; p<0.1 considered as statistical significant).

Factors Associated with the Dengue Epidemic

Table 5, describes the effect of different factors on different outcomes of dengue epidemic. According to the bivariate analysis, the female patients had 14.7 times higher risk of getting bitten by mosquito at home and surrounding environment than male who were working or on travel. Moreover, female patients waited more days to visit hospitals than their male counterparts and were two times less likely to know the sign and symptoms of dengue compared to male patients.

The study also showed that employees/business man are 0.104 times less likely to get bitten compared to students who stays at home and surrounding environment that means they got bitten in working place or travelling most often; students/children group also showed less knowledgeable than other groups since most of them were under aged children.

Table 5.Factors associated with different outcomes related to dengue disease

Variables	Where did you get bitten (home/environment vs. working place/travelling)	How long you were admitted (<7 days vs. more than 7 days)	How long you waited to visit hospital (within 2 days vs. more than 2 days)	Know sign and symptoms of dengue (yes vs. no)
	OR	OR	OR	OR
Sex of the patient				
Male	1	1	1	1
Female	14.7*	.886	5.25	2.0
Occupation of the patient				
Student/ Children	1	1	1	1
Employee/ Business	0.104*	1.5	1.03	2.0
Labor/ farmer	0.000	2.14	1.08	1.57
Housewife	0.667	0.000	1.55	4.40
Age of the patient				
<18 year	1	1	1	1
18-29 year	0.350	0.910	0.926	0.318*
≥30 year	0.750	3.46	0.477	0.255

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Education of the patient				
Illiterate/ Children	1	1	1	1
Primary	0.222	0.889	1.12	.667
Secondary	0.100*	0.769	0.786	0.10*
HSC/ Higher education	0.571	1.0	0.333	0.014*
Location of the residence				
Urban	1	1	1	1
Suburb	2.53	3.16*	0.450	2.05
Rural	3.95*	0.396	1.12	9.0*

*p-value at <0.1 level (results derived from bivariate logistic regression); OR: Odds Ratio.

Patient whose age is 18-29 years were 0.350 times less likely to get bitten by mosquito at home and surrounding environment. Mainly they are bitten in outside of home such as working place, travelling etc. Higher educated persons are mostly get bitten outside of home and also knew about sign and symptoms of dengue compared to other groups. Moreover, rural patients had more chances to get bitten at home and surrounding environment than urban patients who mostly got bitten at working place or while travelling. Housewives were likely to wait more days to visit hospitals than other groups though the result is insignificant across all groups. And rural patients had 9.0 times less chance to know about the sign and symptoms than the urban patients.

Discussion

This particular study attempted to find the influence of socio-demographic, environmental and life style factors on the dengue epidemic in Noakhali district, Bangladesh and as far as socio-demographic and environmental factors concern, most of the patients were from urban and semi-urban setting and their level of knowledge about sign and symptoms for dengue disease varied due to education level where patients with higher education knew the sign and symptoms of dengue epidemics more than their less educated counterparts; similar result was found in some studies conducted in Azad Kashmir,[26] Vietnam[27] and Western Jamaica.[28] Moreover, many patient's income status corresponds to medium to poor status by their income level and this finding is consistent with one study conducted in New Caledonia in urban setting which concluded that poor socioeconomic status of the population had a very robust correlation with dengue incidence. The possible explanation the study provided was poor socio-economy and unemployment influences lifestyle behaviors which may increase the risk of mosquito contact.[8]

A research conducted in Pakistan[7] found that most of the patients affected with dengue had fever 97.5%, pain 40%, vomiting 50%, skin rash 20% which has similarity with our study findings where all patients experienced fever, along with pain 34.6%, and vomiting 44.2% and skin rash 8%. On the other hand, weather condition e.g. rainfall and humidity provide a vital impact on dengue epidemics and one study that conducted in Dhaka city[29] showed that dengue mosquito Aedes aegypti is highly grown in rainy season which has indirect similarity with our study because most of the patients reported that they were affected by dengue during rainy season (June to October).[30]

Many patients also reported that there were ponds, canals or rivers around where they got bitten and more than 55% patients said there were no sewage and garbage management system at place which shows a poor environmental condition around and the study findings also showed similarity with one study which concludes the effect of unhealthy enviromental condition, poor housing, increased human mibility, unplanned urbanizations on increased dengue vector transmission.[16] Life style factors which include use of mosquito net, coil or aerosol in the day and night revealed that more than half of the respondents (55.8%) did not use moquito net, coil, aerosol in their living place and one study conducted in Karnataka[31] provide signifigant result about the correlation between using mosquito net, coil, aerosol with reducing dengue epidemics. Moreover, as Aedes aegypti is a day biting mosquito that means the mosquito is most active during daylight, for approximately two hours after sunrise and several hours before sunset, but in our study all of the respondents (100%) including literate and illiterate people did not use mosquito net or other measures in day time. Results of this study also concludes that older patients (≥30 years) stayed more in hospital than the young ones which increases the likelihood of having more complicated cases and risk of mortality.[24] Furthermore, females expeeinced joint pains, rashes more often than males which might be another area needs to study further. Morever, labor and farmers had more chance to get bitten than other profession group which again shows the effect of poor socioeconomy.[8] One study in Brazil also indicated that for older patients the relative risk of dengue increases significantly as the level

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of socio-environmental deprivation increases.[9] Hence, comparsion with the findings of related study confirms the assoication of different environmental, sociodemographic and lifestyle factors on the dengue outbreak that happened in Noakhli district, Banladesh which is a rapdily growing city in Chittagong Divison, Bangladesh.

Limitation

This was a telephonic survey, hence had various limitation regarding data accuracy and reliability. Some male and female patient afraid to give information to the unknown person. Our project was held on February but dengue outbreak was severed in July to September; because of time gap patient didn't remember correctly some of our study information. The study did not consider many other factors. Moreover, the hospital recording of patient's information weren't digitalized and some of the files were really torn and difficult to read or to draw information out.

Conclusion

Dengue fever is a dangerous and depilating disease and a serious public health concern in Bangladesh causing a mass hysteria, panic and disruption of lives in recent years. This study tried to find out whether the recent outbreak has any relation with the titled factors and the study did find some association with these important factors. These findings could be valuable which might help Bangladesh to take proper steps, intervention and aware the mass population.The biggest issue is that dengue fever is spreading fast all over the world but currently has no specific treatment or vaccine for it and a developing country like Bangladesh always struggles to keep up when the cases are rising. In recent years it has become one of the leading causes of hospitalization and death among children and vulnerable people and become a massive threat to health system to bear. Environmental cleaning, sanitation, maintaining cleanliness around living and working place, planned infrastructure development, proper garbage and disposal system, concern about dengue disease, using various preventive measures, improving socioeconomic status might provide strong positive benefits in terms of controlling dengue vector development, reducing dengue cases or to minimize sufferings if cases occurs.

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Funding Declaration

Competing Interests

The authors declare that they have no competing interests.

Ethical Approval

This study was carried out by undertaking proper permission from ethical committee of NSTU and strictly maintained all the ethical guidelines. Approval for the study was also obtained from the Civil Surgeon Office Noakhali, Noakhali Sadar Upazila Health Complex, RMO and Superintendent of the hospital.

The study was conducted in accordance with the Helsinki Declaration where require; all the participants were well aware of the study pros and cons and upon their consent this observational study was conducted. All the study subjects participated enthusiastically and cooperated during the whole study.

Conflict of Interest: None

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