Spatial Distribution Of Malaria Epidemiology Geographic Information System GIS In Kass Zone, South Darfur State-Sudan

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ABSTRACT

Malaria remains one of the most threatening diseases that caused by parasites and it transmitted to human beings through the inflamed mosquito's bites that referred to as female Anopheles. It is far the endemic disease in the public health classes in Sudan. As much as in Africa and regard the world. Most of the population at risk of malaria fever, which includes citizens, nomads, and immigrants from neighboring endemic countries in addition to farmers and workers. The purpose of this study is to understand the change within the spatial distribution of malaria disease in Kass nation, South Darfur, Sudan by the year 2005–2008. The data for the study collected from the Malaria and Neglected Diseases-Ministry of Health, South Darfur-Sudan and processed analyzed using Geographic Information System GIS aided with other computer programs. Digital maps illustrate the spatial distribution changes for seven years of malaria in six sectors of South Darfur State according to eight parameters. These parameters are Annual Blood Examination Rate ABER, Incidence Rate IR, Fatality Rate FR, and plasmodium falciparum Pf%. It clearly appears the change in the spatial distribution of malaria within a 7-year period, regarding the digital mapping of infections in South Darfur State.

Keywords : Geographic Information System GIS; spatial distribution, Digital maps, South Darfur, Malaria.

1   Introduction

There are 97 international locations all around the world had ongoing malaria transmission in 2013. Approximately 3.2 billion human beings are prone to malaria disease, in six malaria transmission regions in keeping with the world health corporation WHO classifications. Among 2000 and 2015 the disease incidence amongst populations of threat reduced by 37%. The malaria death among the entire population at danger decreased by 60% amongst all age groups in the global [1].

Sudan is one of the pinnacles biggest African countries. The population of around 39 million (estimate 2016), and malaria is the maximum endemic diseases [2]. Additionally identified as an extensive public health life-threatening disease to a whole population, which includes indigenous people, nomads, and immigrants from neighboring endemic countries as well as farmers and workers. Similarly, consistent with the WHO Sudan is classified because the eastern Mediterranean area [1, 3, 4]. Furthermore, Sudan labeled as one of the poorest nations in the world and the Darfur area referred to as a field of political and tribal conflicts, which affects the process of offering health services. The best rates of malaria death located in the age groups much less than five years old. The kids are more susceptible than adults withstand to diseases [5-7]

In general, malaria considered one of as most endemic diseases that affect South Darfur and the Darfur region. The entire variety of malaria

instances in South Darfur state is taking the downward trend from 8850 in 2008 to 3324 in 2011. For the reason that then, increasing trends discovered 5072 cases in 2012. Then decreasing to 2218 cases in 2013 and 1466 instances in 2014 illustrated in (figure 1) [Unpublished data from Malaria and Neglected Tropical Diseases, Ministry of Health].

2. METHODS

2.1 Study site

This study carried out in Kass zone, South Darfur state-Sudan for the period among January 2005 to December 2008. Kass zone positioned in Northern South Darfur state, and covers of approximately 4,300 Km2 of a geographical location. It stretches among 23°41'N-24°52'E longitudes and 11°08'N-13°08' N latitudes, with a population of about 84004 (estimate 2016).

The average annual temperature is 27.1 °C. The highest temperature recorded in May, to round 30.6 °C. Similarly, the coldest month is January, with temperatures average, 23.5°. annual relative humidity is 35.58%, and overall rainfall is 402.49 mm. the lowest and maximum relative humidity had been reported in February and July at the same time as the highest annual rainfall is in August and zero or near zero in November, December, January, and February [8].

Kass zone divided into three localities. Similarly, to terrible health services and shortage of insurance led to the weakness of the health data system. Consequently, patients following surveillance system, and the world fitness organization acknowledges a particular centers system (sentinel site), in particular in such situations system. It is for an early warning of cases to contain the disease in the first period. (Figure 1).
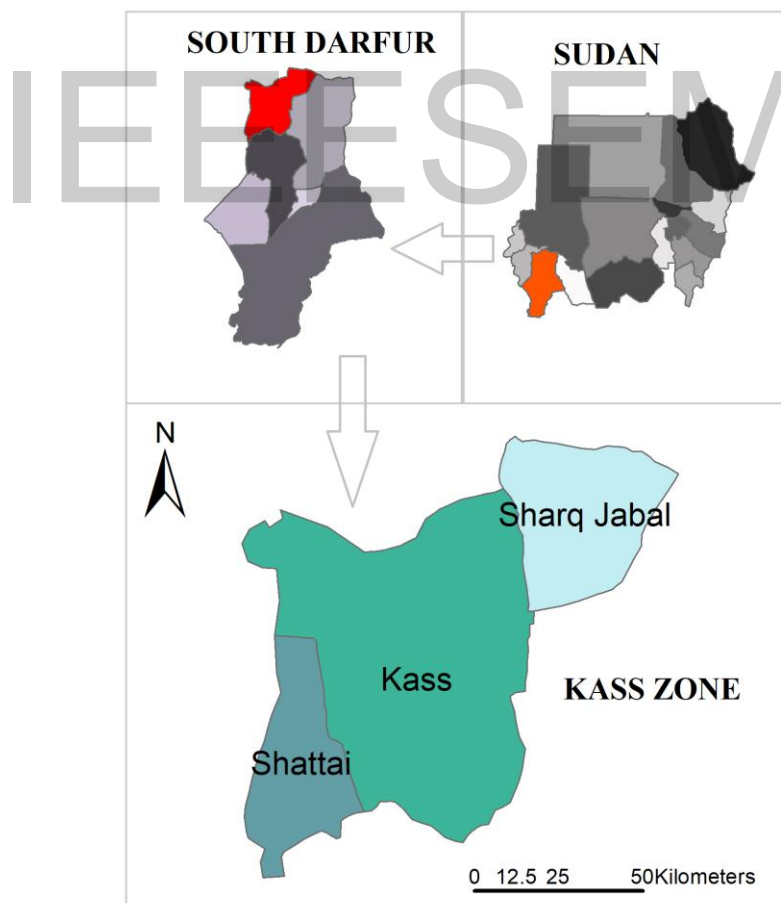

Fig 1: The location of study area

2.2 Study site

The study conducted using old information retroactively to malaria disease for the period of 2005 to 2008. All the data concerned with the condition have obtained from the Ministry of Health of South Darfur state, from malaria and neglected tropical diseases program. As the population number received from the Department of Statistics in South Darfur state, the 2008 census and the backwards projections for the following years until 2005. Maps have varied from department of surveying in South Darfur state. The data classified, processed and analyzed by the use of GIS tool, i.e., ArcGIS (V10.1; ESRI). After the appropriate data equipping. The data processed and analyzed using the Geographic Information System GIS to produce digital maps. These maps are: ABIR, IR, FR, and Pf%.

3 Results

The spatial distribution changes for seven years of malaria in three localities in Kass zone are illustrated by digital maps according to two parameters; ABIR, IR, FR, and PF.

Figure 2 indicates the changes of ABIR in 3 localities of Kass zone, South Darfur Sudan from 2005 to 2008. ABER takes into account the efficiency and adequacy of case detection mechanisms [9]. Within a 4 year periods, values of ABER in Kass locality were constantly reported >10% through the whole study period. The changes of malaria in IR for three localities in Kass zone from 2005 to 2008 graphically shown in Figure 3. Within 4 years duration, Kass locality reported IR >10/10000 population in 2005 and 2008. Sharq Gabal reported <10/10000 population from 2005-2007. Meanwhile, Shattai locality reported IR >10/10000 in 2006 and 2007.

Figure 4 shows the changes in FR on 3 localities in Kass zone from 2005 to 2008. There was malaria fatality cases reported in Kass locality FR > 10% during the study period. Figure 5 indicates the changes in Pf for 4 localities in Kass zone from 2005 to 2008. There was malaria Pf cases reported 71-100% in Kass locality, but Sharq Gabal and Shattai reported Pf <30% in two years for each through the study period.
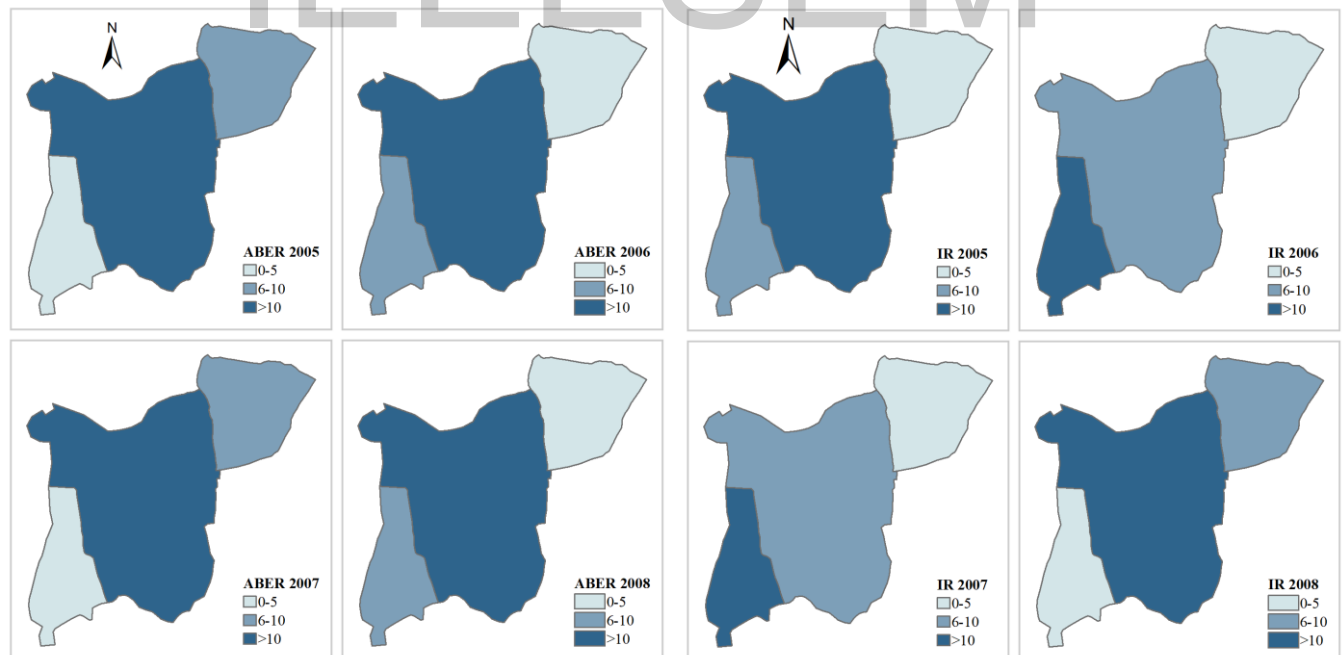

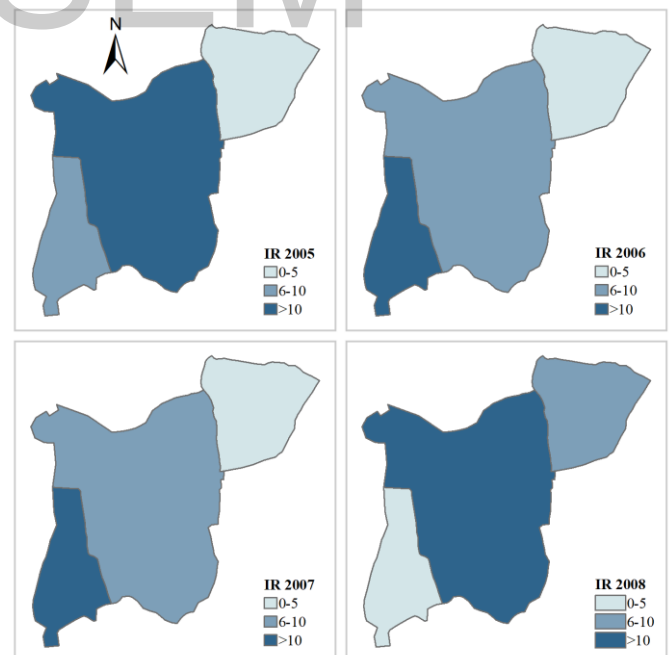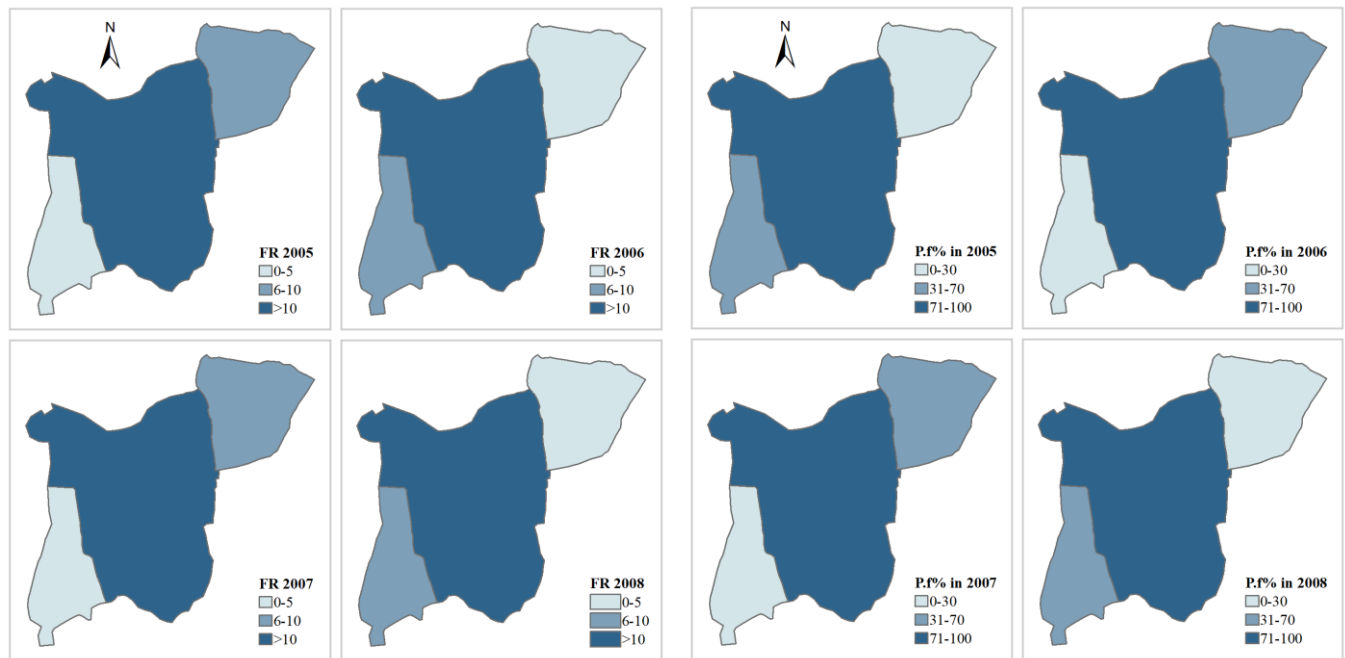**Fig 2:** ABER from 2005-2008 in Kass zone

Fig 3: IR from 2005-2008 in Kass zone

Fig 4: FR from 2005-2008 in Kass zone

Fig 5: Pf% from 2005-2008 in Kass zone

3. Discussions

In this study, the results have demonstrated a large measurements data set among 14832 patients in Kass zone, about 32% <5 years old and 68% >5 years old. The blood checked 24% out of the whole patients. The infections are about 42% out of the checked patients. ABER measures coverage of the surveillance program, and potentially local fever incidence. The distribution of ABER through the four years from (2005 – 2008) in Kass zone indicates that the study area is highly endemic. The higher prevalence of malaria found in Kass locality, IR, ABIR, and Pf was recorded through the four study years, which is the highest case detection in the zone. Because Kass locality is the compound of the camps for displaced persons due to tribal and armed militia groups. Through the entire period, we can see the decreasing of IR towards 2008. Because of the policy of indoor residual spraying (IRS) to sensitive areas and the distribution of insecticide-treated nets (ITNs) in most of Kass localities. However, IR still very high and needs more treating and investigations. Relating to the FR, the malaria fatality cases reported in all Kass zone. Reasons and factors that helps a lot in the presence of death cases that emerged during the study period are, Some delay of the patients visiting the clinics, especially in rural areas, some laboratories failed in the diagnosis of the quality and stage of the disease, leading to failure to determine the appropriate treatment on time. As well as natural factors, such as torrential rain that was hindering malaria control teams and deliver medicines, moreover the lack of paved roads to be provided. There is also a dearth of means of storage of medications on sweeteners for lack of electricity stability [10,11].

Regarding all of the above consequences, we find that the malaria control program in Kass zone is active to some extent, but it still needs more studies and intensive programs. To combat malaria, the government must implement several strategies, such as early case detection, close monitoring of important cases, using bed nets, monitoring of drug resistance, residual spraying, and collaborating with the neighboring states and countries.

4. Conclusions

It clearly appears the change in the spatial distribution of malaria within a 4-year periods, regarding the digital mapping of infections in South Darfur State.

The findings indicate the irregularity variation in malaria distribution through the study period, as well as in the diverse malaria localities. Mainly malaria disease is brought up in the central part of the of Kass zone especially in Kass locality. Our conclusion notes that Kass zone still an endemic area and need more studies and a comprehensive program to decrease the malaria infection.

5. Acknowledgement

6. Authors' contributions

HEH conceived, designed the study, performed the data collection, and prepared the final draft. YB supervised the data analysis, reviewed the manuscript critically, and contributed intellectual input. All authors read and approved the final manuscript.

7. Conflicts of interest

The authors declare that they do not have competing interests.

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