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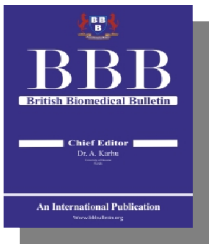

Original

Dengue Fever Infection in Hodeidah, Yemen: Risk Factors and Socioeconomic Indicators

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A B S T R A C T

World Health Organization (WHO) reported that the dengue fever became epidemic in some parts of Yemen, spread in the costal planes of Tihama (Hodeidah). The study aim to evaluate the relationship between the dengue fever infection and the socioeconomic indicators in Hodeidah, Yemen. This was a cross-sectional observational study conducted by recruiting case-series of children, adults and elderly who have dengue fever within the age from 1 month to 80 year. 425 blood samples were collected from patients that received a simple explanation for the aim of the study as an ethical issue. The samples were assayed by Enzyme Linkage Immunosorbent Assay (ELISA) to detect the acute and chronic dengue fever. The results showed that 179 samples were IgM positive and 246 were negative while 262 were found to be IgG positive and 163 were negative. On the other hand , the results showed that a significant correlation between the dengue infection and the socioeconomic indicators namely sex, accommodation, education level ($p < 0.05$), while non – significant correlation ($p > 0.05$) was recorded between the infection and the other indicators namely the age, income and vector breeding sites relationships. In conclusion, this study revealed that, the dengue fever is a major cause of fever in Hodeidah, Yemen. The peak incidence of dengue fever occurs in the male of secondary school and graduate study that habits in random house.

Introduction

In just the past decade, the significance of dengue as a threat to health and a burden on health services and economies has increased substantially. Compared with the situation 50 years ago, the incidence of dengue infection in the world has risen 30-fold[1].

An epidemic of dengue fever in Yemen was reported to have occurred in 1954, which affected 98 % of the population of Hodeidah[2]. In 1984, travelers returning from Yemen to USA that were serologically confirmed to have the dengue[3].

The United Nations International Children's Emergency Fund (UNICEF)[4] reported that the dengue haemorrhagic fever was a notable disease in Yemen since 1994. The first dengue outbreak was confirmed in 2003, in Shabwah governorate. Later, WHO[1] reported that the dengue fever became epidemic in some parts of Yemen, spread in the costal planes of Tehama and Abyan. The previous studies explained prevalence of dengue viruses in many places in Yemen; upon these published papers dengue viruses were clearly endemic in several Yemeni governorates[5].

Dengue virus is transmitted between people by the mosquito vectors belonging to *Aedes aegypti* and *Aedes albopictus*, which are found throughout the world[6,7]. Platt *et al* reported the time of biting activity of the adult mosquitoes that prefer to rest indoors and feed on humans during daylight hours. There are two peaks of biting activity: early morning for 2 to 3 hours after daybreak and in the afternoon for several hours before dark. However, these mosquitoes will feed all day indoors and on overcast days[8]. Also, Zayed *et al*.[9] confirmed that the presence and wide spread of *Aedes aegypti* mosquitoes in Hodeidah governorate, Yemen.

Therefore, this paper aims to evaluate the relationship between the dengue fever infection and the socioeconomic indicators in Hodeidah, Yemen.

Materials and Methods

Study design - ethical issue and questionnaire

A cross-sectional observational study conducted by recruiting case-series of children young, adults and elderly who have dengue fever infection within the age group from 1 month to 80 years. Subjects with dengue fever infection received a simple explanation for the aim of the study as an ethical issue. If they agreed, the subject was interviewed by using of questionnaire which was concentrated on the following indicators namely the age, sex, accommodation (house structure), income level, education level, and vector breeding sites. Confidentiality of the collected data was achieved by keeping data record in a locked room with limited access to the research team only.

Sample collection

The blood samples were obtained from the hospitals, health centers and National Center for Public Health Laboratories (NCPHL). The blood samples were taken from suspected cases after 4-6 days from onset of fever upon[10]. The serum was separated, collected and stored in a sterile container and kept at 2 - 8 °C, for a maximum of 7 days until they were transported to the laboratory where they were analyzed.

Analysis of dengue fever infection by ELISA

Sera from all specimens were tested for anti-dengue immunoglobulin (IgM and IgG) by Enzyme Linked Immunosorbent Assay (*Novagnost kits, GmbH, Germany*)[11-13].

Statistical analysis

The Interview and laboratory data were analyzed using social process for social science (SPSS) and Excel 2010. The descriptive analysis and the Chi-square test were used to make comparisons among categorical variables. For all statistical analyses, a p -value of less than 0.05 was considered statistically significant.

Results

Analysis of dengue virus

Out of 425 tested specimens, 179 specimens were positive for acute infection IgM (42% of all suspected specimens) and 262 specimens were positive for chronic infection IgG (61.6%). Also 96 specimens were positive for both (22.5%). The negative specimens for both IgM and IgG were 83 specimens (19.5%).

Effect of gender and age on dengue fever infection

Dengue fever infection was represented in the males 77.09 % while in the females 22.91 %. However, the correlation between the gender and the acute dengue infection was highly significant ($p < 0.05$). On the other hand, the age range of patients was from 1- 80 years. The higher frequency of dengue fever infection was in patients between 21-30 years (53.07 %) with an average age of 25 years old, followed by age group between 11-20 years (29.05 %), then the age group 31-40 years (7.82%). The lower frequency was in elderly between 51-80 years (1.11%) (Table 2). The correlation between the age groups and the acute dengue infection was significant ($p < 0.05$).

Effect of accommodation - economical properties and education level on dengue fever infection

The relationship between the dengue infection and the type of house and education level was statistically significant ($p < 0.05$), while the dengue infection and the income level was not found statistically significant ($p > 0.05$) (Table 3).

Effect of vector breeding sites on dengue fever infection

The relationship between the increasing of dengue fever infection and the breeding factors were analyzed as presented in Table (4). The higher frequency of dengue infection was in bogs (n = 165) and lower frequency was in tires (n = 47). The correlation between the acute dengue infection and the breeding factor was not significant in which p more than 0.05.

Discussion

This investigation embraces an endemic survey of dengue fever virus in Hodeidah governorate, Yemen during September 2012 to June 2013 through which 425 dengue suspected specimens were collected from 24 different districts in Hodeidah governorate. The specimens were obtained from hospitals, health centers and NCPHL. The collected specimens were diagnosed by immunological method namely ELISA to detect IgM and IgG antibodies of dengue virus which is widely used for laboratory analysis and considered to be a reliable serologic test[14,15].

179 specimens were positive for acute infection IgM (42% of all suspected specimens) and 262 specimens were positive for chronic infection IgG (61.6%). Also 96 specimens were positive for both (22.5%). However, 83 of suspected specimens were never infected with dengue fever virus (19.5%). Interestingly, the proportion of dengue virus of chronic infections were found more than acute infections which indicated the prevalence of dengue fever outbreaks for quite some time. This result is similar to Al-Moyed *et al.*[16].

Furthermore, the distribution of dengue infection between the males was

noted more than in the females. It was rated 77.09 % to 22.90 % which was correlated with dengue infection ($p < 0.05$). The mean reason for this relation is due to male clothes in hot areas which make their bodies more exposure than females. These findings are matched with other studies from Saudi Arabia and Yemen[13,16-19].

The correlation of age groups with dengue infection was non-significant but it was inverse significantly relation with dengue infection as Aziz *et al.*[20], that showed this infection was more severe and complicated which might lead to death**.** Butin this study, the most noted infected age group was 21-30 years (53.07%) with an average age of 25 years, then 11-20 years (29.05%) and the less infected category was 51-90 years (1.11%). This result reflected that the activity of young people makes them at risk of dengue fever infections. These results were similar with Ayyub *et al.*[17] and Madani *et al.*[5].

Some studies reported infected people with different age categories more than the age recorded in this study which is more than 37 years[19], while other studies recorded less than 10 years[21], which indicated the unstable relationship between the dengue infection and the age groups. Serious dengue infection was recorded among children and old people who reflected the relationship between serious dengue infection and human immune system[20].

On the other hand, the education level of studied cases was very important factor. People with secondary education level showed the highest infected group with an average of 45.81%, while people with high education level were the second group with an average of 25.69 % followed by people with primary education level with an average of 20.11%. The lower infection was among illiterates with an average of 8.37%. The most infected groups are near to be in the same level of most infected age groups. These results were similar with previous studies in India[22,23].

As the female mosquito bites primarily during day[24], most cases who get infection are those individuals who are outside their houses especially if there is stegnant water near their schools and places of work[16]. The prevalence of dengue infection was significantly correlated with the house structures ($p < 0.05$) which showed that the infection of dengue between apartment houses (urban) were more than random houses of rural. It was rated 58.85% to 49.16%, respectively, which was similar with Gupta *et al.*[23] in India.

In addition, the outbreaks of dengue fever and dengue haemorrhagic fever were reported in Saudi Arabia, Sudan and Yemen where infections have concentrated in the cities and urban areas along the Red Sea and coasts of the Arabian Sea and Pakistan, this study was reported by WHO[25].

Income status showed non-significant relationship with dengue infection but according to the questionnaire lists, the detection of low status people (4-9 $ daily) which was 53.07 % higher than median (10-30$ daily) income status (46.92%). However, high income people (>30 $ daily) were not recorded in this study. These results were matched with *Alhemiree*[26] (from Yemen. This may indicate a relation between poverty and dengue infection. It was estimated that 32 % of the population in Hodeidah governorate live below poverty line[27]. The prevalence of dengue infection affected by proportion of increasing poverty between populations. So, the dengue fever likely to be poor people viral disease.

Furthermore, the dengue breeding sites were found positive related with dengue infection. The most breeding site was bogs with an average of 92.17 % that associated with most of the suspected cases.

Open drums or containers were the second dengue infection related breeding site with an average of 74.97 % that was noted in urban and rural areas after that pools. Trashes and tires were rated 73.74%, 68.71% and 26.25%, respectively. These breeding sites were associated and prevalent in most of the collected specimens, and environments of the targeted people. Barde *et al.*[5] observed that the water storage containers were the main sources of vector breeding sites for dengue virus activity. These breeding sites were responsible for mosquito prevalence.

The presence of more than one source of uncovered water was considered as the main cause of mosquito reproduction and prevalent around people houses. This result was matched with two studies from United Kingdom (UK)[28,29] and India[30], where some strange behavior was noted in this investigation which was the reproduction of mosquito vectors among dirty water sited in trash heaps which may indicated a modification of mosquitos' reproduction requirements.

Conclusion

In conclusion, the dengue fever infection was significantly correlated with the gender and house structure and education level, while other indicators namely the age, income and vector breeding sites were non-significantly related with the infection. On the other mean, this study revealed that, the dengue fever is a major cause of fever in Hodeidah, Yemen. The peak incidence of dengue fever occurs in male of secondary school and graduate study that habits in random house.

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Table 1. Distribution of dengue fever infection according to districts of Hodeidah, Yemen

Districts	Collected specimens	Positive cases	%	Negative cases	%
Aldahei	12	6	3.35	6	2.44
Alduriehmi	10	4	2.23	6	2.44
Aljarahei	12	4	2.23	8	3.25
Alkanawes	12	5	2.79	7	2.85
Alkhookha	10	4	2.23	6	2.44
Almansoria	9	2	1.12	7	2.85
Almarawa	21	10	5.59	11	4.47
Almeglaf	9	3	1.68	6	2.44
Almuneera	9	3	1.68	6	2.44
Alqotea	17	8	4.47	9	3.66
Alsaleef	1	1	0.56	0	0.0
Alsukhuna	4	2	1.12	2	0.81
Altehieta	36	12	6.70	24	9.76
Aluhia	22	7	3.91	15	6.10
Alziedia	13	5	2.79	8	3.25
Alzuhra	2	0	0.0	2	0.81
Baitalfakieh	33	10	5.59	23	9.35
Bajel	14	7	3.91	7	2.85
Bora	4	2	1.12	2	0.81
Heiss	3	2	1.12	1	0.41
Hodeidah city	120	52	29.00	68	27.62
Jabalrass	8	4	2.23	4	1.63
Marine college	28	19	10.61	9	3.66
Zabiad	16	7	3.91	9	3.66
Total	425	179	100%	246	100%

Table 2. Gender - age and dengue fever infection

Indicators		Infected cases		Non infected cases		*p* value
		Number	Ratio	Number	Ratio	
Sex	Male	138	77.09	163	66.26	< 0.05 *
	Female	41	22.91	83	33.74	
	Total	179		246		425
Age (Year)	1– 10	8		15		> 0.05
	11 – 20	52		61		
	21-30	95		127		
	31 -40	14		35		
	41- 50	8		8		
	51 – 80	2		4		

*: Significant

Table 3. Effect of accommodation - economical properties and educational level on dengue fever infection

Indicators		Infected cases		Non infected cases		*p* value
		Number	Ratio	Number	Ratio	
Accommodation	Random	88	49.17	144	58.53	< 0.05
	Apartment	91	50.83	102	41.46	
	Total	179		246		
Income ($)	4 – 10	95	53.07	133	54.09	> 0.05
	11 – 30	84	46.93	113	45.93	
	> 30	00	00	00	00	
Education	Illustrate	15		42		< 0.05
	Primary	36		52		
	Secondary	82		91		
	Graduate	46		61		

*: Significant; Key: low status income = 4-10 $ daily, mid status income = 11-30$ daily and high status income = more than 30 $ daily.

Table 4. Effect of vector breeding sites on dengue fever infection

Breeding site (factors)	Infected cases	%	Non-infected cases	Total	*p* value
Bogs	165	92.17	232	397	> 0.05
Open drums	132	74.97	199	331	
Pools	123	73.74	175	298	
Trashes	136	68.71	207	343	
Tires	47	26.25	46	93	