ORIGINAL ARTICLE

OUTBREAK INVESTIGATION OF DENGUE FEVER IN SUNDIA, CHAKAISER, SHANGLA, PAKISTAN–2008

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Background: From October 1-6, 2008 media reported increased fever cases along-with some deaths in a village that were found positive for dengue IgM antibody. The provincial health authorities ordered an investigation. Our investigation aimed to determine the magnitude of disease, understand the epidemiological characteristics, and recommend preventive measures. **Methods**: The study was to investigate an epidemic through a descriptive study followed by a case-control study in the village Sundia from October 14th to Nov 2nd, 2008. A case defined as: "Anyone from the village with fever and any one of the symptoms including bone breaking fever (arthralgia, myalgia), rash, bleeding from nose and gums from 21st Sept 2008 to 2nd Nov 2008. For comparison, controls (n=183) i.e., those who did not fulfil the case definition criteria: Systematic random sampling technique was used and data was collected on a *pro forma*. Blood samples were also collected from those who had fever for the last 3 days or more. **Results**: A total of 113 (33%) households were surveyed out of 339 among which 156 (46%) cases were selected based on case definition and all the rest (183) were taken as controls. There were 84 (54%) males and 72 (46%) females. Mean age was 30 (range between 1-80 years). Beside fever, other predominant symptoms were joint pains 94 (60%) and headache 91 (58%). Seventy samples were collected and tested for dengue IgM on ELISA method and 12 (17.14%) were found positive. Logistic regression was done and uncovered water containers (p-value <0.05) to (adjusted OR=1.8; p=0.008), surrounding marshy land (p=0.03) to (adjusted OR=1.75; p=0.02) & tap water (p=0.001) to (adjusted OR=3.2964; p=0.0012) were found to be associated with the fever. **Conclusions**: Investigation showed presence of different risk factors which also pertain to other countries. The gaps in communication lead to the increased number of fever cases. Dengue prevention and control program, capacity building and a strong surveillance system is crucial**.**

Keywords: Dengue, Shangla, KPK, Arthralgia, Myalgia

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INTRODUCTION

Dengue is an acute febrile disease, caused by a single stranded RNA virus, called the Dengue virus. It is transmitted mainly by *Aedes Aegypti* mosquitoes and rarely by the *Aedes Albopictus*, which are found commonly in urban areas and require clean water in order to breed.[1] More than 50% of these infections are symptomless. In symptomatic cases, fever, headache, severe joint and muscle pain etc. are the common presenting features. Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS) are some of the possible and life threatening complications.[2]

Globally there has been a tremendous increase in the number of dengue outbreaks. Pakistan reported its first dengue outbreak in 1994 followed by small outbreaks during 1995 and 1997 with limited number of dengue cases till the 2006. Dengue emerged as a major public health issue in terms of its drastic expansion, severe morbidity and mortality experienced specially during the outbreaks in November 2006 and 07. The outbreak in November 2006 caused about 4,800 cases and more than 50 deaths.[3] The outbreak of 2008 (Sept-Oct) was reported from almost all over the country. It has been documented that Pakistan is at a high risk of large epidemic with serious potential threat of deadly complications leading to sever consequences.[4] During the year 2011, the country experienced yet another outbreak that has claimed over 300 deaths.[5] Here we are presenting a study done after the initial reports of dengue outbreak in Khyber Pakhtunkhwa (KPK) in 2008 that occurred in Tehsil Chakaiser of District Shangla. Investigation of the outbreak started on the directions of the Director General Health Services, KPK.

Sundia village is situated in sub-tehsil Chakaiser of district Shangla, KPK Pakistan and have around 2,730 inhabitants. Area of district Shangla is 1,586 km and dominated by high mountains and narrow valleys in western extremities of Himalaya and is 2,000–3,590 meter above the sea level. Population of the district in

2007 is around 512,212 (based on 3.27% growth rate). The average household size is 8.1.[5,6] Shangla has the lowest Human Development Index (HDI) in the province and second lowest in the country.[6,7] Depending mainly on agriculture and has many springs, small rivers and gets plenty of rainfall annually.[8] The earthquake of 8th Oct 2005 caused damaged 53.1% of the household and causing 46.6% employment losses in agriculture sector. Thirty out of 32 health units were completely or partially damaged. Similarly 414 water supply schemes and 65 sanitation schemes were also damaged.[5] The area was also undergoing military operation which has added to problems.

The outbreak investigation was aimed to determine the prevalence of dengue fever and understand its epidemiological characteristics in Sundia village of Chakaiser, District Shangla; and to put forward recommendations.

MATERIAL AND METHODS

This investigation into an epidemic was done from 21st Sept to 2nd Nov 2008. A pretested structured questionnaire was used as a data collecting tool. Data was collected by two health officials who were formally trained for two days on the questionnaire.

A total of 341 households in village Sundia were estimated by dividing the total population (2730) of Sundia by 8 (8.1 house hold size on average).[5,6] Nearly one third of households (113) were surveyed following a random start from a convenient spot/central point (including health facility, mosque, school, market, *hujra*, clinic, springs). Systematic random sampling method was then used. Three individuals per household were interviewed, and a total of 339 individuals were included. The sample size was calculated as 337 calculated under the assumption by presuming the prevalence for dengue infection as 50% as it was not known. Absolute precision was taken as 5.5% with 95% confidence level.[9] Blood samples were collected for serology from those cases that were suffering from fever for at least 03 days.

The case for the purpose of this study was defined as an individual resident of the area with fever and any one of the symptoms including bone breaking fever (arthralgia, myalgia), rash, bleeding from nose and gums from 21st Sept to 2nd Nov 2008, whereas anyone from the village without fever history was considered as the control. For entomological survey of the area, total catch of adult mosquitoes (using indoor pyrethrum catch spray) method was used. Head of family was requested permission before starting the interview and to allow inspection of their houses, courtyards and gardens. Interviews of the female folks and information about children from mothers/care taker were also conducted in his presence.

RESULTS

Out of 341 households, 113 households were selected for survey. Interviews were obtained from three respondents of every selected house with a ratio of three respondents per one house household (1:3) and thus 339 respondents were interviewed from 113 households. Out of 339 respondents 156 (46%) were identified as cases. The rest 183 were taken as controls and risk factors were assessed.

There were 84 (54%) males and 72 (46%) females.

The age of the total cases ranged from 1year to 80 years with mean and mode of 29, and 40 years respectively. The age distribution of the cases is shown in Figure-1.

As far sociodemographic data is concerned, 138 (88.5%) cases were illiterate while 100 (64%) were married, 50 (32%) were attached with farming profession and almost 54 (75%) of females were housewives.

The Epidemic Curve of confirmed (IgM positive) cases is shown below in Figure-3.

Individuals with IgM dengue antibodies did not show any significance for 6 out of total 13 variables; hence total cases fulfilling the case definition criteria were included in the analysis**.** The results are shown in Table-2.

Logistic regression was carried out and after adjustment, the significance level of 03 variables was increased: uncovered water containers (adjusted OR=1.8; p-value<0.05), surrounding marshy land (adjusted OR=1.75; P-value<0.02) and tap water (adjusted OR=3.2964; p-value<0.05). Empty receptacles in the garden or courtyard, animals on property, plants with water pool and water storage in big tanks also showed statistical association.

There were no association found for socioeconomic variables such as illiteracy, housing conditions, marital status, lack of sanitation and drainage system with dengue fever (OR= 0.2–2.5; p-value=0.09 to 0.62). The results are shown in Table-3.

Seventy blood samples were obtained from those who had fever for more than three days and who consented to give blood and out of those, 12 cases (17.14%) were found positive for anti-dengue IgM. Frequency of various manifestations in all cases and IgM positive cases is shown in Table-1.

For entomological survey of the area total catch of adult mosquito (using indoor pyrethrum catch spray) method was used however the EDO (H) Shangla reported that unfortunately the samples were lost while being transported to Islamabad for analysis as the health official carrying them was caught in crossfire between the militants and Pakistan army and had to rush for his life.

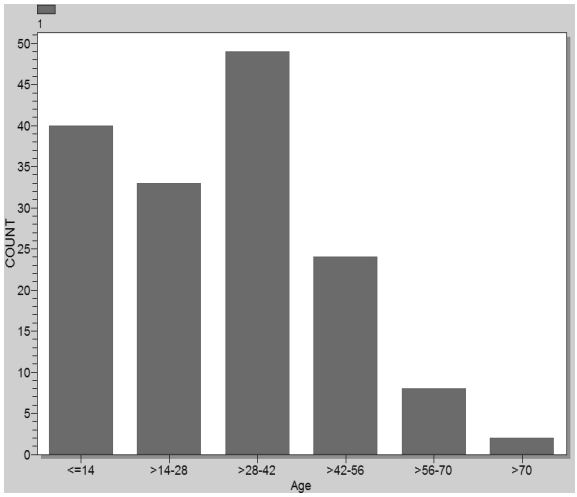

Figure-1: Age distribution of the cases (n=156).

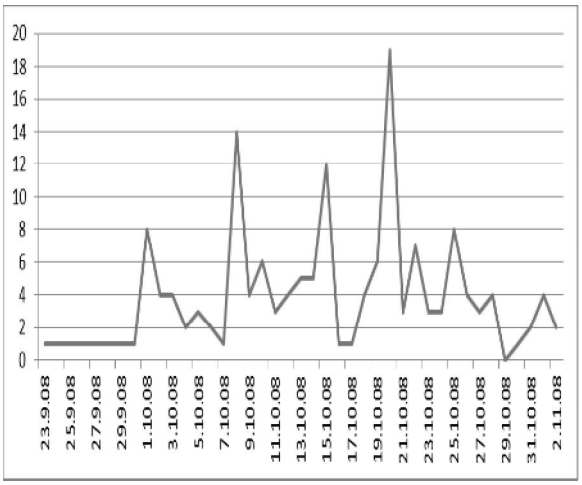

Figure-2: The epidemic curve showing date wise occurrence of cases.

Table-1: List of manifestations of dengue patients

No of variables	Manifestations	Cases	IgM +ve
		No of Cases (%)	No of Cases (%)
1	Fever	156 (100)	12 (100)
2	Joint pain(arthralgia)	94 (60)	10 (83)
3	Myalgia	87 (56)	10 (83)
4	headache	91 (58)	7 (58)
5	RoP	58 (37)	6 (50)
6	Abdominal pain	9 (6)	1 (8)
7	Anorexia	45 (29)	4 (33)
8	Vomiting	32 (21)	1 (8)
9	Skin rash	1 (0.6)	1 (8)

Table-2: Geographical and environmental variables of individuals with IgM dengue antibodies & total cases fulfilling the case definition criteria.

Variable	OR (95% CI)	*p-value*
Uncovered water containers		
IgM	4.4 (1.25–15.37)	0.017
Total Cases	1.76 (1.13–2.73)	0.011
Use of protective methods		
IgM	1.50 (0.45–5.00)	0.50
Total Cases	1.33 (0.83–2.12)	0.23
Plants with temp water pool		
IgM	5.4348 (1.15–25.68)	0.017
Total Cases	1.61(1.05–2.49)	0.028
Animals on property		
IgM	0.029 (0.03–2.36)	0.200
Total Cases	2.49 (1.36–4.57)	0.002
Empty receptacles in house/garden/courtyard		
IgM	3.66 (0.45–29.39)	0.17
Total Cases	2.038 (1.26–3.27)	0.002
Water storage in house (tanks) roof/courtyard		
IgM	10.52 (2.92–37.85)	0.0002
Total Cases	2.01 (1.22–3.32)	0.0054
Water supply (tap water)		
IgM	5 (1.14–21.75)	0.05
Total Cases	2.94 (1.41–6.24)	0.001
Mosquito density		
IgM	0.41 (0.11–1.42)	0.128
Total Cases	2.04 (1.31–3.19)	0.001
Marshy surrounding area		
IgM	1.33 (0.37–4.67)	0.43
Total Cases	1.66 (1.0425–2.649)	0.03
Visitors- dengue endemic area		
IgM	35.5 (5.63–223.70)	0.0002
Total Cases	0.137 (1.01–1.15)	0.03
dengue fever in house/family		
IgM	4.54 (1.30–15.88)	0.01
Total Cases	3.63 (2.08–6.34)	0.000003
Dengue fever in neighbours		
IgM	5.03 (1.33–19.02)	0.02
Total Cases	5.47 (1.80–16.63)	0.0008
Dengue fever in contacts/at work		
IgM	2.01 (0.39–10.20)	0.32
Total Cases	6.38 (1.81–22.48)	0.001

Table-3: Socio-economic variables of Individuals with IgM dengue antibodies & total cases

Variable	OR (95% CI)	*p*-value
Marital status		
IgM	0.63 (0.12–3.54)	0.39
Total Cases	0.89 (0.57–1.39)	0.62
Drainage system		
IgM	0.39 (0.02–12.02)	0.43
Total Cases	1.96 (0.59–6.51)	0.26
Housing condition		
IgM	0.39 (0.22–12.02)	0.43
Total Cases	1.17 (0.28–4.78)	0.54
Toilet types		
IgM	2.55 (0.00–41.54)	0.43
Total Cases	0.85 (0.14–5.38)	0.58
Illiteracy		
IgM	0.22 (0.03–1.53)	0.09
Total Cases	1.2 (0.63–2.5)	0.49

DISCUSSION

Dengue outbreak in Chakaiser-a complete rural setup[4] as opposed to the disease being predominantly urban is the first ever reported from the area. Studies on dengue[10–12] have reported variations in its generally known characteristics. The adaptive capabilities of the vector to any change in environmental and social factors need to be reviewed for an effective control as dengue has no curative treatment and the increasing possibility of DHF & DSS taking the life toll.

The present outbreak was reported a couple of weeks before Eid-ul-Fitr (Muslim's religious celebration). Dengue cases were mostly limited to an area with houses in comparatively close proximity & having visitors from Karachi Sind (a dengue endemic area) for celebrating Eid holidays. The study revealed that the risk of developing dengue fever was 4–6 times more amongst people who had anyone in the family, neighbours or contacts respectively suffering from dengue infection thereby, confirming the previously observed epidemiological significance of the short flight range of dengue mosquito and the distance between the houses. People who had visitors from outside for Eid were 35 times more likely to develop dengue fever (IgM positive).

Relationship of low intensity precipitation at the end of rainy season allowing the female vector to complete its incubation period has been documented. The virus thus emerges, amplifies tremendously and gains a potential to transmit dengue infection[13–15] Shangla received its heavy monsoon rains from June through August and cases were notified in September-October. Many life cycle (1112 days)[16] of *A. aegypti* mosquito (depending on climatic conditions) can be completed increasing the transmission potential and threat to cause an epidemic.

In this epidemic more males were affected. One reason might be that out of the total eleven students reported to have dengue infection, eight were male students. Females were totally denied education and all their schools were bombed/ destroyed due to military operation against terrorist in the area. Female wear clothes with many flairs and folds full sleeves, long trouser & a special sheet "dupatta" to cover the head while at home and outside they also cover their body and face with another sheet "Chaddar". Covering the body and avoiding oneself from being bitten has been documented as one of the main preventive measure and is always been emphasized.[17–19]

The high percentage of cases among males could also be explained in the view that males are the main bread earner in the rural areas are working during the mid-morning or early afternoon-the peak biting times of the *Aedes* mosquito. In our study 58.3% (n=49) of the men were farmers and they have to fold their trousers and sleeves and walk bear footed while working in the fields.

Intermittent tap water supply, unprotected and unused containers have major contribution in this outbreak. Less than 10% of the study population had taps. Water supply was intermittent due to the military action, curfew and damage to the water supply schemes during the earthquake of 2005; as a result they were mostly relying on the spring and stream water. The storage containers are seldom cleaned and small amount of water noticed at the bottom of the big storage tanks (the outlet was a few inches above the tank's floor) inside the houses (courtyard/roof) might have served as a breeding site for dengue infection, as reported by studies in the past.[20,21]

In the study group, more than 25% of cases (symptomatic) were between age group1 to 14 years old. In Pakistan (no child with dengue in 2003 and 2004) dengue infection is on the rise[22], and children between the ages of 10–15 years are more likely to have the disease.[1] While aiming at control measures children must also be targeted. The 29 years median age in our study confirms the decreasing trends in age of susceptible population.[22,23] Probably adults have acquired immunity due to exposure to a previously unnoticed dengue infection in the area. Establishing a strict and vigilant surveillance system will help in preventing the disease.

Marshy area and dengue cases were strongly associated compared to rice fields. Cyclopoid copepods- natural predators for mosquitoes present in the standing water of the rice field can kill *Aedes* larvae.[24] For long term control measure marshy land can be connected to ponds or canals through which these predators could be given access to mosquito larvae. However this ecological management requires intense effort.

Our study does not provide any significant association of the personal protective methods against mosquitoes. Limited role of repellents has been attributed to *Aedes aegypti* being primarily a day biting mosquito (capable of biting during night when hungry)[25] while repellents are used at night time based on the common concept of mosquitoes biting at night time[26,27], however the effects of various repellents on dengue Aegypti has also been reported.[28,29]

Empty receptacles, plants with temporary water pools, mosquito density and animals in the area were also associated with outbreak. Empty receptacles retained water for a long period of time as they were not discarded and is partly due to the lack

of sanitation and partly because mostly people do not consider them as hazardous like other house waste.[30]

Increase in vector densities during climatic conditions (humidity, rainfall, ambient temperature) similar to those of Chakaiser and the risk of transmission of vector born diseases like dengue fever has been reported previously.[31]

CONCLUSION

Analysis of epidemic in Sundia Chakaiser showed that various well-known risk factors were present. The gap observed between the occurrence of outbreak and information to the provincial health department leading to increased number of fever cases. The health department along with its partners needs to concentrate on developing a more coordinated program for dengue prevention and control. Capacity building (community and health staff) & a strong surveillance system leading to early and quick detection of dengue cases and vector control is crucial. The role of an entomologist cannot be ignored and as none is available at least 02 entomologist be deputed at the Provincial RBM Program office at Peshawar. Malaria coordinators at the district level should be trained in recognizing the type of larvae, collection and dispatching the mosquitoes and calculating different entomological indices.

Support Provided: Bed net (LLINs) were provided at Hayyat Medical Complex (HMC) and Executive District Officer Health [EDO(H)] office Shangla for dengue cases (suspected & confirmed) and advised to sleep under it until recovery. Sensitization of on duty staff at HMC on standard preventive measures and community awareness at Shangla through local Imam-e-masjids was arranged. Dengue Rapid Diagnostic Test Kits were also provided both at HMC and EDO Shangla Office.

Fogging /spray machine was immediately provided to EDO (H) Shangla along with fuel for three cycles/month.RBM coordinator Shangla having the technical expertise provided assistance during the fogging. For successful dengue control in future a comprehensive health education program for the community needs to be arranged and the gap between knowledge about dengue its preventive measures and the proper use of preventive practices/ barriers be addressed.

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