Journal of Medicine and Healthcare

SCIENTIFIC Research and Community

Research Article

Open Access

Incidence of Dengue Infection among Febrile Patients in Port Sudan

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ABSTRACT

Objective: Aiming to detect dengue virus antibodies in clinically suspicious patients' serum, contributing to clinical and laboratory advancements in dengue infection management, exploring the association between a clinico-laboratory makeup and Dengue fever, and enhancing the capacity to anticipate, diagnose, and respond to dengue infection.

Methods: At Port Sudan 2015, a descriptive cross-sectional hospital-based study was implemented. Six tertiary care hospitals in Port Sudan were included in the report. Patients who attended assigned hospitals with a suspected dengue infection were investigated. Individuals who are at least 9 months old, residency in study area for at least 7 days, pyrexia with unspecified cause for 2-7 days, thrombocytopenia in malaria negative blood film, as well as ages of 9 months and older considerably involved. Gender, age, residency, and clinical symptoms were used as independent variables while dengue patients posing as the dependent variable. Sample size approximation was created based on previous African community studies. To target respondents, a randomized cluster model was used. Information was gathered through direct interview, as well as questionnaire after signed a consent form. 5ml of venous blood withdraw by a professional nurse from each respondent, then examined for hematological indicators of dengue fever using Sysmex XP-300 Automated Hematology Analyzerand dengue specific IgM antibodies using Panbio® Dengue IgM Capture ELISA. Entering data and analysis of the volunteers' characteristics, the Statistical Package for Social Sciences program (SPSS Inc., Chicago, IL, USA) version 20 was used. Incredibly simple descriptive statistics were used to analyze the laboratory results of the Dengue indicators as well as risk factors.

Results: The study involved 83 cases out of 110 that were tested by ELISA at different hospitals in Port Sudan and determined to be diagnosed with the dengue virus.The incidence rate among febrile patients was 75% (68 cases), with DF documented in 80 cases (96%) and DHF in three scenarios (4%). higher prevalence within the (21-30) age category 50/110. (45%).High occurrence rate during July (63 cases) (57%). Fever was the most noticeable clinical feature 79/83(95%, more evident hematological indicators included thrombocytopenia and leucopenia (88%) 97 out of 110 (71%) 78/110 in each event. Most of study subjects were unaware regarding risk factors with exception of transmission mode.

Conclusions: Study reported high incidence among suspected febrile participants. Most of patients presented as DF, with greater occurrence among reproductive age group and during July.Thrombocytopenia and leucopenia were more prominent clinical manifestations.With the exception of the mode of transmission, the majority of study respondents were unaware of the risk factors.

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Received: August 17, 2021; **Accepted:** August 23, 2021; **Published:** August 26, 2021

Keywords: Dengue fever, Dengue hemorrhagic fever, Dengue shock syndrome, Port Sudan.

Introduction

Dengue fever is one of the most drastic arthropod-borne infectious diseases influencing humans. [1]. Is a tropical disease that has

been even more prevalent in recent decades all over the globe . Caused by the dengue virus (DENV), which is a member of the Flaviviridae family and the Flaviviruses genus [2]. Three structural proteins are encoded by the positive sense single-stranded RNA genome: seven non-structural proteins, as well as the capsid protein, membrane, and envelope glycoproteins (NS1, NS2A,NS2B, NS3, NS4A, and NS4B&NS5). The envelope glycoprotein is linked to important biological properties of dengue viruses, such as receptor binding, haemagglutinin of erythrocytes, and the activation of neutralizing antibodies and a defensive immune response [3]. Dengue fever is a mosquito-borne tropical disease that has been even more prevalent in recent decades all over the globe. Caused by the dengue virus (DENV), which is a member of the Flaviviridae family and the Flaviviruses genus [2]. Three structural proteins are encoded by the positive sense single-stranded RNA genome: seven non-structural proteins, as well as the capsid protein, membrane, and envelope glycoproteins (NS1, NS2A, NS2B, NS3, NS4A, NS4B& NS5). The envelope glycoprotein is linked to important biological properties of dengue viruses, such as receptor binding, haemagglutinin of erythrocytes, and the activation of neutralizing antibodies and a defensive immune response [3]. Other considerations relevant to dengue fever, in regard to the vector, include the presence of the virus and a sufficient number of susceptible non-immune individuals, as well as communication with those vulnerable and the mosquito vector [2]. The disease continuum aggravated by dengue viruses is a dominant contributor of morbidity and mortality [4]. Infection could become symptomless or triggering a mild infection known as dengue fever, or it can escalate very quickly to a life-threatening hemorrhagic form (Dengue hemorrhagic fever "DHF") that can contribute to circulatory failure (Dengue shock syndrome "DSS") and death [5]. Disease identified by substantive signs such as fever, headache, prostration, retro-orbital pain, and conjunctival redness, as well as some other systemic indications such as musculoskeletal, gastrointestinal, respiratory, and neurological issues [6]. Dengue fever is specified as an acute febrile condition spanning 2-7 days with two or more of the following manifestations: intense headache, retro-orbital pain, myalgia, arthralgia, skin rash, hemorrhagic signs, and/or leucopenia[7]. While much emphasis is placed to the conditions that cause extreme and hemorrhagic illness, much less attention has been paid to comparing discrepancies in particular clinical manifestations by dengue serovars [8]. An individual dengue serovar quite often over represents specific clinical manifestations [4]. A higher risk is associated with secondary dengue infection with another virus serotype or specific virulent strains [9]. Diabetes mellitus, lethargy, a thick gallbladder, delayed hospital admission, and less than 40 years of age can all indicate who is at greater risk of contracting extreme dengue [10]. Extreme plasma leaking, resulting in dengue shock syndrome, fluid retention, and respiratory difficulties; excessive bleeding; and serious organ injury are all consequences of severe dengue. Such as involvement of the liver, CNS, and heart, the magnitude of the clinical appearance of both children and adults depends entirely on the patients' immune status, age, and genetic background [7]. The most common symptom in infants and young children is an unidentifiable febrile illness with a maculopapular skin rash [11].Classic dengue fever is most often shown in adolescents and young adults[12]. Patients improve in two to seven days and have no squeals of disease, either short or long. The infection vanishes from the circulation at the same time as the fever drops out [13]. Dengue hemorrhagic fever is usually the result of a secondary dengue infection. It may arise in infants after a primary infection caused by maternally transmitted dengue antibodies[1]. DHF's clinical course is classified into three categories: febrile, critical, and convalescent. The febrile period starts with a sudden onset of fever (>38.5C°), which is preceded by generalized constitutional manifestations and a flush on the face. The fever persists 2-7 days before subsiding,any patients advance to the critical phase (plasma leakage), and is accompanied by tachycardia, hypotension, pulmonary edema, ascites, pericardial effusion, which myocarditis, and is correlated with higher morbidity and mortality [7]. Fever and hemoconcentration was found prior to the commencement of shock due to plasma leakage [14].(KalayanaroojS,et al.2002). The four hypotheses that clarify how disease pathogenesis can contribute to DHF and DSS are as follows; Antibody dependent enhancement (ADE), virus virulence, T-cell induced, as well as molecular mimicry [15].The WHO Dengue Scientific Working Group re-categorized dengue into three levels of severity in 2006, based on clinical indications and laboratory characteristics: dengue without warning signs, dengue with warning signs, and extreme dengue.

Patients and Methods

Study Design

A descriptive cross-sectional hospital-based study was employed between July and September 2015.

Study Area

Sudan's main seaport, positioned on the Red Sea coast 295 miles (475 km) northeast of the Nile River valley.Study comprised six tertiary care hospitals: the Port Sudan Teaching Hospital, the Maternity Teaching Hospital, the Pediatrics Teaching Hospital, the Sudan-line Hospital, the Baroot Hospital, and the Sea Port Corporation Hospital.

Study population

Patients with a suspected dengue infection who attended designated hospitals in Port Sudan during the study period were investigated.

Study variables

Gender, age, month of residency, clinical symptoms: (fever, headache, myalgia, arthralgia, skin rash, respiratory symptoms, gastrointestinal symptoms, and hemorrhagic manifestation) were used as independent variables in the study, with dengue patients posing as the dependent variable.

Sample Size and Data Collection

Following the formula: $n=((p*q*Z^2) / d^2) + 10\%$ (Non respondent rate 10%) ,where n is the sample size, p is the sample proportion, q is equal to p-1, Z is the appropriate cut-off point on the standard normal distribution at 95% confidence (standard value of 1.96) and d is the degree of precision. Margin of error at 5% (standard value of 0.05).Based on studies conducted in an African community, 110 suspicious cases have been identified. The data was gathered by direct staff interviews with patients or their relatives, as well as questionnaires. Each respondent signed a consent form.

Inclusion and exclusion criteria

Individuals who are at least 9 months old, residency in study area for at least 7 days, pyrexia with unspecified cause for 2-7 days, thrombocytopenia in malaria negative blood film, as well as ages of 9 months and older considerably involved. Each respondent no meat such specified criteria was excluded.

Ethical Approve

The patients gave their acceptance first, followed by the Sudan Medical Specialization Board and the appointed health care centers. The data collection protocol for the analysis was approved and authorized. The research was explained in different abundance to the respondents, and written informed consent was secured from

those over the age of 18 and from their guardians for those under the age of 18. To ensure patient anonymity and confidentiality, each participant was offered a separate number.

Data Analysis

For entering data and analysis of the volunteers' characteristics, the Statistical Package for Social Sciences program (SPSSInc., Chicago, IL, USA) version 20 was used. Incredibly simple descriptive statistics were used to analyze the laboratory results of hematological indicators and IgM antibodies as well as Dengue risk factors.

Results

The report comprised 83 cases out of 110 that were examined by ELISA at various hospitals in Port Sudan and confirmed to have the dengue virus. Of those, 67 (55%) were male, with the remainder being female.Male and female suspected cases were 67(60.9 %), 43(39.1 %), and the prevalence rate was 46(68.7 %), 37(86 %), respectively. The incidence rate among febrile patients was 75% (68 cases), with DF documented in 80 cases (96%) and DHF in three scenarios (4%). A history of previous infection was found in 11 cases (13%), with a high occurrence rate during July (63 cases) (57 %).Table:1

Table 1: Gender distribution and dengue incidence

Parameters		Number	Total	Percent %
Gender	Male	67	110	55
	Female	43		45
Dengue	IgM Positive	83		75
	IgM Negative	27		25
Suspected	Male	67		60.9
Dengue patients		46	67	68.7
Suspected	Female	43	110	39.1
Dengue patients		37	43	86.0
Incidence among febrile	-	68	83	75
DHF	-	3		4
DF	-	80		96
History of previous infection	-	11		13
Incidence by months	July	63	110	57
	August	33		30
	September	14		13

The respondents' ages ranged from 9 months to 70 years, with a higher prevalence within the (21-30) age category 50/110. (45%). Fever was the most noticeable clinical feature 79/83(95%,More evident hematological indicators included thrombocytopenia and leucopenia (88 percent) 97 out of 110 (71 percent) 78/110 in each event. Table:2

Table 2: Age distribution, clinicalfeatures, and hematological changes

Parameters		Number	Total	Percent%
Age group (Years)	1 – 10	9	110	8
	11 - 20	18		16
	21 – 30	50		45
	31 – 40	25		23
	41 – 50	6		6
	51 – 60	1		1
	61 – 70	1		1
	Fever	79	83	95
Clinical features	Headache	32		38.5
	Musculoskeletal	25		30
	Bleeding	3		3.6
	Respiratory	4		4.8
	Skin rash	1		1.2
Hematological indicator	Leucopenia	78	110	71

	Thrombocytopenia	97	110	88
	Hematocrit > 45 %	20		18

Water containers were recorded as a source of water for 40/83 (49%) of participants,52/83 (64 %) were unaware of the source's coveringlong-sleeved clothing is unwearied by 56/83 (80 %) of the study population as a preventive precaution,60/83 (72%) with no mosquito repellent applicability. 71/83 (86%) of study subjects were knowledgeable of transmission. Table: 3

Table 3: Dengue infection and associated risk factors for transmission

Parameters		Number= 83	Percent%
	Water containers	40	49
Source of water	Water pipes	19	23
	Beers	24	25
Covering of water container	Covered	31	36
	Uncovered	52	64
Wearing of long sleeved clothes	Wearied	27	20
	Unwearied	56	80
Application of mosquitoes repellent	Applicable	23	28
	Not applicable	60	72
Awareness regarding transmission	Mosquitoes	71	86
	Others	12	14

Discussion

Dengue fever was contracted by both men and women of all ages and identities. The authors showed that 83/110 (75%) of respondents were serologically evidence of dengue infection, which is significantly higher than the 71.6 % registered in a previous study performed in Kassala, Eastern Sudan [16]. According to the study, 67/110 (55 %) of symptomatic patients were males and 43/110 (45%) were females, with a ratio of 1.1:1, This marginal male: female ratio corresponds to a study performed in However, according to another South American report, a male: female ratio of 0.65:1 is listed as characteristic for dengue.There is a general realization that biological disparities based on genetic, immunological, and hormonal factors may impact disease susceptibility and patient outcomes[7]. It has been claimed that there is a statistically significant relationship between IgM antibody marker and male gender.Their ages range from 3 to 63 years old, Individuals of reproductive age (21-40 years) were shown to be more susceptible to dengue transmission than other age categories. The most generally recognized hypothesis about the effect of age and dengue infection is; various dengue serotypes were included in the target population, some respondents might become infected with these serotypes, resulting in clinical signs from secondary infection [17]. Also, individuals in this age group often participated in recreational activities on a routine basis, which strengthened their responsiveness to the infective dengue mosquito bite.[18]. Initially, dengue fever was supposed to be a child's disease, but it has recently been extended to adults and older [19].

During the hot and dry months of July and August, there was a marked increase of dengue virus infection (57% and 30% respectively) in contrast to September (13%) where the temperature is a trifle lower (around 39C° with humid weather). This lends credence to studies claiming that low temperatures have a detrimental impact on the rate of development of mosquito life stages as well as viral replication [20]. However, most of Port Sudan's population decides to leave the region between July and August to avoid the extreme temperatures. Port Sudan is predicted to face two transmission intensities: one short in the winter (i.e., for two months in November and December) and one long in the summer (i.e. 3 months from June to August). These highest concentrations were accompanied by Aedesaegypti mosquito densities peaks in December and June, entomological peaks occurring before the onset of winter (November) and summer (March), respectively [21]. A total of 312 cases clinically diagnosed with Dengue hemorrhagic fever were reported in 2006. The majority of patients were diagnosed in May and June, with a 3.8 % mortality rate [22].The majority of the patients who presented with common dengue symptoms, along with fever 79/83 (95%), headache 32/83 (39%), and musculoskeletal symptoms such as arthralgia, lethargy, myalgia, and fatigability, both of which are common symptoms of a benign dengue infection 25/83 (30 %). Gastro-intestinal (GI) tract manifestations as vomiting 20/83 (24%) and diarrhea 4/83 (4%) were not uncommon .Some respondents 5/83 (5 %) experienced flu-like illness and cough as clinical features. A maculopapular rash on the skin emerged in just one scenario. According to WHO guidelines, just 4% of positive dengue patients (three cases) established hemorrhagic symptoms such as epistaxis and gingival bleeding, with one case progressing to grade III-IV [7]. Dengue fever is a hemorrhagic fever that can result in death. The patient who died was admitted on the sixth day of his illness. In a document on dengue deaths, late hospitalization was reported to be a possible factor that contributes to an increased risk of mortality [23]. Hematological changes were evident: Thrombocytopenia was concluded in 97/110 (88%) of dengue infected individuals, just 20/110 (18%) of dengue-infected patients had increased hematocrit, whereas 71% had leucopenia, As a result, all febrile patients should be examined for dengue antibodies.

Patients in the present report were managed based on their clinical issues. Hydration status was sustained whether orally or by intravenously. For fever and musculoskeletal pains, antipyretics and pain relievers are included. Approximately

38% of dengue-infected patients were treated as outpatients. To mitigate gastrointestinal symptoms such as vomiting and epigastric discomfort, anti-emetics and proton pump inhibitors are used .Blood transfusion is used as a treatment line in two cases of DHF and six patients (7.5 %) of DF. The rest of the patients had fully compensated by the time they were discharged. As a consequence of dengue viral hepatitis, elevated liver enzymes were shown in 24% (twenty cases) of positive dengue patients.According to the findings, 11/83 (13 %) of positive dengue patients have already been infected with the virus, while 72/83(87%) denied previous history of infection.

Port Sudan is grouped geographically into three main sectors: southern, eastern, and middle, each of which is further divided into 39 subsections. The study concluded that water storage is relevant to dengue transmission in Port Sudan. Clean water is either routed into pipes or delivered in motorized tankers. Each sector's water supply varies from that of the others, even within the same sector. Both of these water resources, nevertheless, are inadequate, supplying just one-third of the requisite drinking water[24]. Infection rates are much higher in the eastern (34%) and middle (37%) sectors than in the southern (28%). Due to a lack of drinking water, inhabitants of Port Sudan commonly keep drinking water in water containers, which serve as mosquito natural habitats, close to their residences [13]. Owing to the vast number of small containers such as clay pots and barrels, areas of low socio - economic status; lower and middle income communities (Eastern and Middle sectors) have higher entomological intensity scores than upper class areas (Southern sector). Variable disease incidence is explained by variations in water consumer behavior between neighborhoods. Our conclusions showed that lower neighborhoods may be more particularly prone to dengue than upper-income communities.Although it is known that storing water in open containers increases the risk of exposure, the majority of patients (64%) do not cover their water containers. Just 36% of dengue fever patients mask their water containers.

In terms of personal safety procedures, only 27/83(20%) of dengue affected patients said they wear protective gear, and insect repellents were not widely used at night by infected individuals 60/83 (72%). Fortunately, 71/83 (86%) of dengue patients affected were aware of the mode of transmission, whilst the remaining 14/83 (14%) believed it was spread by consumption of tainted water and direct contact between people (11 % and 3 % respectively).

Conclusions

Annually, Port Sudan experiences two dengue incidents: In the winter (November and December), there is a short plateau, and in the summer, there is a long highest point (from June to August). Mosquito abundance peaks in December and June accompanied these two peaks. Dengue fever is popular in all age brackets, regardless of gender or ethnicity. Residents in dengue-endemic areas are more likely to be exposed to the virus throughout their childhood. The clinico-laboratory character traits of DF and DHF (grade I to grade IV) were clearly distinguishable, with DHF being an extremely morbid disease with multi - organ dysfunctions and a longer hospitalization.There is still a scarcity of information to fully comprehend the disease's clinico-laboratory continuum. Laboratory evaluations that are appropriate in Dengue diagnosis could go a fair distance toward means of prevention.

Limitations of the study

The study had some inconsistencies, namely sample selection for just three months (July, August, and September), which did not cover all dengue seasons and may have been an extraordinarily high or low time for dengue infection. The milder cases treated as outpatients were often neglected because the report prioritized laboratory results over other indicators. Due to financial restrictions, specific documentation of dengue virus serovars by PCR was not performed.As a result, the conclusions may be just the tip of the iceberg when it relates to the overall pattern of dengue transmission.

Declaration of interest

There are no conflicts of interest reported by the authors. The article's information and reporting are ultimately the result of the authors.

Authors' contributions

The authors have contributed equally to the study design and manuscript write-up. All authors read and approved the final version of the manuscript.

Abbreviations

DENV: Dengue virus, DF: Dengue fever, DHF: Dengue hemorrhagic fever, DSS: Dengue shock syndrome, ELISA: Enzyme Linked Immunosorbant Assay,WHO:World Health Organization.

Acknowledgments

Individuals, who collaborated in the current study, as well as the healthcare professionals at all designated hospitals, are thankful for their professional assistance.

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