Epidemiological Surveillance of Dengue Infections: A Community Based Study in Rural, Karachi (2010 - 2012)

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Abstract

Objective: To determine the incidence cases and their demographic, clinical and haematological risk factors of dengue infections in a low resource rural community during outbreaks of 2010-2012   in Gadap town Karachi,Pakistan.

Methods: An active surveillance data collection on epidemiological and clinical observations on patients with Dengue infections in a low resource community during 2010 - 2012 was done. The surveillance reports were collected from union councils of Gadap Town, Karachi. The diagnosis of Dengue fever, Dengue haemorrhagic fever and Dengue shock syndrome was confirmed by IgM and IgG anti bodies detection using Enzyme-linked immunosorbent assays (ELISAs) technique based on World Health Organization (WHO) criteria. The sampling technique was cluster random sampling from the union councils of Gadap Town, Karachi and sample size calculated was 350. Data was collected on a performa after informed consent of patients. Data analysis was done on SPSS version 16. Frequency was reported for categorical variables and chi-square test performed for statistical significance to determine associated risk factors among positive cases of dengue infections.

Results: Out of 350, 105 (30%) cases had dengue infections in rural area of Gadap town Karachi. About 58 (16.6%) had dengue fever, 30 (8.6%) dengue haemorrhagic fever and 17 (4.9%) had dengue shock syndrome. Twelve patients died during treatment. Presence of fever and cutaneous manifestation were observed in all cases. The significant associated risk factors were found in female, unmarried having 5 years education and severe pain at $p<0.001$.

Conclusion: In endemic areas during dengue surveillance dengue infections were found in 30% cases. The significant associated risk factors were female, unmarried, with 5 years education and severe pain. Febrile illness represented patients with typical clinical features and haematological findings suggestive of dengue fever.

Keywords: Dengue fever, dengue haemorrhagic fever, clinical pattern, epidemiology, surveillance, community.

Introduction

Dengue infection is an emerging infectious disease becoming global public health problem. The epidemiological studies have shown irregular epi-

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demic outbreaks and desynchronized dynamics of all four virus serotypes[1]. According to World Health Organization (WHO) approximately 40 % of the world's population is at risk for dengue[2]. Beatty et al, reported that the dengue fever is a major public health problem in tropical and sub-tropical regions of the world[3]. Entomologic investigations from 1980 showed that *Aedes aegypti* has been responsible for the outbreaks[4-5]. There have been outbreaks in Pakistan which include all four dengue serotypes[6]. The spectrum of dengue virus infection in human ranged from unapparent or mild febrile to severe[7] and fatal haemorrhagic disease[8]. The confirmed cases had either dengue fever simply or severe

manifestations in the form of Dengue fever (DF), Dengue haemorrhagic fever (DHF) and Dengue shock syndrome (DSS)[9]. Young HM et al, have developed a population based mathematical model and reported that vector mosquito Aedes aegytpi and the incidence is strongly influenced by temperature and humidity which varies seasonally[10].

There has been considerable health, social and economic consequences of dengue infection particularly in hot climate in developing countries, like Pakistan[11]. There have been possible emergence and re-emergence of the mosquito-borne arbo viruses globally[12-13]. Some studies have shown dengue infections in children more common 13.45% in India from a tertiary care hospital which is alarming as there has been substandard health care infrastructure in tropical low resource countries like Pakistan[14]. In Pakistan dengue outbreaks have been observed as endemic disease in low resource communities.

The main objective of this study was to determine the incidence cases and their demographic, clinical and haematological risk factors of dengue infections in a low resource rural community during outbreaks of 2010-2012 in Gadap town Karachi, Pakistan.

Patients and Methods

This was an active surveillance data of epidemiological, clinical and haematological observations in a low resource communities during 2010 - 2012 in Gadap town, Karachi. An active surveillance was conducted in three Union Councils of Gadap Town, Karachi. The diagnosis of dengue fever, dengue haemorrhagic fever and dengue shock syndrome was confirmed by IgM and IgG anti bodies based on WHO criteria on ELISA technique[2]. The WHO criteria based on the measures included acute febrile illnesses of any duration with two or more of the manifestations: headache, retro orbital pain, arthralgia, rashes/petichea, haemorrhagic manifestation and leucopenia.

A cluster random sampling was used.The sample size was estimated by 72% attack rate in a thickly populated community[10]. Sample size was calculated at 5% significance and confidence level 95% with the power of study at 80%. The final sample size calculated was 350 with the addition of refusal by the patients and loss to follow-up.

An institutional approval was taken to collect the data from the community and follow-up the cases for dengue infection outcome. The identified dengue infection cases from Gadap town were referred to tertiary care hospital and provincial dengue cell for further management. There were outbreaks of dengue infections during August to January 2010-2012. Blood samples were obtained from patients during an acute febrile illness from 2-15 days duration. The clinical manifestations included headache, muscular or joint pains and rashes. The immunoglobulin IgM $\geq$ 40 units or IGg $\geq$ 100 were taken as positive dengue infections. In some of the cases Reverse Transcrptase polymerase chain reaction was performed by extracting RNA.

Out of these three hundred fifty cases DHF/DSS were referred to tertiary care centers for further management. Case records of 105 seropositive patients were analyzed and patients were admitted to special units of dengue infections. Demographic, clinical and haematological data were analyzed to determine the risk factors associated in seropositive dengue infections.

The collected information was analyzed on SPSS version[16] (SPSS Inc., Chicago, IL, USA). Patients` age, weight, height, family income per month presented as mean ± SD. For qualitative variables like gender, ethnicity, educational levels and haematological reports were presented as frequency and percentages. Stratification was done for age and educational level to determine the outcome of dengue infection. Chi-square test was used to compare the qualitative variables.

Results

Out of 350 there were 105 (30%) cases had dengue infections in rural area of Gadap town Karachi. About 58 (16.6%) had DF, 30 (8.6%) DHF and[17] (4.9%) had DS. A systematic analysis was

performed based on the onset of symptoms in the study population as shown in (Table 1).

Samples taken on day 4 and 5 of illness are of low yield for isolation as well as serology.

Therefore, timing of serological diagnosis of IgM and IgG in this active surveillance were important for early diagnosis and further treatment. The diagnosis of DF in the community is based on early detection of DF to reduce mortality, therefore the timing of test was very important in this study.

Twelve patients died during treatment. Fever and cutaneous manifestation were observed in all dengue infections. Females were 54% and known diabetes mellitus in 25.7% patients. Other characteristic of study were found in participants have been shown in Table 2.

Married male patients were less 91 (44.8%) among IgM positive cases compared to 112 (52.2%) married females. However, unmarried male were more 105 (41.7%) compared to unmarried females 16 (18.6%) at the p<0.0001 which was significant among the categories of marital status.

Along with febrile illness, thrombocytopenia, severe headache, rash, nausea and vomiting, chills and rigors were major manifestaions. Other major clinical findings included myalgia 59%, headache 68.8%, bleeding manifestations 45%, pharyngitis 45%, retro orbital pain 25.8%, headaches 46.8%, vomiting 76.7% and abdominal pain 39.5%. Among dengue positive cases hepatosplenomegaly 9%, Spleenomegaly 18% and lymphadenopathy 8% were observed. Hematological manifestations included mean haemoglobin 11.23 ± 2.5 mg. Mean total leucocyte count was 4.12 ± 2.35, a mean platelets count at admission was 41.69 ± 35.65, mean platelets count at treatment started was 2.66 ± 4.44 and mean platelets recovered after treatment was 119.25 ± 551.4. There were 178 (35.6%) with no previous history of treatment for the febrile illnesses. There was history of febrile illness followed by use of antimalarial drugs among confirmed dengue infection patients.

The significant risk factors for positive IgM were 112 (52.2%) female at p<0.001 compared to 91 (44.8%) male. Educational level was significant 91 (44.8%) with 5 years completed education and severe pain in 108 (53.2%) at p<0.001 as shown in Table 3. The correlation of IgM with duration of illness among the study patients is presented in Fig.1.

Discussion

Gadap town population has been living in crowded rooms with poor sanitation and lack of water supply so storage of water in houses is mandatory. Urbanization in Gadap town, is common and posing a major challenge to epidemiology of dengue infections and vector control activities.

In the current study febrile illness was observed in 97.7%. The major clinical features observed were thrombocytopenia, severe headache, rash, nausea, vomiting myalgia in all patterns of DF, DHF and DSS. The serological tests have greatly enhanced dengue infection.

The high level of IgG is characteristics of secondary dengue infection[16]. In this study 9% of the patients showed secondary serological response. A high mortality 35 (10%)[17] was seen in DHF/DSS cases with secondary responses therefore close monitoring and management is mandatory to reduce adverse outcome. The DHF had immediate and late complication and DSS were associated with mortality[17]. The early serological diagnosis was possible with government support.

Table 1. Types of samples and intervals since onset of symptoms in the study population

Type of sample	Interval since onset of symptoms
1.Acute- phase sample	Taken on or *before day 5 after onset of symptom
2.Convulse scent- phase	G or more days after beginning after symptoms

Since Dengue fever has been an endemic viral disease affecting tropical and subtropical regions globally, it has predominantly affected urban and

Table 2. Demographic Characteristics of Dengue infections in Patients of Gadap Town, Karachi.

S.No	Demographic Characteristics	No	Percentage (%)
1	Age (Years) Mean ±SD 42.74±14.9	--	--
2	Gender		
	Male	161	46
	Female	189	54
3	Ethnicity		
	Balochi	63	18
	Sindhi	140	40
	Urdu	21	60
	Pathan	126	36
	Others	63	18
4	Income Per Month		
	6000	187	53.4
	6001-10000	82	23.4
	10001-20000	58	16.6
	20001-300000	23	6.6
5	Occupation		
	Employed	203	58
	House wife	147	42
6	Educational level		
	No education	63	18
	5 Years education	140	40
	8 Years education	56	16
	14 Years education	35	10
	16 Years education	56	16
7	Socioeconomic status		
	Upper Middle	115	32.86
	Lower middle	89	25.43
	Poor	90	25.71
	Very Poor	56	16
8	Comorbidities		
	Cardiovascular diseases	29	8.3
	Tuberculosis	27	7.7
	Hypertension	135	38.6
	Diabetes	90	25.7
	No comorbidity	69	19.7
10	IgM Antibodies		
	Positive	105	30
	Negative	184	52.6
	Equivocal	61	17.4

Table 3. Association of IgM reports and dengue infections in Gadap Town, Karachi (n=350)

| S. No	Characteristics	IgM Positive N=350 Number %	IgM Negative N=350 Number%	IgM Equivocal N=350 Number%	p-value
1	Gender				
	Male	91 (44.8)	70 (81.4)	0 (0)	<.0001*
	Female	112 (52.2)	16 (18.6)	61 (100)	
2	Marital status				
	Married	91 (44.8)	70 (81.4)	0 (0)	<.0001*
	Unmarried	105 (41.7)	16 (18.6)	39 (63.9)	
	Widow/Divorced	7 (3.4)	0 (0)	22 (36.1)	
3	Educational level				
	No education	28 (13.8)	21 (24.4)	14 (23.)	<.0001*
	5Yrs education	91 (44.8)	28 (32.6)	21 (34.4)	
	8Yrs education	14 (6.9)	21 (24.4)	21 (24.4)	
	14Yrs education	28 (13.8)	7 (8.1)	0 (0)	
	16Yrs education	42 (20.7)	9 (10.5)	5 (8.2)	
4	Pain				
	Mild	95 (46.8)	33 (38.4)	0 (0)	<.0001*
	Moderate	0 (0)	53 (61.6)	61 (100)	
	Severe	108 (53.2)	0 (0)	0 (0)	
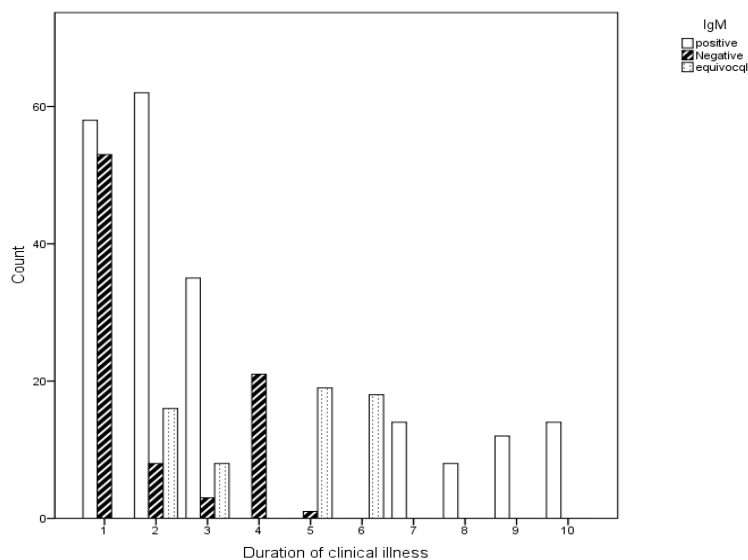
Fig.1. Association of duration of Illness and IgM report in the sample (n=350)

semi urban areas in Sindh, Karachi[18]. There is an increase in global prevalence of dengue[19]. The WHO estimates that there may be 50-100 million cases of dengue virus infections globally every year, which result in 250,000 to 500,000 cases of DHF and 24,000 deaths each year. The clinical observations of DF, DHF, & DSS in rural low resource area have special clinical pattern of the dengue infections in Pakistan. The processing of samples for serological diagnosis takes approximately one week, and the PCR results take approximately 3 days. Dengue is characterized by an acute febrile illness accompanied by headache, retro-orbital pain, body pain (petechial rash) haemorrhagic manifestation[20]. The laboratory diagnosis requires a blood sample taken during the acute period of the disease and a second sample that can be taken from day 6 after the onset of symptoms.

ELISA technique was used for confirmation of dengue infection in the community. The incidence of dengue infections was 30%. The significant associated risk factors were female, unmarried, 5 years education and severe pain in low resource community. These associated demographic, clinical and haematological risk factors were common in outbreaks of dengue infection in August to January 2010-2012.

The significant factors found in this study keeping other factors constant were females , five years education and severe pain as there were more cases and research participants had theses risk factors more common compared to non dengue cases.

The eradication of *Aedes aegypti* in endemic areas needs holistic startegies for control of vector in rural Karachi. The strategies currently have not been successful therefore the controls of infection require efficient vaccine. The development of an efficient dengue vaccine is difficult because the vaccine must be tetravalent to include all four serotypes. The social mobilization and communication are critical to sustainable dengue prevention and control[21].

Conclusion

In endemic areas during dengue surveillance dengue infections were found in 30% cases. The significant associated risk factors were female, unmarried, with five years education and severe pain. Febrile illness represented patients with typical clinical features and hematological findings suggestive of dengue fever.

The surveillance for this study was only conducted in one rural area of low resource community.

Conflict of Interest

The authors claimed no conflict of interest for this publication

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