The temporal and spatial incidence and transmission of malaria in South Sudan (2011-2018)

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This is a summary of an original public health research thesis that was submitted in 2019 to the Department of Pathogen Biology, School of Public Health, Southern Medical University, Guangzhou, Guangdong Province PR-China. The thesis (with all analyses, figures and references) is available from Iboyi Amanya Jacob amanyajazy@yahoo.com

Introduction: A variety of factors, including settlement structure, climate and environmental issues, influence the temporal and spatial distribution of malaria. The aim of this research was to investigate these spatio-temporal factors from 2011 to 2018 in South Sudan and relate them to malaria control programmes and so inform decision-making.

Method: All cases, clinically diagnosed or microscopically confirmed, were extracted from the Ministry of Health's database. These data were correlated with climatic, geographic (spatial) and seasonal factors. This enabled the definition of clustering patterns.

Results: A total of 12,290,614 malaria cases were reported in the eight years of the study. The numbers were 1,810,835 in 2011, and 2,068,518 in 2015 with a peak at 2,640,439 in 2014. The average incidence was 3.33/10,000 people. Incidence peaked at 3.97/10,000 in 2014, and declined to 2.81/10,000 in 2015. Figure 1 shows the incidence of cases over the study period and Figure 2 shows the monthly incidences.

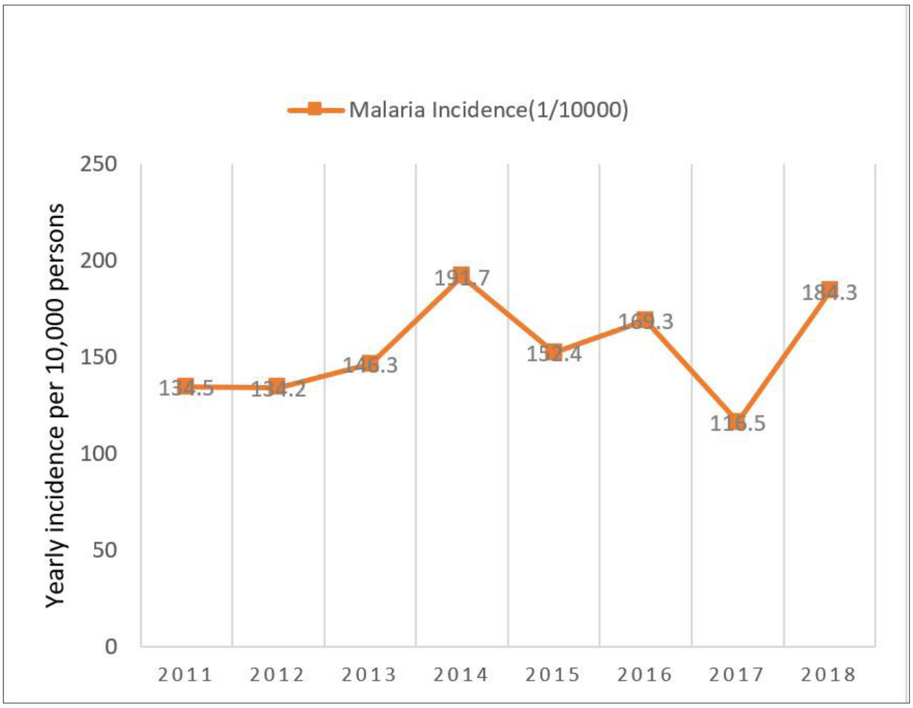

Figure 1. Incidence of malaria per 10000 people in all counties 2011 - 2018

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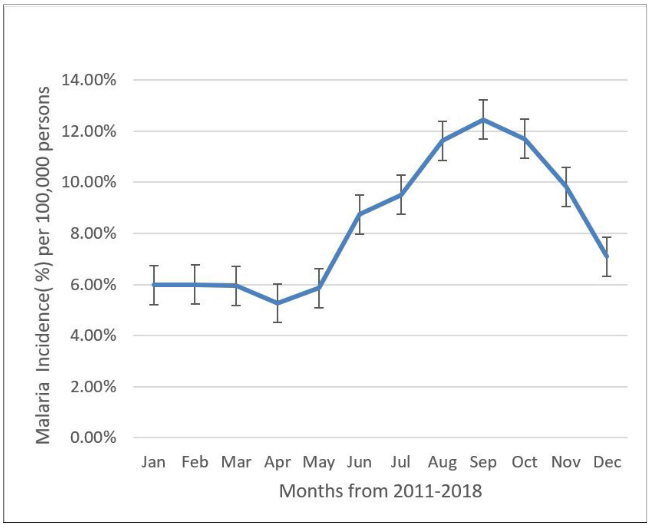

Figure 2. Monthly incidence of cumulative cases of malaria 2011-2018

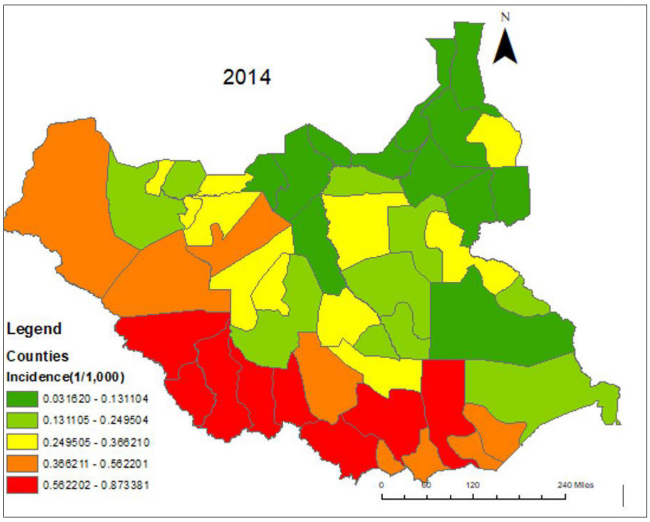

Figure 4. Incidence of malaria cases per 1

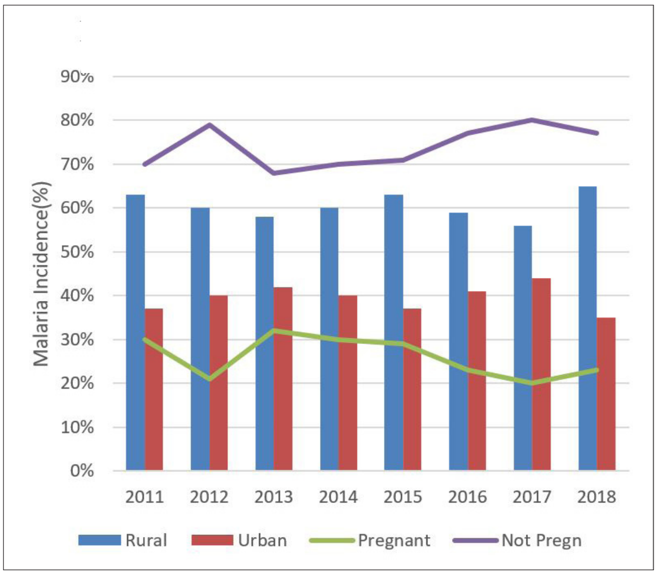

Figure 3. Malaria incidence by residence and pregnancy status.

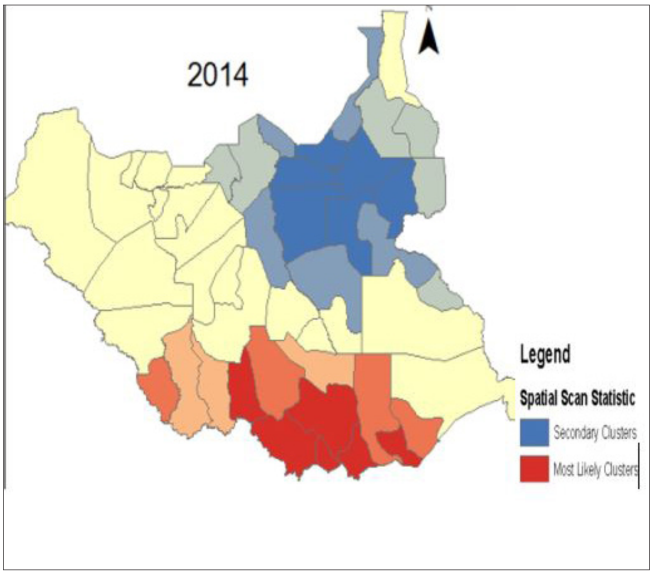

Figure 5. Hot-spots and Clusters of malaria incidences in 2014

About half (56.3%) of the cases were aged under five years; 56.4% were females and 43.6% were males. Figure 3 shows incidence by residence and pregnancy status.

Figure 4 shows spatial distribution of malaria in 2014 (the year of highest incidence) and Figure 5 the clusters and hotspots for the same year.

Rainfall was related to incidence (rho =0.82; P<0.001) (Figure 6) as was humidity (rho = 0.58, P< 0.048). However there did not appear to be a significant link with temperature (rho= -0.301 P<0.341).

Discussion: Knowing the temporal and spatial distribution of malaria and the root causes of the increasing disease burden helps in targeting prioritized strategies to eradicate malaria.

Major factors most significantly associated with malaria transmission in South Sudan are rainfall and humidity. Monthly malaria incidence increased as rain intensifies with incidences beginning to rise in June, sharply peaking in August to October and declining in November as rain diminishes. Our study found that the malaria distribution was more clustered in the southern region of the country than in the north, and that the southern region was the area with a high incidence of hotspots of malaria with a significant correlation with meteorological conditions.

The groups especially affected were under-five year olds and pregnant women. In 2014, malaria in the under-fives year olds accounted for more than half of the total cases in South Sudan; this could be attributed to high rates of malnutrition, anaemia and diarrhoeal diseases making these children more susceptible to malaria infection and

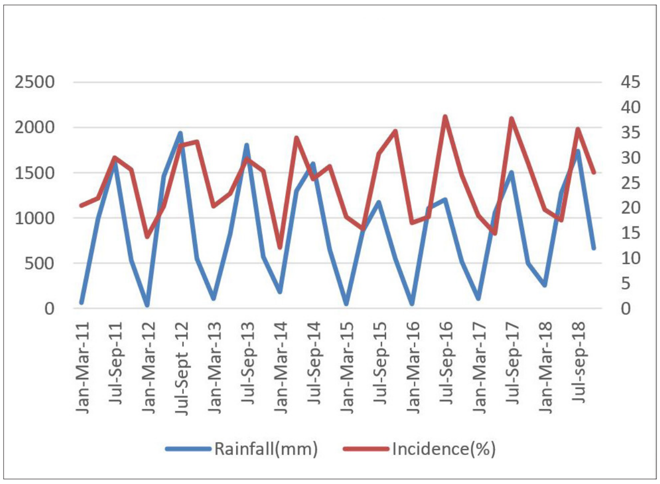

Figure 6. Relationship between malaria incidences and rainfall from 2011-2018

death; our analysis showed that malaria is more severe in this age group. Females are particularly exposed to infection when collecting fire-wood, and drawing water; rural areas reported more cases than urban ones. Women are felt to be at higher risk than men which might be related to gender differences in ownership of resources, access to education, health care seeking behaviours, and mosquito net usage.

Our spatiotemporal analysis is important in determining the epidemiology of vectors, and to provide management strategies because it focused on basic planning units (counties) which are the smallest geographic locations targeted to rural populations.

Trend analyses showed that malaria control in South Sudan during the period of our study was very weak and the country was vulnerable to outbreaks because there had been ongoing violence that caused deterioration in public health services.

Conclusion: More information on malaria prevalence, spatiotemporal distribution and its associated factors are vital to focus and improve malaria programme interventions. Our results indicate the importance of linking these findings with malaria control programmes.

Taking into account weak public health system, difficult geographic terrain, rising trade and peoples' movements, inadequate vector control interventions, and observed relationships between climatic variables and vectors, the findings concluded that climate changes intensify the risk of outbreaks in hard-to-reach areas, if other non-climatic drivers of parasite-borne infection remain constant.

There appears to be a knowledge gap regarding mosquito nets ownership and utilization and there needs to be more focus on health education programmes and mosquito net supply. Overall, efforts and resources are called for improving coverage among vulnerable populations.