Dengue Epidemic in Postconflict Swat District, Khyber Pakhtunkhwa, Pakistan, 2013

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Abstract. Swat, a lush green valley of 1.3 million persons, remained under militant insurgency from 2007 to 2009, which damaged the health infrastructure. An outbreak of dengue fever (DF) was declared in the valley in 2013. To investigate this outbreak, we established active surveillance of national hospitals and private clinics, reviewed available clinical and laboratory records, and conducted entomological survey. From August to November 2013, 16,000 suspected patients with acute febrile illness were presented to health facilities. Among those, 9,036 were confirmed positive for DF by clinical manifestation and presence of nonstructural protein 1-soluble antigen. Of 9,036 patients, majority were men and aged 21–40. The epidemic peaked in September 2013 ($N = 6,487$). The attack rate was 7.18/1,000 populations. Among the confirmed case-patients, 36 deaths were reported, and proportion of mortality was 0.4%. Each year, increase in age was significantly associated with risk of complication due to DF leading to death ($P < 0.001$).

DF is an important mosquito-borne viral disease of humans and primarily transmitted by *Aedes aegypti* vector.¹ DF or dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) can be caused by four different serotypes of dengue fever virus (DENV), that is, DENV-1, DENV-2, DENV-3, and DENV-4.² DENV infection are usually inapparent; however, the clinical manifestations can be transformed from mild disease to severe DF with bleeding and ultimately shock.³

Pakistan, a subtropical country is a hotspot for many vector-borne diseases.⁴ Cases of DF have been registered in Pakistan from 2006 to 2011. However, dengue was first time detected from Pakistan in early 1980s from different provinces.⁵ Currently, almost all major cities of the country have been affected with DF due to increased human mobility.⁶ Catastrophic floods of 2010 in the country also worsened the situation of DF with increased breeding opportunities for vector mosquitoes.⁶

In postconflict Swat, from 2007 to 2009, huge damages were caused to the economy and infrastructure due to militancy and subsequent military operation, which also affected 18 health facilities in Swat District.⁷ In 2013, an epidemic of DF erupted in Swat.⁸ This study was conducted to investigate this epidemic and to report epidemiological characteristics of all dengue cases.

Swat is an administrative district in Khyber Pakhtunkhwa (PKP), with an estimated population of 1,257,602 individuals.⁹ It is bounded by Chitral and Ghizer districts in the north, Kohistan and Shangla districts in the east, Buner district and Malakand protected area in the south, and by the districts of Upper and Lower Dir in the west. A total of 86.62% of the population lived in rural areas, whereas only 13.38% live in urban areas. Active surveillance of clinical records was established at tertiary care hospitals and private clinics to determine the severity of the epidemic, from August 1 to November 30, 2013. All outpatients and inpatients

that were registered during epidemic period, that is, 2013, and fulfilled the case definition were included. Their medical records were examined and recorded using a predesigned questionnaire. The referral hospitals kept logbooks that included hospital admission and discharge dates, along with diagnostic results. Parallel to active surveillance, passive databases maintained at the District Health Department, hospital record, and clinic logbooks for diagnoses consistent with DF case definition after August 1, 2013 were also reviewed. Complete records of suspected patients were retrieved. Data were collected about demographic characteristics, date of onset of signs, laboratory testing, and outcome. A case of DF was defined as feverish illness (38.5°C) with body or joint pains and one of the following: headache, rash, nausea/vomiting, or hemorrhagic manifestations in an inhabitant of Swat. DF, DHF, and DSS were defined according to World Health Organization criteria¹⁰ and confirmed by NS1 antigen strip test.

The proportion of cases by age group, gender, area of residence, and reporting month was calculated. The epidemic curve was drawn to observe the dynamics of epidemic. χ^2 test was done to determine the relationship between gender, age group, larval presence, and dengue outcome (live or dead). A P value of < 0.05 was considered statistically significant. Attack rate and proportion of mortality for DF were calculated. Epidemiological and temporal analyses were performed in R-3.2.3 for Macintosh (2015) (available at <https://cran.r-project.org/bin/macosx/>). QGIS-2.14.3 (available at <https://www.qgis.org/en/site/forusers/download.html#>) was used to visualize the spatial distributions of cases in Swat District. To confirm the presence of vector, an entomological survey of 330 locations in 22 union councils (UCs) of two tehsils of Swat, selected by convenience sampling method, was conducted in September 2013. From each UC, 15 samples were collected with mosquito traps from breeding sites and water containers kept outdoor, water supply, and waste disposal sites, and were identified morphologically for species identification with the consultation of an entomologist. Ethical approval of study protocol was obtained from District Health Office, Swat. Anonymity and confidentiality of patient data were assured.

A total of 16,000 suspected patients with acute febrile illness were presented to health facilities and 9,036 confirmed

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FIGURE 1. Epidemic curve of dengue fever cases in Swat District from August to November 2013.

patients fulfilling the case definition of DF illness were detected. The epidemic peaked in September 2013 with 6,487 cases. The epidemic began in August and number of cases declined in November (Figure 1). Spatial pattern of epidemic showed highest number of cases reported in urban UCs (Mingora Urban = 1,305/173,868, Saidu Sharif = 786/29,859, Shahdara = 709/2,8815, Amankot = 704/2,5027) (Figure 2, Figure 3). The attack rate was 7.18/1,000 populations (95% confidence interval [CI] = 7.04–7.33) or almost seven per 1,000 people. Higher attack rate was reported from urban areas (41.25 per 1,000 population, 95% CI = 40.25–42.13), compared with rural communities (1.7 per 1,000 population, 95% CI = 1.6–1.8).

Thirty-six deaths occurred due to complication of DF during this epidemic and proportion of mortality was 0.4%, which is less than the proportion reported from Punjab province (1.6%).¹¹ However, other endemic countries have reported different ranges of mortality, for example, in south-east Asia, mortality ranges from 0.09% to 0.33%, in Asia, 0.22% to 1.61%, in South America and Caribbean, it ranges from 0.05% to 0.37%.¹²

Of 9,036 patients, proportion of male positive DF cases was higher ($N = 6,161$, 68.18%) as compared with female ($N = 2,875$, 31.82%) and is supported by other reports.^{13,14} Females may have minimum exposure to mosquitoes because in KPK, they mostly wear long dresses with full

FIGURE 2. Number of dengue fever (DF) cases in different union councils of Swat District, 2013.

FIGURE 3. Spatial distribution of dengue fever cases in different union councils (UCs) of Swat. Graduated red circles show number of cases in each UC.

sleeves especially in Pashtun culture where women are encouraged to minimize the exposure of body parts. Fully covered dress save them from mosquito bites.¹¹ Mean, median, minimum, and maximum ages were 29 years, 26 years, 4 months, and 101 years, respectively. Among all the reported DF cases, the highest number of cases was in age group 21–40 ($N = 4,542/9,036$, 50%) compared with other age groups (Supplemental Figure 1). Adults are more likely to have clinical dengue than children due to various factor including prior exposure, dengue immune status at the time of current infection, and a number of intrinsic physiological parameters that vary with age.¹⁵ Furthermore, the ageing societies like southeast Asian are truly at risk of increase in dengue incidence.¹⁶ Of 36 deaths, median age was 30 years, 70% ($N = 25$) were male, whereas 30% were female ($N = 11$). Age was found to be a significant characteristic among live and dead dengue cases. Age group 41–60 was strongly associated with DF outcome ($P < 0.001$), which means with increase in age, the chances of deaths increases. Elderly people are more likely to have underlying diseases like diabetes mellitus, asthma, hypertension, ischemic heart disease, and chronic kidney disease, which could enhance the complication leading to death.¹⁵

Out of 330 locations visited in entomological survey, 30% were positive and 70% were negative for larval pres-

ence. The survey results showed higher prevalence of dengue vector in Shahdara (10/15, 66%), followed by Amankot (9/15, 60%), Banr (7/15, 46%), and Kanju (7/15, 46%) (Supplemental Figure 2). Human infection was also high in these UC, that is, Shahdara ($N = 709$), Amankot ($N = 704$), Banr ($N = 394$), and Kanju ($N = 84$). These UCs also have higher human population density.¹⁷ The urbanization resulted into various problems like poor water sewerage system, waste management systems, substandard housing, and poor sanitation, which ultimately favored the breeding and transmission of *A. aegypti* in Swat, and hence amplified the likelihood of dengue transmission to its inhabitants.¹¹

The epidemic was at its peak between August and November 2013. Humidity increases in these months due to rainfall, which may enhance environmental conditions for breeding of mosquito that results into its increased population density.¹⁸ July–September is monsoon season in Pakistan and due to high rainfall, the probability of transmission of dengue virus increases. In the present study, increased hospitalization was observed due to DF during these months. Similar observations have been reported in earlier studies.^{11,13,19,20}

This study suggests the need to improve public awareness about self-protection from dengue vector specifically during and postrainy season. In poor communities, dengue and other similar febrile infections inflict severe financial difficulty on families, especially if hospitalization is required. These results may be used to identify high-risk group and areas; to assist targeted risk-based surveillance in those areas.

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