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Full Length Research Paper

Dengue fever in a border state between Sudan and Republic of South Sudan: Epidemiological perspectives

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Dengue fever is a vector-borne disease; it is transmitted to humans by infected *Aedes mosquitoes*. In this study, we estimated the prevalence of IgG antibodies in a border oil rich state between Sudan and the new republic of South Sudan, estimated the prevalence of dengue IgG antibodies in Lagawa locality populations age 15 to 60 years in 2012 and described the most affected groups within the locality. This is a cross sectional community-based study with multi-stage cluster sampling technique conducted in 2012. Overall dengue IgG prevalence was found to be 27.7% with 95% confidence interval (CI) (24 to 31%) in Lagawa locality. Dengue looks to be having a burden in South Kordofan state on the top of its current complicated political and geographical contexts. Community awareness regarding dengue fever in the state has to be raised in addition to implementing vector control programs, insuring community participation and sustainability.

Key words: Vector borne disease, communicable diseases, surveillance, South Kordofan.

INTRODUCTION

Dengue is a vector-borne virus which is transmitted to humans by infected *Aedes* mosquitoes. It is a disease of tropical and sub-tropical areas (Guzman and Isturiz, 2010). Dengue disease severity varies from asymptomatic infections to undifferentiated fever and small proportion of cases present as a severe form known as dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS) (Halstead, 1990; Wichmann et al., 2011). Dengue burden have been rising in the recent years and has become a public health problem of global importance. The World Health Organization (WHO) estimates that two-fifths of the world's population is at risk of dengue infection (Murrell et al., 2011).

Regionally, it is known that dengue virus has circulated in the African continent since the early 20th century (Guzman and Isturiz, 2010). Sudan is known to have dengue virus circulating. Dengue is a considerable contributor of febrile illness causes in Sudan health care facilities (Woodruff et al.,1988).

Dengue serotype 3 was found in outbreak in children in

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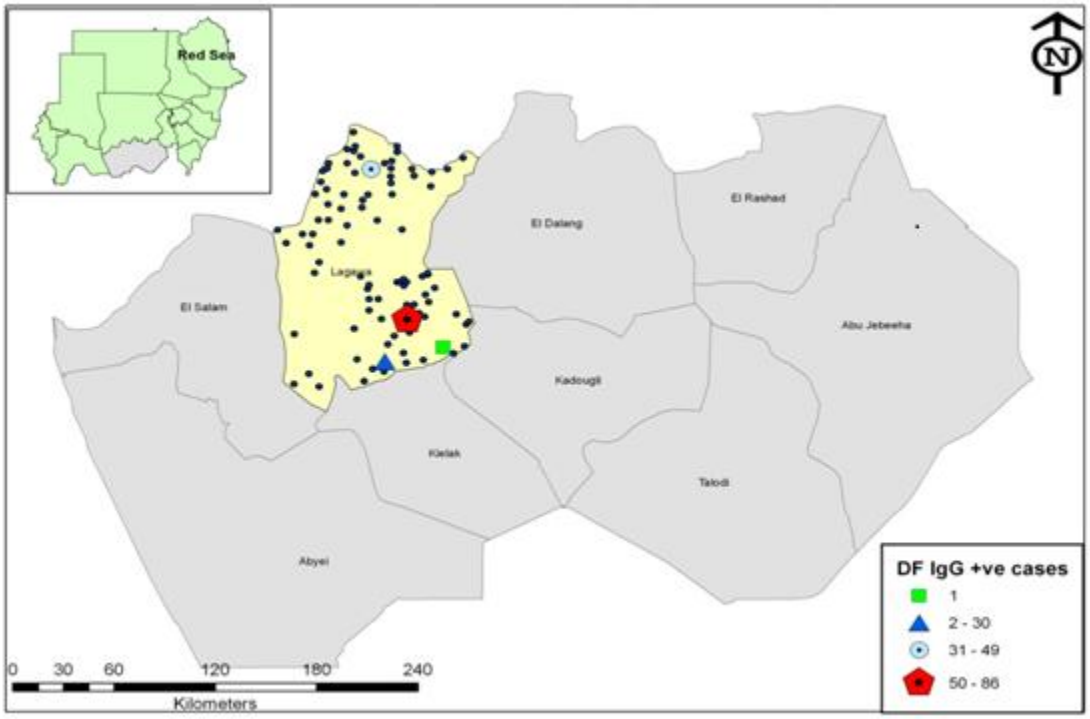

Figure 1. Dengue IgG prevalence per sampled location, Sudan, 2012.

Port Sudan in 2005 (Abdallah et al, 2012). Suspicion of dengue in all cases with fever in Port Sudan was an important finding and conclusion of the study (Ali Khider and Mubarak, 2006). Moreover, presence of DEN-1, DEN-2 and DEN-3 was confirmed in the port city of Jeddah just across the Red Sea with connections with Port Sudan (Fakeeh and Zaki, 2001). Lately, in 2011 an outbreak of non-specific symptoms was detected through the National surveillance system in Lagawa locality within South Kordofan state.

Apart from yellow fever, no proper epidemiological studies had been conducted to estimate the prevalence of Viral Hemorrhagic Fevers (VHFs) in border States between Sudan and South Sudan. Dengue fever in eastern Sudan was studied in a better way and many control achievements were documented. DF prevalence rate in Red Sea and Kassala States was found to be 9 and 6%, respectively (Sayed Shareef, Public Health Inistitute, Sudan unpublished observations). On the other hand all previous entomological studies in Sudan documented the presence of diverse groups of arthropods which are the primary vectors for viral hemorrhagic fevers including dengue.

Ethical approval was obtained from the ethical review committee in Aga Khan University in November, 2011. Permission from the Sudan Federal Ministry of Health (FMOH) was issued in July, 2011. Signed, informed consent was obtained from all participants.

MATERIALS AND METHODS

Study area and study population

Study area of the investigation was the state of Southern Kordofan which is a border state in current demarcations between Sudan and republic of South Sudan (Figure 1). Population 15 to 60 years old of South Kordofan state was considered to be the targeted population, 15 to 60 years old population of Lagawa locality was the source population. Both sexes and anyone who gave the consent for interview and blood sampling were included. Visitors to the area for less than 14 days and immunocompromized patients (for example, patients with HIV, transplants, malignancies) were excluded. Side by side, subjects with chronic kidney disease or those who were taking immunosuppressant therapies for any medical reason were also excluded. Subjects who might have altered immunological response to infections as well as pregnant or women in the puerperal period due to altered immune responses to Dengue virus were also not included.

Sampling techniques

A multi-stage cluster sampling technique (Bennett et al.,1991) was used. Clusters (Popular Administrative Units (PAU)) were selected using a probability proportionate to size technique (PPS).

Households and participants were randomly selected.

Sample size

Altogether, 615 participants were interviewed in the period from April 15th to April 25th, 2012. The estimated prevalence of DF in Sudan eastern states was 9.4%. A design effect of 1.5 and a rate of 2% for missed data are taken into account to calculate the sample size which was maximized with an error as ± 3%.

Tools and quality assurance

All required epidemiological data was collected through standard structured questionnaire that underwent validation and editing after small piloting study. 4 to 5 mls venus blood samples were collected from the participants using sterile syringes and vacutainers with ideal identification labeling and maintained in cold chain. Blood samples were analyzed using Panbio Enzyme-linked immunosorbent assay (ELISA) kits for (DFIgG indirect). Positive and -negative control serum specimens were used, and the ELISA kits tested (Panbio) before analyzing the serum samples. The ELISA PanBio indirect DF IgG test has high sensitivity (99.72%) and specificity (99.62%) according to the manufacturer (Hang and Nguyet, 2009). Summary statistics were computed using SPSS-19 and STATA-12 software.

RESULTS

Basic characteristics

Among the study participants, females were 51%. Age of participants was found to be normally distributed with mean of 37 years and standard deviation of 12.6 years, knowning that the study population was between15 to 60 years old. 41% of the participants were residing in urban settlements including Lagawa town, 15.5% of the participants reported to have travelled to the republic of South Sudan previously while 13.2% reported travelling history to Red Sea State, the endemic area of dengue fever in Sudan. More than 35% of the participants were farmers, while more than 36% were unemployed since all students were gathered under this category. Medical review history showed that 38.2% of participants had complained of fever during the last three months before the interview while only 7.8% were found to experience fever with a hemorrhagic manifestation during their life course. A very considerable proportion (77.8%) of study participants were found to be vaccinated against yellow fever (YF), almost all of them got the vaccination during 2005 YF outbreak in South Kordofan. Main characteristics of the participant are presented in Table 1.

Regarding the important entomological indicators, the study noticed that 90.7% of participants were storing water at home and only 67% of them were properly covering the water containers at the time of interview. Despite that, the presence of indoor mosquito breeding was only confirmed in 9% of visited households. Also, the study has documented the habit of mosquito net usage in a proportion of 90.8% among interviewed participants. Majority of participants sleep under the nets at night while only 2% of them use the nets at both day and night. 24.8% of visited households were found to have windows screens, 14.7% of them were perfectly intact during the survey visit. Regarding insecticide indoor spraying, only 9.2% of the participants were performing regular indoor spraying at visited households. 79.3% of visited households were found to keep domestic animals within their homes, 31.3% were keeping goats and 40% were keeping more than one animal type including goats, sheep and cows at the time of visit.

Dengue IgG prevalence

The overall prevalence of dengue IgG in Lagawa locality is found to be 27.7% (95% CI: 24.1 to 31.3%). Participants of the age group (35 to 39 years) were found to have the highest DF IgG prevalence rate 35.3%, while the age group (≥ 45 years) found to have the lowest prevalence rate (23%). Females had shown a higher prevalence rate than males (30%). Government employees have shown the highest prevalence among other occupations, with prevalence rate approaching 40%. Residents of Lagawa (urban settings) sector have shown prevalence rate approaching 50%. Dengue IgG prevalence per specific characteristic are shown in Table 2.

DISCUSSION

This was the first study estimating the burden of dengue fever infection among apparently healthy people in the boarder state between Sudan and the new republic of South Sudan. Based on that purpose, this study attempted to measure the study outcome by quantification of the prevalence of DF IgG among the study population. DF IgG is generally considered as an indicator for cumulative infection (Nishiura, 2006; Vanwambeke et al., 2006). The overall prevalence of dengue IgG in Lagawa is 27.7% (95% CI: 24.1 to 31.3%). While this is the first study to estimate the prevalence rate of DF IgG in South Kordofan, earlier studies conducted in the eastern part of Sudan found the prevalence of DF IgG ranging between 6 to 9.4%, and in some neighboring countries as high as 14 to 31.33% (Fakeeh and Zaki, 2001; Coldren et al., 2005). Females in the study area were having higher prevalence of DF serological outcome compared to male's population, this finding is suggesting the high exposure to the infected mosquito and this supports the claim that the main

Table 1. Distribution of basic characteristics among the study population.

Characteristic	(N=600)	
	N	%
Age		
Less than 35 years	141	23.5
35-39 years	139	23.2
40-44 years	167	27.8
45 years and more	153	25.5
M±SD	37±12.6 years	
Sex		
Males	294	49
Females	306	51
Occupation		
Farmer	212	35.3
Animal keeper	45	7.5
Shop keeper	51	8.5
Government employee	73	12.2
None employed	219	36.5
Education level		
Illiterate	214	35.7
Traditional religious education (Khalwah)	102	17
Basic education	192	32
Secondary education	77	12.8
University or higher	15	2.5
Duration of continues residence in South Kordofan (M±SD)	33.6±15 years	
Residence cluster (locality)		
Lagawa	250	41
Alsunut	161	27
Jangaru	120	20
Shingil	69	12
History of:		
Fever during the last 3 months	229	38.2
Fever with bleeding	47	7.8
Yellow Fever vaccination	467	77.8
Travel to Red Sea State	79	13.2
Travel to South Sudan	93	15.5
Indoor water storage	544	90.7
Indoor breeding of mosquito	54	9
Use of mosquito nets	545	90.8
Timing for mosquito nets		
At night	522	87
At day time	11	1.8
Both day and night	12	2
Use of mosquito repellant	45	7.5

Table 1. Contd'.

Intact screens	88	14.7
Regular indoor insecticidal spraying	55	9.2
Keeping domestic animals at home	476	79.3
Type of animals		
Sheep	81	13.5
Goats	291	48.5
Cows	104	17.3

Table 2. Dengue IgG prevalence by characteristics among the study population.

Characteristic	DF IgG prevalence per strata	
	n/N	%
Positive dengue fever IgG serology	166/600	27.7
Less than 35 years	34/141	24.1
35-39 years	49/139	35.3
40-44 years	48/167	28.7
45 years and more	35/153	22.9
Sex		
Males	73/294	24.8
Females	93/306	30.4
Occupation		
Farmer	54/212	25.5
Animal keeper	12/45	26.7
Shop keeper	13/51	25.5
Government employee	29/73	39.7
None employed	58/219	26.5
Education level		
Illiterate	55/214	25.7
Traditional religious education (Khalwah)	10/102	9.8
Basic education	54/192	28.1
Secondary education	42/77	54.5
University or higher	5/15	33.3
Residence cluster (locality)		
Lagawa urban settings	80/161	49.7
Lagawa rural settings	86/250	34.4

source of DF infection is the household itself, since the key breeding sites for dengue vector are found at home (Kohn, 1990; Chen et al., 2006).

In such rural settings and very conservative community, it is quite normal to observe all females expending the major portion of their time at home. Elder participants in this study were found to have a lower prevalence of DF IgG antibody than younger population; this finding is very interesting since the current scientific knowledge regarding DF and other vector born diseases are

believed to be prevalent more as age advances, since it depends on the exposure which is increasing with the age assuming IgG antibody will still be detected (Ferguson et al., 1999). On the other hand, some investigators found that younger adult (particularly 30 to 35 years) populations tend to be more reactive to the majority of serological tests (Teixeira et al., 2002) which supports our results, this could be also justified by the fact of decrease immunological response and serological reactivity for many viruses in elder population (Schoub et al., 1992; Ergunay et al., 2011).

This study documented that participants who live in popular administrative units within Lagawa town are more affected than those who live outside Lagawa town. This finding is also very coherent and consistent with the current knowledge regarding DF etiology since the responsible mosquito vector is classified as an urbanized mosquito that predominantly grow and expand with the population urbanization dynamics. Many DF ecological studies found increasing and re-emerging of the disease with the rapid urbanization process (Gubler ,1998). Distribution of DF IgG prevalence among the participant's occupations ranked the government employees on the top of the list with prevalence rate approaching 40%, this might be true due to specific exposure at the place of work particularly at rainy seasons since many potential breeding sites might not carefully look at. An other explanation; this result might be distorted by confounding effect of some other factors associated specifically with governmental employees such as age, residence, travelling history etc. (Vanwambeke et al., 2006). Secondary school educated participants have the highest prevalence rate (> 50%). This also might be attributed to the above mentioned justifications for occupations.

As a conclusion, Dengue looks to be having a burden in South Kordofan state on the top of its current complicated political and geographical contexts.The community awareness regarding dengue fever has to be raised in addition to implementation of vector control programs insuring community participation.

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