

**Occurrence of Malaria and Dengue co-infection and their vectors surveys in  
Kassala city, Sudan (SGS 18-75)**

*Sudan*

**GENERAL INFORMATION:**

- **PI name:** Khider Alebid Dafallah Alsedig
- **Reporting Period:** Final Progress Report
- **Objectives of the study:**

**General:**

To assess the burden of malaria and dengue co-infection in Kassala city, Sudan

**Specific:**

- 1- To determine the frequency of Malaria and Dengue co –infection in Kassala city
- 2- To determine the malaria and dengue vectors abundance in occurrence of concurrent infection

## **INTRODUCTION:**

Both 'malaria' and 'dengue' are known to be rapidly spreading mosquito-borne diseases and of high importance in terms of both mortality and morbidity, posing a worldwide public health problem due to ease in globalised travel.(1) Malaria is a protozoan parasitic infection caused by *Plasmodium* spp. which is usually transmitted by *Anopheles* spp. Dengue is also a mosquito-borne disease that is due to infection by single stranded RNA viruses of four distinct serotypes (DEN-1, 2, 3 and 4) under the family *Flaviviridae*. Each of these serotypes is usually transmitted by *Aedes aegypti*.(2)

Malaria and dengue are endemic in similar tropical regions, and therefore, may result in the possibility of co-infection. Urban demographic expansion, deforestation and agricultural settlements in peri-urban areas, are known causes of the increase in the probability of concurrent infection of these two diseases.(3)

Concurrent infections of malaria and dengue are when both the diseases occur simultaneously in an individual. Since there are similarities in the clinical characteristics between these two infections, diagnosis of malaria and dengue co-infections might be either misdiagnosed or misinterpreted as mono-infections. There are many cases of malaria-dengue co-infections reported from various regions in the world following the first case which was reported in July 2005 in France.(4)

The two diseases share many clinical features and may be clinically indistinguishable. It is important, however, to differentiate between the two conditions, as malaria is treatable and any delay in treatment may result in a poor outcome. The reported frequencies of concurrent infection in febrile patients presenting to outpatient departments of hospitals in various studies have been quite variable and range from 1% in French Guiana<sup>2</sup> to 6% in India<sup>3</sup> and 27% in Pakistan.(5)

Sudan is endemic for malaria, whereas dengue has established itself in an epidemic transmission cycle. (6) The outbreak of dengue in Sudan was observed since 1984 in Port Sudan caused by serotype 1, 2, and recently in Kassala 2010, Port Sudan 2014 and Alflashir 2014.(7)

Review of records in the reporting health facilities revealed that over 80%, 58% and 33% of the cases tested for dengue also positive for malaria in West, Central and East Darfur,

respectively. This point out the high level of co-infection with malaria amongst patients with severe symptoms who tested positive for Dengue Fever, and has implications on the approach for vector control and surveillance activities.(8)

Kassala witnessed increasing of dengue cases during the last three years according to the clinical services records. (9) A key strategy of the dengue control program relies on vector control to reduce viral and parasite transmission.(10)

Malaria become major health problem in last few years with an incidence rate of 14 cases per 10,000 populations in Kassala State.(11) Clinical manifestations include symptoms that are non specific and cannot be distinguished reliably from other febrile illnesses or other malarias, in addition to misdiagnosis for both malaria and dengue detections may also lead to ambiguity in term of the disease burden in this area.

## **Material and Methods**

### **Study site:**

Kassala city (15°27'N 36°24'E), area 1115 Km<sup>2</sup>, is the capital of the state. Kassala. A seasonal river “Algaash” crosses Kassala longitudinally, and divides it to eastern and western regions. Kassala state is bordered by Eritrea and Ethiopia to the east, Red Sea state to the north; Khartoum and River Nile states to the west and Gedaref state to the south west. Kassala state land space is 42.282 Km<sup>2</sup>. In the northern parts of the state the climate is the red sea climate, while in the other parts the environment is a desert, semi desert, and valley and savannah climate with large fruit farms inside Kassala locality. The average rainfall is 350 to 911 ml and the temperature is 30°C to 51°C. Kassala locality is the locality of the state capital. Kassala locality contains Kassala town, which is the capital of the state. It is location 10°12'N 34°19'E. The land space of Kassala locality is 1.115 Km<sup>2</sup>. Kassala locality is located along the main Khartoum-Port Sudan highway which makes it a main trading center besides the connections with Eritrea and Ethiopia. Kassala locality population is 298,529 living in 97 neighborhoods. The total number of households in Kassala locality is 52853 according to 2008 census. The average family size is 6.3. The drinking water sources are superficial, ground and deep ground waters. In the urban areas

the percentage of the population getting clean drinking water is 68% and in the rural areas this drops to 40 %.

**For entomology survey:**

**1- *Aedes aegypti* (dengue vector)**

A total of 6 districts from kassala were selected and inspected for larvae and Pupa of *Aedes aegypti* (dengue vector) and *Anopheles arabiensis* (malaria vector), houses were 25 houses per district. Monthly survey was conducted during wet season for three months (September, October, and December 2019).

**2- *Anopheles arabiensis* (Malaria vector)**

A total of 60 rooms were inspected for *Anopheles spp.* (adult stages) in six districts inside Kassala city (10 rooms per district). The survey was conducted monthly for three months (September, October, and December).

Also a total of 30 breeding sites were investigated for *Anopheles spp.* (aquatic stages) in six districts (5 breeding sites per district).

**For hospital base survey:**

A total of 398 blood samples were collected from five hospitals in kassala (Kassala Teaching Hospital, Kassala Police Hospital, Al-kuity Hospital, Rama Hospital and Doctor's Hospital) 78 of 198 samples were Malaria positive using microscopic examination test.

Collected sample was distributed as 98 blood samples from kassala teaching hospital, 40 blood sample from kassala police hospital, 40 blood samples from al-kuity hospital, and 20 blood samples from doctor's hospital. These four hospitals located in different site in kassala city, where represent most of febrile cases in kassala.

**Ethical considerations:**

Ethical approval was obtained from the National Ethical Committee of the Federal Ministry of Health, Sudan (NO. 4-11-18).

Informed consent was written and was presented for each study participant; informed consent must read carefully and understand it before. If the participant is unable to read the statement and needs to be explained or translated, the representative of the participant legally will explain and translate it.

**Activity implementation:**

Time period	Activities
16 November 2018	Ethical approval has be approved from National Ethical Committee /Federal Ministry of Health, Sudan
20 April 2019	First installment of the fund have been received
June 2019	Equipment and collection materials have been purchased.
August 2019	Orientation for project team has been implemented at both local and national levels.
7 – 20 September 2019	Field collection for both vectors of malaria and dengue has been done in addition to hospital base survey for both malaria and dengue suspected cases during the Wet season in kassala.
October 2019	Second field collection for both malaria and dengue vectors has been done.
2 – 10 December	Third field collection for both malaria and dengue vectors has been done.

## Preliminary Results

### 1- *Aedes aegypti* (Dengue Vector)

A total of 6 districts from kassala were selected and inspected for larvae and Pupa of *Aedes aegypti* (dengue vector). Houses were 25 houses per district. Monthly survey was conducted during wet season for three months (September, October, and December 2019).

#### Survey NO. 1 (September 2019) for *Aedes aegypti*:

A total of 150 houses (25 houses in 6 districts) were surveyed for *Ae. aegypti*. Out of these, the House Index (HI) % and Container Index (CI) % in Kassala during September 2019 were 60.7% and 32.32% respectively. **Table (1).**

**Table (1): HI% and CI% during September 2019 from selected districts in kassala city**

District	Banat	Mukram	Alkhatmia algadema	West gash	Hi alarab	Barno
House index (HI) %	76	64	76	64	28	56
Container Index (CI) %	28.6	39.1	48	36.7	11.5	30.2

#### Survey NO. 2 (October) for *Aedes aegypti*:

A total of 150 houses (25 houses in 6 districts) were surveyed for *Ae. aegypti*. Out of these, the House Index (HI) % and Container Index (CI) % in Kassala during October 2019 were 32.7% and 13.75% respectively. **Table (2).**

**Table (2): House and Container index during October 2019 from selected districts in kassala**

District	Banat	Mukram	Alkhatmia algadema	West gash	Hi alarab	Barno
House index (HI) %	12	40	20	40	36	48
Container Index (CI) %	4.8	19.6	7.8	16.2	13.6	20.8

**Survey NO. 3 (December) for *Aedes aegypti*:**

A total of 150 houses (25 houses in 6 districts) were surveyed for *Ae. aegypti*. Out of these, the House Index (HI) % and Container Index (CI) % in Kassala during October 2019 were 43.8% and 16.9% respectively. Table (3).

**Table (3): HI% and CI% during December 2019 from six selected districts in kassala city**

District	Banat	Mukram	Alkhatmia algadema	West gash	Hi alarab	Barno
House index (HI) %	26	55	36	54	37	55
Container Index (CI) %	9.8	21.7	10.0	19.7	24.4	15.5

## 2. Adult of *Anopheles arabiensis* (Malaria vector)

A total of 60 rooms were inspected for *Anopheles spp.* (adult stages) in six districts inside Kassala city (10 rooms per district). A total of 183 Mosquitoes were collected from all 6 districts during September 2019. Out of these, 78 of 183 were *An. arabiensis* according to (HOPKINS et al.1952), and the density per room was 2 adult of *An. arabiensis* per room. (Table 4)

In October 2019 a total of 204 mosquitoes were collected from all 6 districts during October 2019. Out of these, 55 of 204 were *An. arabiensis* according to (HOPKINS et al.1952), and the density per room was 1 adult of *An. arabiensis* per room. (Table 5)

**Table (4): *An. arabiensis* (Adult stages) collected from six selected district in Kassala city during September 2019**

District	Total NO. of Mosquitoes collected	NO. of Male	NO. of Female	<i>Anopheles spp.</i>	Other spp.	<i>Anopholes arabiensis</i>
Banat	16	6	10	12	4	10
Mukram	17	5	12	7	10	7
Alkhatmia algadedda	22	10	12	10	12	10
West gash	9	6	3	5	5	5
Hi alarab	62	22	40	31	31	30
Barno	57	34	23	16	41	16
<b>Total</b>	<b>183</b>	<b>83</b>	<b>100</b>	<b>81</b>	<b>103</b>	<b>78</b>



**Table (5): *An. arabiensis* (Adult stages) collected from six selected district in kassala city during October 2019**

<b>District</b>	<b>Total NO. of Mosquitoes collected</b>	<b>NO. of Male</b>	<b>NO. of Female</b>	<i>Anopheles spp.</i>	<b>Other spp.</b>	<i>Anopholes arabiensis</i>
<b>Banat</b>	13	7	6	5	8	5
<b>Mukram</b>	22	14	8	8	14	8
<b>Alkhatmia algadeda</b>	17	14	3	6	11	6
<b>West gash</b>	66	38	28	16	50	15
<b>Hi alarab</b>	34	23	11	5	29	5
<b>Barno</b>	52	30	22	16	36	16
<b>Total</b>	<b>204</b>	<b>126</b>	<b>78</b>	<b>56</b>	<b>148</b>	<b>55</b>

#### **Larvae of *An. arabiensis***

A total of 30 breeding sites were investigated for *Anopheles spp.* (aquatic stages) in six districts (5 breeding sites per district), result found that density of Anopheles larvae per dip was 20.6., 35, and 19 larvae during September, October, and December respectively.

#### **Identification of Mosquitoes Samples**

A total of 3785 mosquito larvae were collected and identified according to (HOPKINS et al.1952), 2115 larvae were *Ae. aegypti* and 1070 larvae were *An. arabiensis*.

**Hospital base survey:**

A total of 398 blood samples were collected from five hospitals in kassala city (Kassala Teaching Hospital, Kassala Police Hospital, Al-kuity Hospital, Rama Hospital and Doctor's Hospital) 193 of 398 samples were Malaria positive using microscopic examination test. **Table (6).**

Collected sample was distributed as 140 blood samples from kassala teaching hospital, 40 blood samples from kassala police hospital, 40 blood samples from al-kuity hospital, 120 blood samples from Rama Hospital, and 58 blood samples from doctor's hospital. These five hospitals located in different site in kassala city, where represent most of febrile cases in kassala.

**Table (6): Malaria Positive and Malaria Negative Samples from selected hospital in Kassala city**

<b>Hospital</b>	<b>Sample collected</b>	<b>Malaria positive</b>	<b>Malaria negative</b>
Kassala Teaching Hospital	140	53	87
Kassala Police Hospital	40	26	14
Al-kuity Hospital	40	12	28
Rama Hospital	120	65	55
Doctor's Hospital	58	37	21
<b>Total</b>	<b>398</b>	<b>193</b>	<b>205</b>

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