



Original Research

Knowledge and beliefs of the city dwellers regarding dengue transmission and their relationship with prevention practices in Dhaka city, Bangladesh



Kabirul Bashar^{a,*}, Shohel Mahmud^b, Asaduzzaman^a, Eilma Akhond Tusty^c, Afroza Bintey Zaman^d

^a Laboratory of Entomology, Department of Zoology, Jahangirnagar University, Savar, Dhaka, 1342, Bangladesh

^b Department of Statistics, Jahangirnagar University, Savar, Dhaka, 1342, Bangladesh

^c Department of Biotechnology and Genetic Engineering, Jahangirnagar University, Savar, Dhaka, 1342, Bangladesh

^d Department of Urban and Regional Planning, Jahangirnagar University, Savar, Dhaka, 1342, Bangladesh

ARTICLE INFO

Keywords:

KAP
Aedes
Mosquito
Dengue
Dhaka
Bangladesh

ABSTRACT

Objectives: The objectives of the study were to explore knowledge, attitudes, and practice (KAP) of dengue fever among Dhaka city dwellers and the potential associated factors.

Study design: A cross-sectional survey was conducted among the city dwellers in Dhaka north and south city corporations using a standardized questionnaire from November to December 2019.

Methods: Households were selected by purposive sampling and interviewed face to face by the trained interviewers. The association between education and occupation with the dengue practice was tested using the chi-square test statistic.

Results: Around 96% of respondents claimed that they heard about Dengue, and 80% of them correctly identified its causes. Nearly half of the people did not know the breeding season and ecology of dengue vector mosquitoes. Though the city dwellers were well-known about Dengue's burden, they were reluctant to take preventive measures to get rid of this disease. More than 70% of people mentioned that every family member regularly sleeps under a bed net. Moreover, we found a significant relationship between the education level ($p < 0.05$), as well as the occupation of the respondents ($p < 0.05$) with the practice to prevent and control Dengue. We did not find any information, education, and communication (IEC) activities in the city during our survey.

Conclusion: Many people didn't know the specific preventive measures to minimize potential exposure to Dengue. This lack of knowledge is likely due to inadequate coverage with IEC activities. So, IEC intervention programs may need to start soon in highly dengue-endemic cities to reduce the burden.

1. Introduction

The global occurrence of Dengue has increased radically in recent decades. Nearly half of the world's population is now at risk. There are an estimated 100–400 million infections each year [1]. This viral disease has hastily spread in all regions of WHO in recent years, including Bangladesh. Although the risk of infection existing in 129 countries [2], 70% of the actual encumbrance is in Asia [3]. Dengue viruses are transmitted by female mosquitoes principally of the species *Aedes (Ae) aegypti* and, to a lesser extent, *Aedes albopictus* [1]. The high density of *Aedes aegypti* causes the outbreaks of these viruses in many endemic areas [4]. Adding to the loss of human lives, each outbreak causes severe

destruction to the economy and the affected communities' welfare, with economic costs reaching over \$10 per person. For these causes, DF has received growing attention as the importance of public health [5].

Bangladesh was supposed to be free from Dengue except for some sporadic incidence since 1965 [6]. Accordingly, the people, the medical profession, city authority, and the disease control program were not aware of Dengue in various aspects like diagnosis, management, prevention, and control. The dengue outbreak in Dhaka city in 2000 improved the notion and other attributes related to Dengue. More than 5500 hospitalized cases of DF and DHF in Dhaka and other major cities of Bangladesh were recorded in June 2000 [6,7]. Since then, a significant number of dengue cases were reported every year [8,9]. More than 100

* Corresponding author.

E-mail addresses: bkabirul@juniv.edu (K. Bashar), mahmud.shohel40@gmail.com (S. Mahmud), asadzamanju@gmail.com (Asaduzzaman), tusty@bgeju.edu.bd (E.A. Tusty), afrozabinteyzaman@gmail.com (A.B. Zaman).

<https://doi.org/10.1016/j.puhip.2020.100051>

Received 21 May 2020; Received in revised form 15 October 2020; Accepted 16 October 2020

Available online 29 October 2020

2666-5352/© 2020 The Author(s). Published by Elsevier Ltd on behalf of The Royal Society for Public Health. This is an open access article under the CC BY-NC-ND

license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Table 1
Key demographic and urban features of Dhaka City corporation areas.

City	Number of Zones	Number of Wards	Area (Sq. km)	Number of Holdings	Population (Million)
Dhaka North	10	54	196.22	172,254	3.95
Dhaka South	10	75	109.25	165,000	3.88
Total	20	129	305.47	337,254	7.83

Data source: DNCC and DSCC office.

thousand dengue cases and 179 confirmed deaths in 2019 were noted (Fig. 2) by Health Emergency Operation Center and Control Room, DGHS, in Bangladesh [10]. As national surveillance is passive and based on only 41 hospitals in Dhaka and all hospitals in other districts, it is assumed that occurrences are under ascertained.

The awareness level of the inhabitants is fundamental to develop a strategy for future public health policies [11] because, without proper knowledge and attitude, scarce resources for rural and regional health may easily be depended on information campaigns that can contribute a little to alter the public's current understanding of preventive measures [11].

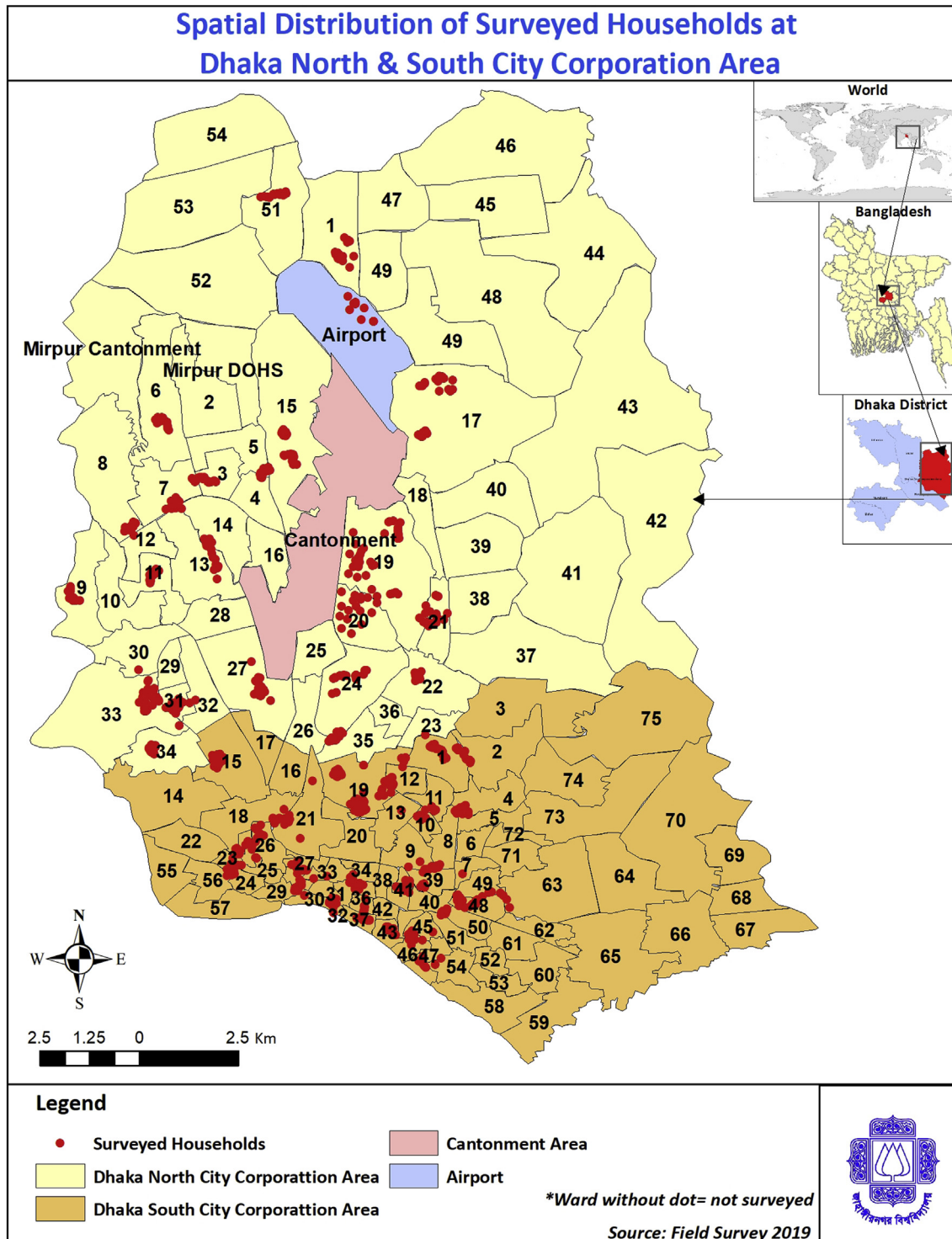


Fig. 1. Spatial distribution of the surveyed households in Dhaka north and south city corporation areas.

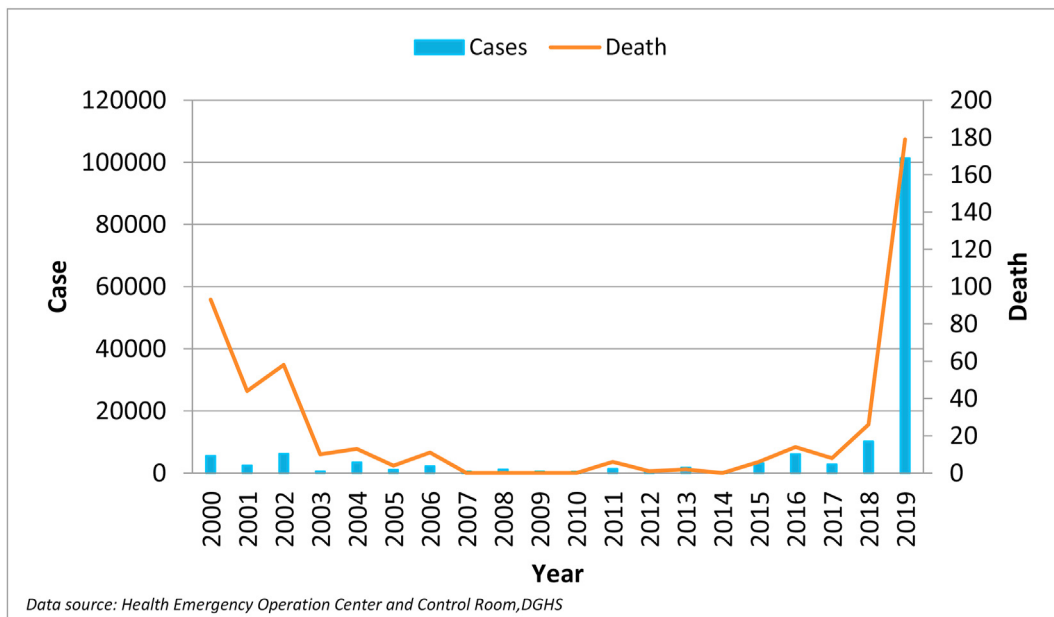


Fig. 2. Yearly hospitalize patient and confirm death due to dengue in Bangladesh in 2000–2019.

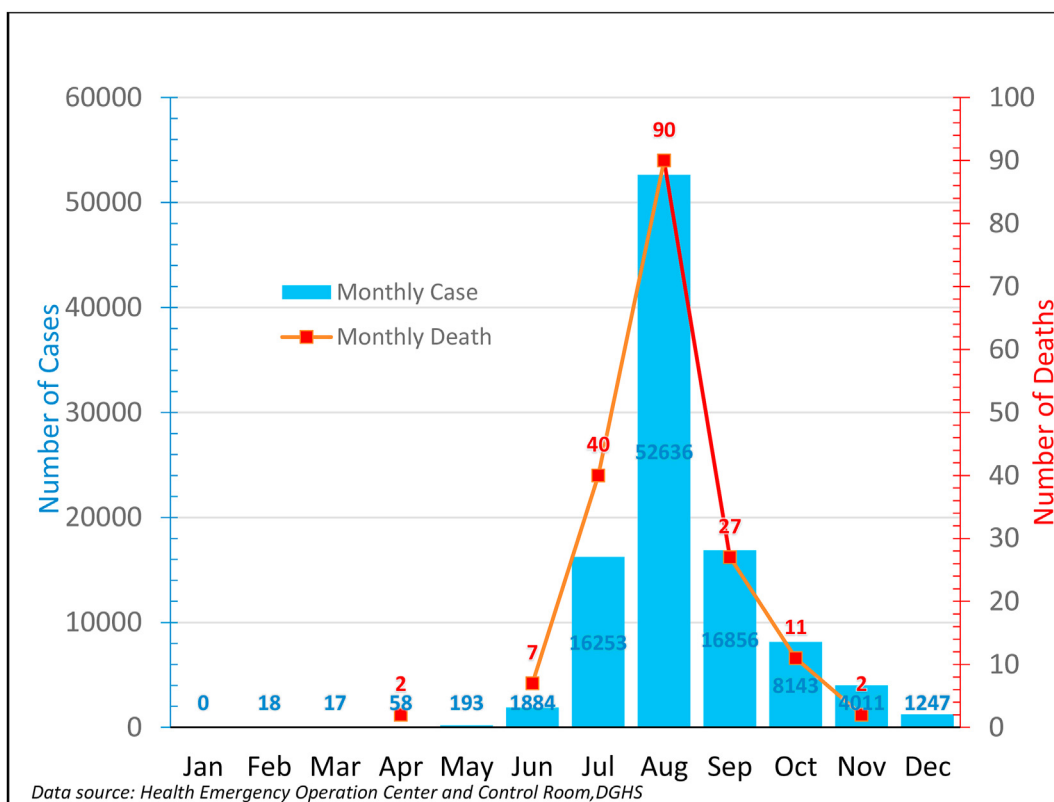


Fig. 3. Monthly hospitalize patient and confirm death in 2019 due to dengue in Bangladesh.

Moreover, community knowledge and preventive behaviors regarding the cause, transmission, prevention, treatment of dengue fever are important socio-cultural factors that have influenced the adoption of dengue fever preventive measures [12]. Moreover, vector mosquitoes' biology and ecology and Dengue fever's epidemiology are strongly associated with human habits [12,13]. Thus, assessments of people's knowledge, attitudes, and practices might be of great importance to improve integrated mosquito management strategies [14]. This study holds practical value to the country's policymakers for implementing public health information drive

to assist in reducing and ultimately preventing *Aedes* transmitted diseases like Dengue, Chikungunya, Zika, etc.

2. Methods

2.1. Study area and population

Dhaka, the capital of Bangladesh, located in South Asia, is the world's ninth-largest [15], and the sixth-most densely populated city in the world

Table 2
Demographic characteristics of the respondent in Dhaka city.

Characteristics	DNCC		DSCC		P-value
	Number	%	Number	%	
a. Gender					
Male	287	63.8	236	52.8	0.001
Female	163	36.2	211	47.2	
b. Education					
No education	91	20.2	62	13.9	0.041
Primary	120	26.7	143	32.0	
Secondary	157	34.9	168	37.6	
Tertiary	82	18.2	74	16.6	
c. Occupation					
Government employed	18	4.0	40	8.9	0.000
Private employed	91	20.2	49	11.0	
Business	56	12.4	50	11.2	
Daily Wage Earner	43	9.6	21	4.7	
Student	39	8.7	63	14.1	
Housewife	115	25.6	139	31.1	
Caretaker	87	19.3	81	18.1	
Others	1	0.2	4	0.9	
d. Age					
<18	19	4.2	28	6.3	ns
18–27	85	18.9	91	20.4	
28–37	141	31.3	119	26.6	
38–47	82	18.2	80	17.9	
48–57	74	16.4	67	15.0	
>57	49	10.9	62	13.9	
e. Family type					
Nuclear	340	75.6	297	66.4	0.007
Joint	101	22.4	132	29.5	
Extended	9	2.0	18	4.0	
f. Types of house					
Independent	91	20.2	98	21.9	0.000
Multistoried	159	35.3	220	49.2	
Semi-pucca	95	21.1	75	16.8	
Slum	28	6.2	17	3.8	
Others	77	17.1	37	8.3	
g. Marital Status					
Unmarried	91	20.2	81	18.1	ns
Ever married	359	79.8	366	81.9	

[16,17], with a population of 21,006,000 people in the Greater Dhaka Area [18,19]. Geographically, the central area of Dhaka city (belonging to Dhaka North and South City Corporations) lies between 23.69° and 23.89° North latitudes and 90.33° and 90.44° East longitudes [20] (Table 1). The area has a tropical monsoon climate characterized by wide seasonal variations in rainfall, high temperatures, and high relative humidity [21]. Three seasons are generally recognized: a hot, muggy summer from March to June; a hot, humid, and rainy monsoon season from June to November; and a warm-hot, dry winter from December to February [21]. The north (DNCC) and south (DSCC) City Corporation has ten zones with 54 and 75 wards, respectively (Table 1). The present study was conducted in five zones, with 36 wards from DNCC and 57 from DSCC.

2.2. Study design and survey procedure

A cross-sectional survey was conducted among the people resided in Dhaka, Bangladesh's capital, from November to December 2019. Households were selected by purposive sampling methods. Eighteen houses from each ward were taken for the survey, and the house interval was 100. Research assistants/assessors were entered in the middle of the ward and selected the first house using the sweepstake method. Adult (>18 years old) members of the houses were chosen for the interview, which was available in the house at that time. The assessors noted the respondent's address and the type of structure of the house then selected the person to be interviewed. A standardized, self-administered, pre-tested questionnaire based on the knowledge, attitudes, and practices survey was developed. The questionnaires also inquired about the background and socio-demographic data. The questionnaires were

Table 3
Knowledge of the Dhaka city dwellers regarding dengue and its transmission.

Characteristics	DNCC		P-value	DSCC		P-value
	Number	%		Number	%	
a. Heard about dengue						
Yes	430	95.6	0.000	433	96.9	0.000
No	20	4.4		14	3.1	
b. Family member suffer from dengue						
Yes	51	11.9	0.000	35	8.1	0.000
No	379	88.1		398	91.9	
c. How someone gets dengue						
Mosquito bite	344	80.0	0.000	356	82.2	0.000
Through water	14	3.3		3	0.7	
Through food	10	2.3		4	0.9	
Others	7	1.6		4	0.9	
Don't know	55	12.8		66	15.2	
d. Mosquito causes dengue fever						
<i>Anopheles</i>	9	2.1	0.000	9	2.1	0.000
<i>Culex</i>	12	2.8		5	1.2	
<i>Aedes</i>	155	36.0		169	39.0	
Others	29	6.7		22	5.1	
Don't know	225	52.3		228	52.7	
e. <i>Aedes</i> mosquito breeding season						
Summer	45	10.5	0.000	24	5.5	0.000
Rainy	195	45.3		196	45.3	
Winter	29	6.7		15	3.5	
Don't know	161	37.4		198	45.7	
f. Dengue vector mosquito breeds						
In dirty water	231	51.3	0.000	212	47.4	0.000
Clean and contained water	74	16.4		76	17.0	
In drain	32	7.1		33	7.4	
In pond	15	3.3		3	0.7	
others	10	2.2		29	6.5	
Don't know	68	15.1		80	17.9	
g. Dengue can transmit from one another						
Yes	125	29.1	0.000	101	23.3	0.000
No	113	26.3		129	29.8	
Don't know	192	44.7		203	46.9	
h. Dengue may occur repeatedly						
Yes	171	39.8	0.000	181	41.8	0.000
No	42	9.8		53	12.2	
Don't know	217	50.5		199	46.0	

scored using SPSS 22. Permission and authorization of the work were obtained from the Jahangirnagar University, Bangladesh. Before the interview, each participant was informed about the study's purposes, and verbal consent from the respondent was taken. Verbal permission was also obtained from the respondents' to capture and publish the interview photographs. The face-to-face interviews were conducted by the trained research assistant, who required approximately 30 min for each interview. A single-day workshop program was arranged to trained research assistants for the work. To minimize respondent bias, we conducted the KAP survey simultaneously by different members of the team. Eight hundred and ninety-seven (897) households were selected out of a planned 900 homes as part of the survey sampling framework (Fig. 1).

2.3. Data analysis

When conducting a survey, households were recorded using the GPS essential app of the smartphone. ArcView GIS 3.3 and Arc GIS 10.8 software were used to map the households' distribution where interviews had been conducted. The collected data were coded, reviewed, entered, cleaned, and analyzed into the SPSS software program (IBM SPSS; version 22). Descriptive statistics for the collected data were recorded,

Table 4
Attitude and belief of the Dhaka city dweller regarding dengue.

Characteristics	DNCC		P-value	DSCC		P-value
	Number	%		Number	%	
a. Dengue is a problem in Bangladesh						
Yes	401	89.1	0.000	419	93.7	0.000
No	32	7.1		11	2.5	
Don't know	17	3.8		17	3.8	
b. Enough efforts are taken to control dengue						
Yes	110	24.4	0.000	101	22.6	0.000
No	298	66.2		302	67.6	
Don't know	42	9.3		44	9.8	
c. Govt. initiative in the last 2 months						
Yes	145	32.2	0.000	179	40.0	0.000
No	305	67.8		268	60.0	
d. Responsible to prevent dengue						
Health department	35	7.8	0.000	28	6.3	0.000
City corporation	206	45.8		191	34.4	
City residents	148	32.9		192	43.0	
All	61	13.6		36	8.1	
e. Best way to get rid of						
Using insecticides	33	7.3	0.000	25	5.6	0.000
Keep surroundings clean	271	60.2		281	62.9	
Mosquito net	18	4.0		19	4.3	
Controlling mosquito	39	8.7		31	6.9	
Treating the patients	6	1.3		3	0.7	
Others	18	4.0		29	6.5	
Don't know	65	14.4		59	13.2	
No	21	4.7		20	4.5	
Don't know	347	77.1		316	70.7	

and associations were assessed using the chi-square test. Results were documented as frequencies, chi-square, and p-values. For all purposes, the p-value of less than 0.05 was considered as the level of significance.

3. Results

3.1. Dengue cases and deaths in 2019

Dengue outbreaks in Bangladesh exceeded all previous records in 2019, mostly in the capital city of Dhaka. A total of 101,354 dengue hospitalize cases with 179 dengue-related confirm deaths had been officially recorded (Figs. 2–3). The seasonal prevalence of dengue cases and death reveal monthly fluctuations. Dengue cases were found almost throughout the year, with significant peaks in August in 2019. The highest number of dengue cases and high density of *Aedes* mosquitoes were found during monsoon season (July–September) in Bangladesh, and the instances decreased gradually in October (Fig. 3).

3.2. Demographic characteristics of the respondents

A total of 897 participants in Dhaka north (450) and south city (447) perfectly finished the full interview about their knowledge attitude and practice on Dengue and its transmission. The majority of the north city corporation (DNCC) respondents were male (63.8%, 287). The male and female respondents' ratio was slightly closer in the south city corporation (DSCC) than in the north. About 34.9% (157) respondents completed their education up to the secondary level in DNCC, while it was slightly higher in south city corporations (37.6%, 168). A similar pattern was found in both cities for the tertiary level (Bachelor degree) of education. The housewives were the foremost respondents in the north (25.6%) and the south (31.1%) city. The maximum percentage of the respondents in both cities was between the ages of 28–37 years. All most all of the respondents resided in a nuclear family, and most of them were married. The city dwellers living in various types of the house but multi-storeyed buildings were dominant in both DNCC (35.3%) and DSCC (49.2) (Table 2).

Table 5
The practice of the city dwellers regarding dengue and its prevention.

Characteristics	DNCC		P-value	DSCC		P-value
	Number	%		Number	%	
a. Taking measure to prevent Dengue						
Yes	210	46.7	ns	202	45.2	0.042
No	240	53.3		245	54.8	
b. Treatment when you get a high fever						
Immediate treatment	285	63.3	0.000	260	58.2	0.000
(allopath)						
Self-method	135	30.0		138	30.9	
Tradition healer	11	2.4		11	2.5	
Others	19	4.2		38	8.5	
c. Place of receiving treatments						
Govt. hospital	165	36.7	0.000	156	34.9	0.000
Private hospital	122	27.1		135	30.2	
Private clinic	85	18.9		73	16.3	
Clinic	32	7.1		30	6.7	
Others	46	10.2		53	11.9	
d. Use anything to get protection from mosquito						
Yes	425	94.4	0.000	409	91.5	0.000
No	25	5.6		38	8.5	
e. Spend in a month for mosquito insecticides						
≤50	83	18.4	0.000	89	19.9	0.000
Less than 100	49	10.9		58	13.0	
Less than 200	188	41.8		168	37.6	
≥200	130	28.9		132	29.5	
f. Family members sleep under the bed net						
All	341	75.8	0.000	322	72.0	0.000
Only Children	20	4.4		14	3.1	
Some	31	6.9		32	7.2	
None	58	12.9		79	17.7	
g. Any controlling measure for mosquito breeding in the last 6 months						
Yes	151	33.6	0.000	124	27.7	0.000
No	299	66.4		323	72.3	
h. People use to get rid of mosquito						
Aerosol	130	17.6	0.000	143	23.1	0.000
Coil	261	35.4		231	37.4	
Cream	20	2.7		6	1.0	
Bed net	290	39.3		216	35.0	
Others	37	5.0		22	3.6	
i. Enough efforts are taken to control dengue						
Yes	110	24.4	0.000	101	22.6	0.000
No	298	66.2		302	67.6	
Don't know	42	9.3		44	9.8	

3.3. Knowledge regarding Dengue and its transmission

Around 96% of respondents claimed that they heard about Dengue. Therefore, they were asked for further questions regarding dengue vectors and its transmission and prevention. Nearly 12% of participants in DNCC claimed that at least one of their family members suffered from Dengue within the last one year. On the other hand, this quantity was comparatively lower in the DSCC (8.1%). There was a significant difference in respondents' views regarding the knowledge about Dengue from different city corporations ($p < 0.05$). More than 80% of people correctly identified the causes of Dengue in Dhaka. Besides, around 37% of respondents correctly specified the genus name of dengue vector mosquitoes. However, nearly 55% of the respondents did not have adequate awareness regarding the breeding season and dengue vector mosquitoes' ecology. Likewise, very few (16.7%) of the respondents correctly mentioned *Aedes* mosquitoes' breeding sites (Table 3). Lacks of knowledge on dengue transmission from one person to another were also observed among the Dhaka dwellers.

City dwellers do not have a clear idea of whether Dengue may occur repeatedly or not. We found a significant difference (0.05) in the respondents' opinions regarding breeding seasons of *Aedes* mosquitoes and the dengue transmission process. Around 50% of the respondents said that the dengue vector mosquito breeds in dirty water (Table 3).

Table 6

Association of education of the respondents with the practice to prevent dengue and its transmission.

Practice	Educational qualification								P-value
	No education		Primary		Secondary		Tertiary		
	Number	%	Number	%	Number	%	Number	%	
a. Taking measure to prevent dengue									
Yes	48	31.4	97	36.9	163	50.2	104	66.7	0.000
No	105	68.6	166	63.1	162	49.8	52	33.3	
b. Measurement taking in case of high fever									
Immediate treatment	82	53.6	155	58.9	207	63.7	101	64.7	Ns
Self-method	56	36.6	84	31.9	90	27.7	43	27.6	
Traditional method	4	2.6	9	3.4	6	1.8	3	1.9	
Others	11	7.2	15	5.7	22	6.8	9	5.8	
c. Place of taking treatment									
Govt. hospital	64	41.8	103	39.2	102	31.4	52	33.3	0.000
Private hospital	34	22.2	61	23.2	110	33.8	52	33.3	
Private clinic	15	9.8	50	19	62	19.1	31	19.9	
Clinic	5	3.3	18	6.8	26	8	13	8.3	
Others	35	22.9	31	11.8	25	7.7	8	5.1	
d. Use anything to protect from mosquito									
Yes	134	87.6	244	92.8	305	93.8	151	96.8	0.013
No	19	12.4	19	7.2	20	6.2	5	3.2	

3.4. Attitude and practice of the city people regarding dengue prevention and control

Though the city dwellers were well-known about Dengue's burden, they were reluctant to take preventive measures to get a ride from this disease. City residents have mixed opinions regarding their responsibilities to control mosquitoes in and around their house. Nearly seventy percent of the city people said they did not find any city authority to take action regarding mosquito control for the last six months. Even 67.8% (305) in the north and 60% (268) in south city people claimed that the government didn't take any initiative in the last two months to control mosquito breeding. Nearly 40% of people firmly believe that mosquito control is the sole responsibility of City Corporation. Around 61% of respondents knew that keeping surroundings clean is the best way to prevent *Aedes* breeding but do not take enough steps to do it (Table 4). Less than fifty percent of the participants (DNCC, 46.7%; DSCC, 45.2%) reported that they had taken measures to prevent themselves from Dengue. More than 90% of people were using one or more protective measures to get rid of mosquito. The most common step taken by the city dwellers were using of bed net (>37%) and mosquito coil (>36%). Many people were taking multiple precautionary measures to control and prevent mosquitoes. More than 72% of respondents were stated that every member of their family sleeps under a bed net regularly. About 50% of people spend an average of 100–200 Bangladeshi taka (USD 1.2–2.4) in a month to prevent them from mosquito bites. However, nearly 60% of city dwellers taken immediate treatments when they get high fever. A government hospital was a preferable place for getting treatment for both North and South city people. A significant difference ($p < 0.05$) of the opinions of the respondents regarding preventive behavior was found in both cities (Table 5).

3.5. Association of education with the practice of the people regarding the prevention and control of Dengue

We analyzed the data and tried to determine the association of the people's education with the prevention and control practice. Significant ($p < 0.05$) relations were found with the educational qualification and the practice of the city people to prevent and control Dengue (Table 6). Respondents who had completed their secondary (50.2%) and tertiary (66.7%) level of education were more likely to take measure to prevent Dengue than who had no education (31.4%) or only completed their primary level (36.9%). Secondary (63.7%) and tertiary (64.7%) level educated peoples were more likely to take prompt measures in high fever cases. Illiterate (41.8%) and primary (39.2%) level people preferred to go to the government hospital to get treatment rather than private hospitals.

But in the case of secondary (31.4%) and tertiary (33.3%) level of education, it didn't differ significantly (Table 6).

3.6. Relation of occupation with the practice of the people regarding prevention and control of Dengue

We found significant ($P < 0.05$) relation of the city dwellers' occupation with immediate measures to prevent Dengue and take treatment when they acquired dengue fever. Peoples those who were associated with government (58.6%) and private (54.3%) job, as well as business (50.9%), were active to take measure to prevent Dengue. The majority of the respondents of all occupations would like to take immediate treatment for high fever. However, most private employees, 43.6%, went to the private hospital to take treatment, and government employees (43.1%), preferred government hospitals for their treatment. Nearly 90% of city dwellers used mosquitocidal or repellent products (coil, aerosol, bed-net, etc.) to protect themselves from the mosquito (Table 7).

4. Discussion

Understanding a community's knowledge of Dengue viruses and its transmission process is necessary to develop an intervention plan and educational materials. The community-based study was conducted in Dhaka city to describe the knowledge, attitudes, and preventive behaviors related to dengue management and identify preventive behavior determinants. The present study helped in elucidating the knowledge and preventive behavior of Dhaka city dwellers regarding Dengue. Our results suggest that the majority of participants heard about the Dengue before this study. But we pinpoint the gaps of knowledge regarding multiple aspects of Dengue, including vectors breeding habitats and seasons, transmission risks, and prevention methods. The majority of the respondents were acquainted with the dengue virus transmission via mosquito bites, but the further transmission was blurred. Our results showed optimum knowledge of dengue symptoms, but they do not have a clear idea about *Aedes* mosquitoes' breeding sites and preventive measures. Our results are similar to the findings of Ahmed et al. in Dhaka [22] but in contrast with studies in Thailand [23], India [24], and Nepal [25], in which the majority of the people did not know about the symptoms of Dengue. The people of Dhaka city believe that Dengue is an important concern in their community. Linking these gaps in knowledge is crucial in designing programs to educate people on dengue preventive measures. Nearly half of Dhaka city people have taken precautionary measures to prevent themselves from Dengue, similar to some other studies [22,26]. Although the respondents correctly mentioned the dengue vector (*Aedes*

Table 7
Association of occupation of the respondent with practice to prevent dengue and its transmission.

Occupation of the respondents	Govt. employee		Pvt. employee		Business		Daily worker		Student		Housewife		Caretakers		others		P-value
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	
	a. Taking measure to prevent dengue																
Yes	34	58.6	76	54.3	54	50.9	17	26.6	39	38.2	119	46.9	69	41.1	4	80	0.001
No	24	41.4	64	45.7	52	49.1	47	73.4	63	61.8	135	53.1	99	58.9	1	20	
b. Measurement taking in case of high fever																	
Immediate treatment	42	72.4	83	59.3	70	66	33	51.6	53	52	152	59.8	109	64.9	3	60	ns
Self-method	12	20.7	40	28.6	30	28.3	27	42.2	33	32.4	85	33.5	44	26.2	2	40	
Traditional method	0	0.0	4	2.9	1	0.9	0	0.0	6	5.9	6	2.4	5	3	0	0	
Others	4	6.9	13	9.3	5	4.7	4	6.3	10	9.8	11	4.3	10	6	0	0.0	
c. Place of taking treatment																	
Govt. hospital	25	43.1	31	22.1	37	34.9	22	34.4	40	39.2	83	32.7	83	49.4	0	0.0	0.000
Private hospital	13	22.4	61	43.6	31	29.2	13	20.3	33	32.4	79	31.1	26	15.5	1	20	
Private clinic	12	20.7	28	20.7	18	17	4	6.3	16	15.7	50	19.7	27	16.1	3	60	
Clinic	5	8.6	10	7.1	11	10.4	4	6.3	1	1	19	7.5	11	6.5	1	20	
Others	3	5.2	10	7.1	9	8.5	21	32.8	12	11.8	23	9.1	21	12.5	0	0.0	
d. Use anything to protect from mosquito																	
Yes	57	98.3	134	95.7	98	92.5	58	90.6	93	91.2	232	91.3	157	93.5	5	100	ns
No	1	1.7	6	4.3	8	7.5	6	9.4	9	8.8	22	8.7	11	6.5	0	0.0	

egypti) but did not have adequate knowledge about the breeding habitats and control measures. We watched television and newspapers advertisement regarding dengue prevention but did not find any posters, leaflets, or social motivation programs at the community level during the study. Dhaka city dwellers have better knowledge regarding Dengue and its vectors than the general people of Pakistan [27], Thailand [28], Malaysia [29], and Maldives [30]. Most of the respondents (64%) of Dhaka city did not answer the Dengue's right cause. In contrast, Hongkong peoples (95.8%) have a better knowledge of it [31]. It's because different authorities conducted regular public awareness campaigns in Hong Kong [31]. Similar observations were reported in India (82.4%) [32], Philippines (68.7%) [33] and Brazil (60.8%) [12]. Major sources of information about dengue fever prevention were mass media, such as newspapers, television, and radio in Bangladesh. Huge television or radio campaigns have achieved high levels of coverage in many countries, such as Malaysia [29], Thailand [23,34], and Jamaica [35]. There might be a direct link between knowledge and preventive behavior [36]. Due to the inadequate supply of water from the Dhaka Water Supply & Sewerage Authority (DWASA), many people of the city stored water in their own houses in a different type of water-holding containers like a drum, bucket, water tank, etc. But they were not paying attention to changing the water regularly. Megacity Dhaka is speedy, growing, and unplanned. Our study discovered that unplanned urbanization is continuing in every part of the city and under-construction sites are the principal sources of Aedes mosquitoes breeding. The owners of the buildings or Real Estate & Housing Association of Bangladesh (REHAB) should take preventive measures in their construction sites to prevent mosquito breeding. Personal communications of health personnel and health volunteers might place more emphasis on these issues. Compare to the people of Maldives [30], Dhaka city people were using more repellent product to prevent themselves from mosquito bites. However, approximately one-third of the adults in the Maldives used mosquito coils during the day and night. Though the people of Dhaka city used a mosquito coil, aerosols, and bed net, most of every family has the experience to have Dengue or Chikungunya. The City dwellers were using mosquito control products mostly at night time. The use of coils only at night may not decrease dengue infection because dengue vector mosquito is known to bite mostly during several hours after dawn and before dusk [37]. In the future, health educators should also emphasize this point of the behavior of the city people. Like the Maldives [30], a significant relation between dengue prevention and knowledge regarding vectors breeding was found among Dhaka's city dwellers. Our study makes known that students were reluctant to take any measure to prevent or control Dengue, although they knew about it. Illustration and description of Dengue and its preventive measure should be incorporated in the junior school curriculum, and the school teachers' strong motivation is essential to minimize these gaps. Interestingly, almost everybody said that "nothing was visible rather than fogging as a vector control steps taking by the city corporation." Moreover, the fogging was not so frequent and regular. Though the city dwellers were well-known about Dengue's burden, they were reluctant to take preventive measures to get a ride from these diseases. Truly, there was no association between knowledge and preventive practice, a finding that has been stated in other studies [29,38]. According to their own opinion, they agreed that they are not making enough effort to control Dengue and its vectors. City dwellers have mixed opinions regarding their responsibilities to control mosquitoes in and around their house. Nearly 40% of people strongly believe that it is the sole responsibility of City Corporation. Integrated vector control (IVM) methods should be implemented in Dhaka city to manage Aedes transmitted diseases. Moreover, city dwellers need to play an active role in destroying breeding sources of Aedes to reduce the burden of Dengue in Dhaka.

5. Conclusions

It was clear that the city dwellers were familiar with Dengue's burden, but they were reluctant to take preventive measures to get a ride from it. Similarly, many people didn't know the specific preventative measures to minimize potential exposure to Dengue. This lack of knowledge was likely due to inadequate coverage with information, education, and communication (IEC) activities. So, IEC intervention programs may need to be revised accordingly. Health workers may need to be trained on Dengue and its preventive practice and be responsible for aware people. For example, residents should be careful at peak risk periods, on the proper use of bed nets, and how and when to best use insecticides in the home. Description with Dengue's illustration and its preventive measure should be incorporated in the junior school curriculum, and strong motivation of the school teachers is essential to minimize these gaps. Practical dengue preventive approaches should be affordable and readily available to the populations and access to treatment. To conclude, year-round entomological surveillance should be started, and insecticides resistance should be continuously evaluated in highly dengue-endemic cities.

Authors' contributions

KB designed the study. KB, SM, A, EAT, and ABZ have done the fieldwork. SM computed data entry and analysis. ABZ enter the GIS data and produce the maps. KB, SM, A, EAT, and ABZ collaborated to write the manuscript. All authors read and approved the final manuscript.

Funding

We haven't received any financial support from anybody or any organization for this study.

Declaration of competing interest

The authors declare that they have no competing interests.

Acknowledgments

We want to thank the city dwellers of Dhaka north and south city corporations for cooperating with us. Heartiest thanks are due to our friends and the people who helped directly or indirectly carry out the study. Also, very grateful to Dr. Ayesha Akter, in charge of the Health Emergency Operation Centre and Control and assistant director, DGHS, to provide the dengue data. Thanks to Md. Khalilur Rahman, Senior Entomologist, DGHS, and government of the people's republic of Bangladesh, provided us some logistic support and guidance. Thanks to the DSCC and DNCC for provided us with demographic data. This work is partially supported by the Ministry of Education grant ID LS2018824, Government of the People's Republic of Bangladesh.

References

- [1] Dengue and severe dengue, n.d. <https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue>. (Accessed 17 April 2020).
- [2] O.J. Brady, P.W. Gething, S. Bhatt, J.P. Messina, J.S. Brownstein, A.G. Hoen, et al., Refining the global spatial limits of dengue virus transmission by evidence-based consensus, *PLoS Neglected Trop. Dis.* 6 (2012), e1760, <https://doi.org/10.1371/journal.pntd.0001760>.
- [3] S. Bhatt, P.W. Gething, O.J. Brady, J.P. Messina, A.W. Farlow, C.L. Moyes, et al., The global distribution and burden of dengue, *Nature* 496 (2013) 504–507, <https://doi.org/10.1038/nature12060>.
- [4] I. Fernández-Salas, R. Danis-Lozano, M. Casas-Martínez, A. Ulloa, J.G. Bond, C.F. Marina, et al., Historical inability to control *Aedes aegypti* as a main contributor of fast dispersal of chikungunya outbreaks in Latin America, *Antivir. Res.* 124 (2015) 30–42, <https://doi.org/10.1016/j.antiviral.2015.10.015>.
- [5] F. Espinoza-Gómez, C.M. Hernández-Suárez, R. Coll-Cárdenas, Educational campaign versus malathion spraying for the control of *Aedes aegypti* in Colima, Mexico, *J. Epidemiol. Community Health* 56 (2002) 148–152, <https://doi.org/10.1136/jech.56.2.148>.
- [6] M.M.M. Amin, A.M.Z. Hussain, M. Murshed, I.A. Chowdhury, S. Mannan, S.A. Chowdhuri, et al., Sero-diagnosis of dengue infections by haemagglutination inhibition test (HI) in suspected cases in chittagong, Bangladesh 23 (1999) 5.
- [7] E.B. Yunus, A.M. Bangali, M.A.H. Mahmood, M. Mushfiqur, A.R. Chowdhury, K.R. Talukder, Dengue outbreak 2000 in Bangladesh: from speculation to reality and, *Exercises* 25 (2001) 6.
- [8] R. Farhana, K.F. Awatef, H. Khanum, T. Akter, Prevalence of dengue fevers among the patients of different economic status attended at the local hospital in Dhaka, Bangladesh *J. Zool.* 42 (2014) 161–168, <https://doi.org/10.3329/bjz.v42i2.23352>.
- [9] (4) (PDF) Emergence of Dengue in Bangladesh a major international public health concern in recent years, ResearchGate n.d. https://www.researchgate.net/publication/277667579_Emergence_of_Dengue_in_Bangladesh_a_major_international_public_health_concern_in_recent_years. (Accessed 18 April 2020).
- [10] জ্যেষ্ঠ, প্রত্নবৈদ্যক বর্ডিনউজ টা-য়ান্টফি-র উটকম. ১১ মাস পর ডেঙ্গুহীন হাসপাতাল n.d. <https://bangla.bdnews24.com/bangladesh/article1728697.bdnews>. (Accessed 18 April 2020).
- [11] N. Dike, O. Onwujekwe, J. Ojukwu, A. Ikeme, B. Uzochukwu, E. Shu, Influence of education and knowledge on perceptions and practices to control malaria in Southeast Nigeria, *Soc. Sci. Med.* 63 (2006) 103–106, <https://doi.org/10.1016/j.socscimed.2005.11.061>.
- [12] N. Dégalier, P.T. Vilarinhos, M.S. de Carvalho, M.B. Knox, J. Caetano, People's knowledge and practice about dengue, its vectors, and control means in Brasília (DF), Brazil: its relevance with entomological factors, *J. Am. Mosq. Contr. Assoc.* 16 (2000) 114–123.
- [13] K. Bashar, N. Tuno, Seasonal abundance of *Anopheles* mosquitoes and their association with meteorological factors and malaria incidence in Bangladesh, *Parasites Vectors* 7 (2014) 442, <https://doi.org/10.1186/1756-3305-7-442>.
- [14] R. Rico-Hesse, Dengue virus virulence and transmission determinants, *Curr. Top. Microbiol. Immunol.* 338 (2010) 45–55, https://doi.org/10.1007/978-3-642-02215-9_4.
- [15] The 10 largest cities in the world. WorldAtlas n.d. <https://www.worldatlas.com/articles/the-10-largest-cities-in-the-world.html> (accessed April 18, 2020).
- [16] Bangladesh Population and Housing Census, Bangladesh bureau of statistics 2015. <https://web.archive.org/web/20151208044832/http://www.bbs.gov.bd/WebTest/Application/userfiles/Image/National%20Reports/Union%20Statistics.pdf>, 2011. (Accessed 19 April 2020).
- [17] "Sector Assessment (Summary), Urban Transport", 2020.
- [18] Dhaka population 2020 (demographics, maps, graphs). World Population Review n.d. <https://worldpopulationreview.com/world-cities/dhaka-population/> (accessed April 19, 2020).
- [19] Dhaka, Bangladesh metro area population 1950-2020 n.d. <https://www.macrotrends.net/cities/20119/dhaka/population>. (Accessed 19 April 2020).
- [20] (4) Dhaka megacity: geospatial perspectives on urbanisation, environment and health | request PDF, ResearchGate n.d. https://www.researchgate.net/publication/n/244989522_Dhaka_Megacity_Geospatial_Perspectives_on_Urbanisation_Environment_and_Health. (Accessed 18 April 2020).
- [21] Geography of Bangladesh, Wikipedia, 2020.
- [22] T.U. Ahmed, K. Bashar, G.S. Rahman, M. Shamsuzzaman, S. Samajpati, S. Sultana, et al., Some socio-demographic factors related to dengue outbreak in Dhaka City, Bangladesh, *Bangladesh J. Zool.* 35 (2007) 213–222.
- [23] B.H.B. Van Benthem, N. Khantikul, K. Panart, P.J. Kessels, P. Somboon, L. Oskam, Knowledge and use of prevention measures related to dengue in northern Thailand, *Trop. Med. Int. Health* 7 (2002) 993–1000, <https://doi.org/10.1046/j.1365-3156.2002.00950.x>.
- [24] N. Gupta, S. Srivastava, A. Jain, U.C. Chaturvedi, Dengue in India, *Indian J. Med. Res.* 136 (2012) 373.
- [25] M. Dhimal, K.K. Aryal, M.L. Dhimal, I. Gautam, S.P. Singh, C.L. Bhusal, et al., Knowledge, attitude and practice regarding dengue fever among the healthy population of highland and lowland communities in central Nepal, *PLoS One* 9 (2014), e102028, <https://doi.org/10.1371/journal.pone.0102028>.
- [26] (4) Knowledge and attitudes in Puerto Rico concerning dengue prevention | Request PDF. ResearchGate n.d. https://www.researchgate.net/publication/7773410_Knowledge_and_attitudes_in_Puerto_Rico_concerning_dengue_prevention. (Accessed 18 April 2020).
- [27] A. Itrat, A. Khan, S. Javaid, M. Kamal, H. Khan, S. Javed, et al., Knowledge, awareness and practices regarding dengue fever among the adult population of dengue hit cosmopolitan, *PLoS One* 3 (2008), e2620, <https://doi.org/10.1371/journal.pone.0002620>.
- [28] C.J.M. Koenraadt, W. Tuiten, R. Sithiprasasna, U. Kijchalao, J.W. Jones, T.W. Scott, Dengue knowledge and practices and their impact on *Aedes aegypti* populations in Kamphaeng Phet, Thailand, *Am. J. Trop. Med. Hyg.* 74 (2006) 692–700.
- [29] F. Hairi, C.-H.S. Ong, A. Suhaimi, T.-W. Tsung, M.A. bin Anis Ahmad, C. Sundaraj, et al., A knowledge, attitude and practices (KAP) study on dengue among selected rural communities in the Kuala Kangsar district, Asia, *Pac J Public Health* 15 (2003) 37–43, <https://doi.org/10.1177/101053950301500107>.
- [30] N. Ahmed, S. Taneepanichskul, KNOWLEDGE, ATTITUDE AND PRACTICE OF DENGUE FEVER PREVENTION AMONG THE PEOPLE IN MALE, MALDIVES, 2008.
- [31] M.-L. Ho, Y.-K. Luk, R.Y.L. Choy, Knowledge, attitude and practices of Hong Kong residents for dengue fever prevention, *J Hong Kong College of Family Physicians* 28 (2006) 68–75.
- [32] S. Matta, S. Bhalla, D. Singh, S.K. Rasanias, S. Singh, Knowledge, attitude & practice (KAP) on dengue fever : a hospital based study, *Indian J. Community Med.* 31 (2006) 185.
- [33] M.M. Mahilum, M. Ludwig, M.B. Madon, N. Becker, Evaluation of the present dengue situation and control strategies against *Aedes aegypti* in Cebu City, Philippines, *J. Vector Ecol.* 30 (2005) 277–283.

- [34] M.G. Guzmán, G. Kourí, Dengue: an update, *Lancet Infect. Dis.* 2 (2002) 33–42, [https://doi.org/10.1016/s1473-3099\(01\)00171-2](https://doi.org/10.1016/s1473-3099(01)00171-2).
- [35] F. Shuaib, D. Todd, D. Campbell-Stennett, J. Ehiri, P.E. Jolly, Knowledge, attitudes and practices regarding dengue infection in Westmoreland, Jamaica. *West Indian Med J* 59 (2010) 139–146.
- [36] H.-H. Pai, Y.-L. Lu, Y.-J. Hong, E.-L. Hsu, The differences of dengue vectors and human behavior between families with and without members having dengue fever/dengue hemorrhagic fever, *Int. J. Environ. Health Res.* 15 (2005) 263–269, <https://doi.org/10.1080/09603120500155732>.
- [37] Centers for Disease Control and Prevention. Health Information for International Travel 2008. Atlanta, GA n.d.
- [38] L.B.L. Claro, H.C.B. Tomassini, M.L.G. Rosa, [Dengue prevention and control: a review of studies on knowledge, beliefs, and practices], *Cad Saude Publica* 20 (2004) 1447–1457, <https://doi.org/10.1590/s0102-311x2004000600002>.