

A perspective of the epidemiology of malaria and anaemia and their impact on maternal and perinatal outcomes in Sudan

Ishag Adam¹, Elhassan M. Elhassan¹, Abd Elrahium D. Haggaz², Abdel Aziem A. Ali³, Gamal K. Adam⁴

¹Faculty of Medicine, University of Khartoum, Sudan

²University of Gezira, Wad Medani, Sudan

³Faculty of Medicine, Kassala University, Sudan

⁴Faculty of Medicine, Gadarif University, Sudan

Abstract

Introduction: Both malaria and anaemia have adverse effects on maternal and perinatal outcomes. Thus there is an urgent need to investigate the co-epidemiology of malaria and anaemia and their combined impact on maternal and perinatal outcomes in the different regions of Sudan
Methodology: Various cross-sectional and case control studies conducted during the years 2003-2010 to investigate the epidemiology of malaria and anaemia and their impact on maternal and perinatal outcomes in different regions of Sudan were compared.

Results: While 13.7% of antenatal attendants in New Halfa had peripheral microscopically detected *Plasmodium falciparum* malaria, placental malaria (using histological examinations) was prevalent in 32.0-40% and 19.5% of parturient women in New Halfa and Gadarif Hospitals, respectively. Malaria was a risk factor for anaemia in New Halfa and for stillbirths in Omdurman Maternity Hospital. Anaemia was present in 52.5%, 62.6% and 80.2% of pregnant women in Medani, New Halfa, and Gadarif Hospitals, respectively. In Gadarif, 57.3% of pregnant women had a folate deficiency, while 1% had a vitamin B12, deficiency. In Medani, zinc and copper deficiencies were detected in 45.0% and 4% of pregnant women, respectively. Anaemia was a risk factor for low birth weight in Al-Fashir, for fetal anaemia in New Halfa, and for stillbirth in Kassala Hospital.

Conclusion: More care should be taken to ensure proper nutrition and malaria prevention such as bed nets and intermittent preventive treatments to avoid these diseases and their effects on maternal and perinatal outcomes.

Key words: malaria; anaemia; pregnancy; perinatal; Sudan

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Introduction

Malaria in pregnancy is a major public health problem in tropical and subtropical regions of the world and makes a significant contribution to maternal and perinatal morbidity and mortality [1,2]. Each year more than 500,000 women die during pregnancy or childbirth [1] and more than four million babies die in the first 28 days of life, accounting for 38% of mortality in children five years of age or under worldwide [3,4]. Maternal malaria infection is estimated to account for three to eight percent of all infant deaths [5].

Several studies have reported malaria as the primary reason for anaemia in pregnant women in other countries with unstable or stable malaria transmission [6,7]. Anaemia during pregnancy is associated with increased maternal morbidity and mortality [8]. The control of anaemia in women of reproductive age is one of the Safe Motherhood

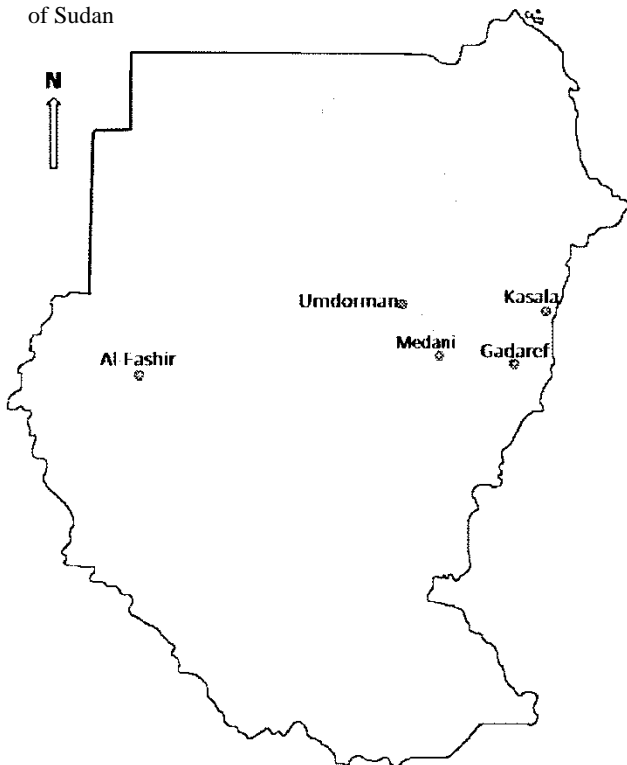
Initiatives [9]. In Sudan, the largest country in Africa, malaria with unstable transmission dominates most parts including the eastern and central areas [10]. High rates of maternal and perinatal mortality have been observed in the different regions of Sudan; both malaria and anaemia were the major causes of these high levels of mortality [11-13].

Understanding the epidemiology of malaria and anaemia during pregnancy is important for deciding the control strategies. Studies investigating these parameters are thus vital and may be of great interest in providing health planners and caregivers with fundamental guidelines for the implementation of preventive measures. Therefore, the aim of this work was to determine the epidemiology of malaria and anaemia among pregnant women in different regions of Sudan by comparing the data from various individual studies [14-22].

Methodology

During the years 2003-2010, various cross-sectional and case control studies [14-22] have been conducted to investigate the epidemiology of malaria and anaemia among pregnant women and to investigate the effect of malaria and anaemia on maternal and perinatal outcomes in the different regions of Sudan (Figure 1). These studies were designed to answer the desired research questions as applicable (e.g., cross-sectional studies for prevalence and risk factors). Likewise, different statistical methods were used to analyze the data as applicable per study. Each study indicated that both

Figure 1: Map showing hospital locations in different regions of Sudan



informed patient consent and ethical clearance from the different institutes in Sudan was obtained. The studies were analyzed individually and then compared. The data were not pooled.

Results

Prevalence of maternal malaria in Eastern Sudan

Cross-sectional studies were used to investigate the prevalence of malaria in pregnancy in Eastern Sudan. While 13.7% (102/744) of prenatal attendants

Table 1. Epidemiology of malaria during pregnancy in Sudan

Region	Prevalence	Risk factors	Reference
New Halfa	13.7% (102/744)		Adam <i>et al.</i> [14]
New Halfa	40% (57/142)		Adam <i>et al.</i> [15]
New Halfa	32.0% (94/293)	Blood group O	Adam <i>et al.</i> [16]
Gadarif	19.5% (46/236)	Lack of antenatal care	Adam <i>et al.</i> [17]

in New Halfa Teaching Hospital had peripherally microscopically detected *Plasmodium falciparum* malaria (diagnosed using blood films), placental malaria (diagnosed using placental histopathology) was prevalent in 32.0% (94/293) and 19.5% (46/236) of parturient women in New Halfa Teaching and Gadaref Hospitals, respectively (Table 1). In one other study at the New Halfa Teaching Hospital, 40% (57/142) of pregnant women were positive for malaria either by blood smear microscopy (17/142; 12%) or using *P. falciparum*-specific polymerase chain reaction (PCR) on peripheral blood specimens (40/142; 28%) [15]. That is, 32% (40/125) of the smear-negative pregnant women were found to have submicroscopic malaria.

Risk factors for maternal malaria

In all these studies [14-17], neither age nor parity was a risk factor for malaria in these settings. In New Halfa Teaching Hospital, mothers with blood group O were at higher risk for placental malaria.

Epidemiology of maternal anaemia in the different regions of Sudan

Likewise, cross-sectional studies were used to investigate epidemiology of anaemia in these settings. Anaemia was present in 52.5% (104/200), 62.6% (466/744) and 80.2% (224/279) of pregnant women in Medani, New Halfa, and Gadaref Hospitals, respectively. In Gadaref, 57.3% (160/279) of pregnant women had a folate deficiency and 1%

had a vitamin B12 deficiency. In Medani, zinc and copper deficiencies were present in 45% (90/200) and 4% (8/200) of pregnant women, respectively (Tables 2, 3).

Table 2. Epidemiology of anaemia during pregnancy in Sudan

Region	Elements	Deficiency/Prevalence	Reference
Gadarif	Iron	11.1% (31/279)	Abdelrahim <i>et al.</i> [19]
	Folic acid	57.7% (161/279)	
	B ₁₂	1.0% (3/279)	
Kassala	Iron	14.8%(37/205)	Ali <i>et al.</i> [20]
	Zinc	38% (95/250)	
Medani	Iron	6.5%(13/200)	Bushra <i>et al.</i> [21]
	Zinc	45%(90/200)	
	Copper	4.0%(8/200)	

Risk factors for anaemia

Malaria and pica (eating mud) were risk factors for anaemia in New Halfa and for stillbirth in Omdurman Maternity Hospital [18,23]. Age was not a risk factor for anaemia in all these studies. With the exception of one recent study conducted in Kassala, parity was not a risk factor for anaemia in all other studies.

The effect of anaemia on perinatal outcomes

Anaemia was a risk factor for low birth weight in Al-Fashir, for fetal anaemia in New Halfa, and for stillbirth in Kassala Hospital [24,25].

Discussion

Previously, high rates of maternal and perinatal mortality in the different regions of Sudan were observed [11-13], although malaria and its related anaemia were not included in these high rates of maternal and perinatal mortality. The main finding of the current analyses of previous studies was that there is a high prevalence of malaria and anaemia among pregnant women in the different regions of Sudan. Malaria and anaemia were furthermore observed to be predictors for poor perinatal outcomes. As in previous studies, anaemia was reported as a risk

factor for fetal anaemia and low birth weight [22,24]. Several studies have reported malaria as a primary reason for anaemia in pregnant women in other countries [6,7]. Maternal anaemia and malaria have

Table 3. Micronutrients and trace elements deficiencies during pregnancy in Sudan

Region	Prevalence	Risk factors	Reference
New Halfa	62.6% (466/744)	Malaria, pica	Adam <i>et al.</i> [18]
Gadarif	80.2% (224/279)		Abdelrahim <i>et al.</i> [19]
Kassala	58.4% (146/250)	Parity, zinc	Mohamed <i>et al.</i> [20]
Medani	52.5%(104/200)	Pica	Bushra <i>et al.</i> [21]
Elfashir	53.5% (230/430)		Haggaz <i>et al.</i> [22]

been reported in areas of unstable malaria transmission in Thailand and in Ethiopia, as well as in areas with stable malaria transmission [26,27]. Regardless of the transmission level and pre-pregnancy level of malaria immunity, maternal anaemia remains the most frequent consequence of malaria during pregnancy [28].

After documenting the high prevalence of malaria and anaemia among pregnant women in Eastern Sudan, precautionary measures against malaria, such as bed nets and intermittent preventive treatments, were recommended. Interestingly, there was poor knowledge of malaria and perception toward its treatment among pregnant women, as well as among interviewed midwives in the area [29]. Indeed, socio-demographic factors such as lack of education and prenatal care were reported to be related to infection with malaria and maternal and perinatal outcomes. For example, lack of prenatal care was observed as risk factor for placental malaria in Gadarif [17] and lack of education and prenatal care were risk factors for poor perinatal outcomes in Khartoum [30].

Although Sudan is the largest African country and has different cultures that might be influenced by ethnicity and other factors, malaria and anaemia have high prevalence and interactions with each other irrespective of culture or ethnicity, and pregnant

women are at risk for malaria and anaemia regardless of their age and parity, with the exception of one study in Kassala. In other African countries with intense malaria transmission, primigravidae and secundigravidae were the risk factors for malaria and its associated anaemia [6,7]. It is expected that multigravidae with previous feto-maternal interactions due to malaria infection should portray an immunological picture of malaria different from that of primigravidae. This difference would be a result of both immune cell priming, especially against malaria parasites, and the development of antibodies against adhesion molecules responsible for placental sequestration of parasites [31].

Human immunodeficiency virus (HIV) infection has become more prevalent and must now be considered a possible etiologic factor for anaemia and among the causes of poor maternal and perinatal outcomes in sub-Saharan Africa [32]. Previously, we have shown that pregnant women in central Sudan had low HIV prevalence and that they were poor uptakes for HIV testing and counseling [33,34], which could explain the scarcity of data concerning HIV in Sudan. Other communicable diseases were reported to have poor maternal and perinatal outcomes in most regions of Sudan; for example, viral hepatitis in Khartoum and visceral leishmaniasis (kala-azar) in eastern Sudan [35,36].

A limitation of this study is that it reviewed previous hospital-based studies, which might not reflect the situation in the community. Larger focused studies on the impact of malaria and anemia in pregnancy in Sudan and associated risk factors are therefore needed.

In summary, there was high prevalence of anaemia and malaria in the different regions of Sudan. Preventive measures such as bed nets and intermittent preventive treatments should be employed to reduce these diseases and their impact on maternal and perinatal outcomes..

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Corresponding author

Ishag Adam
 Faculty of Medicine,
 University of Khartoum,
 Khartoum, Sudan
 Email: ishagadam@hotmail.com

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