

# Malaria in pregnancy in Hodiedah, Republic of Yemen

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المالاريا أثناء الحمل في الحديدة، جمهورية اليمن  
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**الخلاصة:** تُعدُّ المتصورات المنجلية المسبب الرئيسي للمالاريا في جمهورية اليمن، وتوافق مع عواقب ضائرة بالحوامل وبالولدان. وقد تمت مقارنة معدلات الانتشار والمظاهر السريرية (الإكلينيكية) للمالاريا في 500 من النساء منهن 260 حاملاً و240 غير حامل. وقد استخدمت الفحوصات السريرية والتقصيات المختبرية بالإضافة إلى استبيان تفصيلي لتجميع المعطيات. ووجد أن معدل انتشار المالاريا لدى الحوامل (55%) أعلى منه بين غير الحوامل (20%)، كما أن فقر الدم أكثر شيوعاً وبشكل يُعتدُّ به إحصائياً لدى الحوامل منه لدى غير الحوامل، كما أنه أكثر شيوعاً لدى الحوامل المصابات بالمالاريا منه لدى غير الحوامل المصابات بالمالاريا.

**ADSTRACT:** In the Republic of Yemen, *Plasmodium falciparum* is the predominant causative agent of malaria and is associated with adverse consequences for pregnant women and their babies. The prevalence and clinical manifestations of malaria among 500 pregnant (260) and non-pregnant (240) women were compared. Clinical examinations, laboratory investigations and a structured questionnaire were used to collect data. The prevalence of malaria was higher among pregnant women (55%) than non-pregnant women (20%). Anaemia was significantly more prevalent among pregnant woman than non-pregnant women and also more prevalent in pregnant women with malaria than non-pregnant women with malaria.

## Le paludisme pendant la grossesse à Hodeïda (République du Yémen)

**RESUME** En République du Yémen, *Plasmodium falciparum* est l'agent étiologique prédominant du paludisme ; il est associé à des conséquences néfastes pour les femmes enceintes et leur bébé. La prévalence et les manifestations cliniques du paludisme chez 500 femmes enceintes (260) et non enceintes (240) ont fait l'objet d'une comparaison. Des examens cliniques, des analyses de laboratoire et un questionnaire structuré ont été utilisés pour recueillir des données. La prévalence du paludisme était plus élevée chez les femmes enceintes (55 %) que chez les femmes non enceintes (20 %). L'anémie était significativement plus répandue chez les femmes enceintes que chez les femmes non enceintes ; en outre, elle était plus répandue chez les femmes enceintes atteintes de paludisme que chez les femmes non enceintes atteintes de paludisme.

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## Introduction

Many researchers consider malaria to be an endemic disease in the Republic of Yemen. *Plasmodium falciparum* is the predominant causative agent of malaria in this country [1–5].

Malaria infection due to *P. falciparum* has been widely recognized as associated with important adverse consequences in pregnant women [6] and malaria during pregnancy can have severe consequences for both the mother and the fetus [7]. Pregnancy has been observed to be an important risk factor for mortality among female malaria patients [8].

It is recognized that anaemia can be associated with pregnancy and is aggravated by malaria infection [9–11]. Diagne et al. found that the incidence of malaria attacks was on average 4.2 times higher during pregnancy than during the control period [12]. In areas endemic for malaria, pregnant women frequently present with a placenta that has been infected by *P. falciparum*, an infection associated with a reduction in birthweight of the offspring [13]. Pregnant women are highly susceptible to malarial infection, resulting in maternal anaemia and low birthweight (LBW) infants [14].

Many other authors have confirmed that placental malaria increases the risk of delivery of an LBW infant and that this potentially increases the risk of perinatal and infant mortality [15–19]. Moreover Matteelli et al. found that women with active placental malaria infection are more likely to have babies of LBW (15.5%) than those with past chronic infection (1.4%) or no infection (1.5%) [20]. Furthermore, malaria has a considerably greater socioeconomic impact than other common diseases, especially with regard to a woman's household commitments and work [21].

Therefore, we aimed to determine the prevalence of malaria among pregnant and non-pregnant women and assess the impact of malaria on the prevalence and severity of anaemia among pregnant and non-pregnant women. Furthermore, the impact of pregnancy on the prevalence and severity of anaemia among those infected with malaria and non-infected women was measured and the clinical manifestations of malaria among pregnant and non-pregnant women were compared.

## Methods

A cross-sectional descriptive and comparative study was conducted in Hodiedah, Republic of Yemen.

Sample size was calculated using *Epi-info* version 6.02. Thus 500 women of reproductive age were enrolled in the study. Of these, 260 women were pregnant and 240 were not pregnant. A multistage sampling technique was used to select the calculated sample. The city of Hodiedah was operationally divided into four zones, each zone was divided into sectors and one sector from each zone was randomly selected. Each randomly selected sector was divided into several streets, from which two streets were randomly selected. From each street we selected an approximately equal number of pregnant and non-pregnant women. Informed consent was obtained from every woman included in our study.

For data collection purposes, a questionnaire was used for gathering personal data and a clinical examination, including inspection of the skin and sclera for discoloration and spleen palpation, was performed. The following laboratory investigations were also performed.

- Microscopic examination of thick and thin blood film for malaria was carried

out. Blood was obtained using a finger stick and stained with Giemsa.

- Haemoglobin was determined using a colorimetric assay.
- For malaria positive cases: liver function tests were performed. Using a kinetic method, the cut-off for aspartate amino-transferase was 38 U/L and for alanine aminotransferase it was 40 U/L. A colorimetric assay was used for determination of bilirubin.
- Urine was tested for proteinuria using a dipstick.

Disposable lancets and syringes were used for collecting blood samples and sterile containers were used to collect urine for analysis.

SPSS was used for data entry and analysis.

## Results

Our study included 500 women, all of whom were of reproductive age. The mean age of our sample was  $25.53 \pm 6.81$  years with an age range of 15–45 years. Of the 500 women, 260 were pregnant and 240 women were not. The age distribution of pregnant and non-pregnant women is given

in Table 1. Distribution of pregnant women according to the number of pregnancies is given in Table 2.

As regards malaria, 191/500 (38.2%) women were infected with malaria parasites. Of the 191 cases of malaria, 177 were caused by *P. falciparum* (92.7%), 13 were caused by *P. vivax* (6.8%) and only 1 case was due to *P. malariae* (0.5%).

The rate of infection was higher among younger age groups for both pregnant and non-pregnant women. Also, the rate of infection was higher among pregnant than non-pregnant women in all age groups (Figure 1). Overall, the rate of infection was 55% and 20% among pregnant and non-pregnant women respectively.

Of the 191 malaria-infected women, 107 (56%) had enlarged spleens, 59% for pregnant women and 52% for non-pregnant women. The infection rate was higher among primigravidae than among multigravidae, while frequency of enlarged spleen was higher among multigravidae (Figure 2). Among pregnant women the infection rate was higher during the third trimester than in the first and second trimesters, while the prevalence of enlarged spleen was higher during the first trimester than during the second and third (Table 3).

Table 1 Age distribution among the pregnant and non-pregnant women

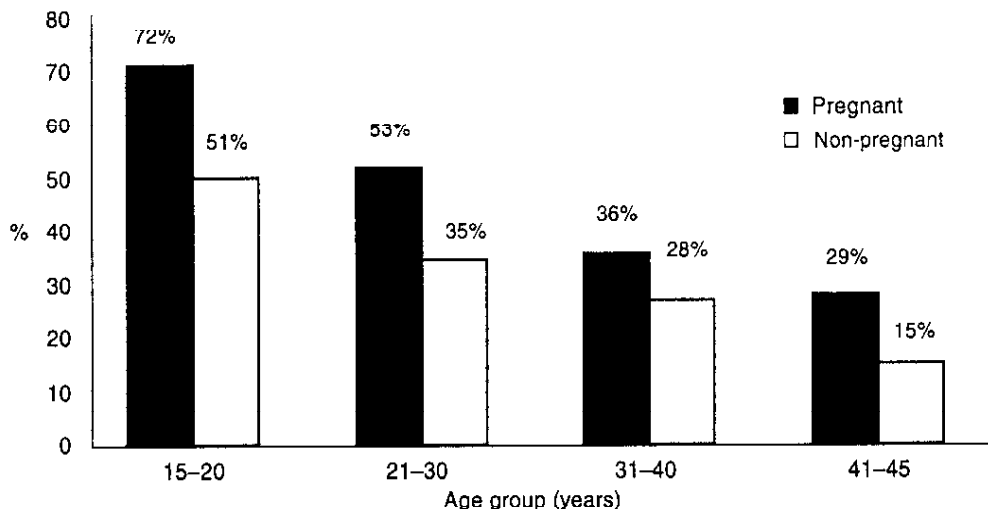
Age group (years)	Pregnant		Non-pregnant		Total	
	No.	%	No.	%	No.	%
≤ 20	78	30.0	77	32.1	155	31.0
21–30	128	49.2	117	48.8	245	49.0
31–40	47	18.1	40	16.7	87	17.4
≥ 41	7	2.7	6	2.5	13	2.6
Total	260	100	240	100	500	100

**Table 2 Distribution of pregnant women according to the number of pregnancies**

Number of pregnancies	No.	%
1-2	65	25.0
3-4	75	28.8
5-6	72	27.7
≥ 7	48	18.5
Total	260	100

More than two-thirds of the malaria cases with enlarged spleen had first and second degree spleen enlargement (34.6% and 38.3% respectively), while only 19.6% and 7.7% had third and fourth degree enlargement. The average spleen enlargement was 2.2.

Studying anaemia among our sample, we found that the mean value of haemoglobin (Hb) was 10.769 g/dL, the median was 10.600 g/dL with standard deviation = 2.642. The lowest value was 5.5 g/dL and the maximum value was 15.9 g/dL. Pregnant women were more susceptible to anaemia than non-pregnant women and the mean Hb level was 10.071 g/dL and 11.505 g/dL among the pregnant and the non-pregnant respectively. To determine the impact of malaria infection on Hb level, we compared the level between infected and non-infected pregnant women (Table 4) and found the Hb level was significantly lower in the infected pregnant women than in the non-infected pregnant women. Some symptoms of malaria infection were equally prevalent among pregnant and non-pregnant women, whereas others were more prevalent among pregnant women (Table 5). Also, during clinical inspection of the skin and sclera, pallor and jaundice were



**Figure 1 Rate of malaria infection among pregnant and non-pregnant women according to age group**

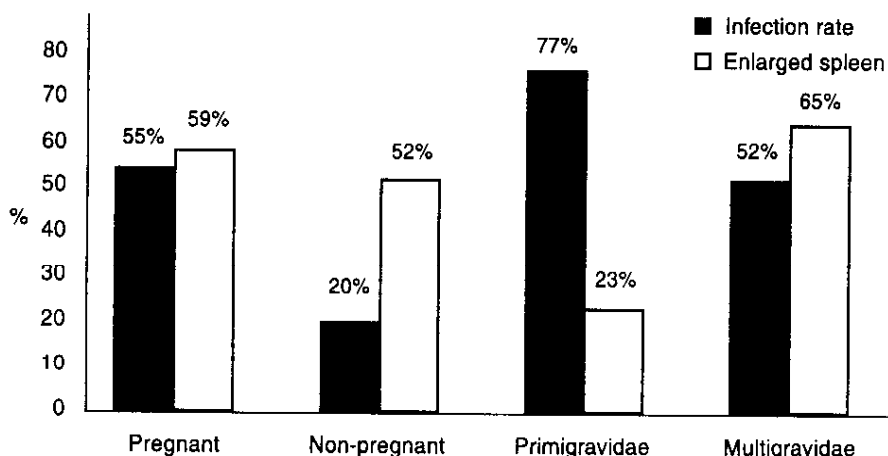


Figure 2 Infection rate and prevalence of enlarged spleen in pregnant and non-pregnant women and primigravidae and multigravidae

two times higher among infected pregnant women than among infected non-pregnant women (Table 5).

In many tropical and subtropical countries malaria can manifest as gastrointestinal tract (GIT) disorders. We found that among pregnant women with malaria, 54 of 143 (37.8%) suffered from GIT disorders, while among non-pregnant women with malaria only 8 of 48 cases (16.7%) had symptoms of GIT disorders. Nausea

was the most common GIT disorder among pregnant women infected with malaria, while among non-pregnant women infected with malaria diarrhoea was the most predominant GIT disorder.

Every malaria case in our sample was investigated for liver function and proteinuria (Figure 3). It was clear that liver function disorders and proteinuria were higher among infected pregnant than infected non-pregnant women. We repeated these investigations after one week and at that time they were within normal values; normalization of these investigations means that these disorders among our cases were transitory.

Table 3 Infection rate and prevalence of enlarged spleen among pregnant women according to trimester ( $n = 260$ )

Trimester	No of women	Infection rate (%)	Prevalence of enlarged spleen (%)
First	110	38.2	85.7
Second	85	51.8	68.2
Third	65	87.7	31.6
Total	260	55.0	59.0

## Discussion

The prevalence of malaria among pregnant women was higher than among non-pregnant women. The relative risk was 4.889, indicating that pregnant women are at an almost five times greater risk of malaria than non-pregnant women. Statistical anal-

Table 4 Impact of pregnancy and malaria infection on haemoglobin (Hb) level

Category	No.	Mean Hb $\pm$ s (g/dL)	Mean difference	Significance
<i>Pregnant</i>				
No	240	11.505 $\pm$ 2.429	1.434	t-test = 6.293 P < 0.001
Yes	260	10.071 $\pm$ 2.649		
<i>Pregnant with malaria</i>				
Yes	143	8.272 $\pm$ 1.680	3.966	t-test = 18.169 P < 0.001
No	117	12.268 $\pm$ 1.831		

s = standard deviation.

ysis found a highly significant statistical difference ( $\chi^2 = 64.76$ ,  $P < 0.001$ ). In this regard our findings are similar to findings of other researchers. For example, Diagne et al. found that the incidence rate of malaria attacks was on average 4.2 times higher during pregnancy than during the non-pregnant period [12]. Other authors have

also found that pregnant women are highly susceptible to malaria infection compared to non-pregnant women [14]. Furthermore, the primigravidae were at a 1.5 times greater risk of getting malaria infection than the multigravidae (Figure 2). This finding agrees with the findings of Shulman, Graham and Jilo [22], but contradicts the Diagne et al. study [12], which reported a significant increase in the risk of malaria among the multigravidae.

*P. falciparum* was the predominant causative agent of malaria in our sample; this finding is similar to the findings of other studies conducted in the Republic of Yemen [1-4].

The mean Hb level was lower among pregnant woman than among non-pregnant women ( $P < 0.001$ ; t-test = 6.293). Our findings in this regard were similar to the findings of Thomson who reported that 41.5% of pregnant women in Namibia were found to be anaemic (Hb < 11 g/dL). In our study, 53.5% of the pregnant women were anaemic, while only 25.0% of the non-pregnant women were anaemic (Hb less < 11 g/dL). Therefore anaemia was more prevalent among pregnant women than among non-pregnant women (relative risk = 2.14). Moreover, the Hb level was

Table 5 Frequency of some malaria signs and symptoms among pregnant and non-pregnant women

Sign/symptom	Frequency (%)	
	Pregnant (n = 143)	Not pregnant (n = 48)
Headache	90.0	90.0
Fever	84.5	85.4
Shivering	68.3	58.3
Sweating	75.4	50.0
Fatigue	61.3	50.0
Malaise	57.7	37.5
Gastrointestinal disorders	37.8	16.7
Pallor	41.6	20.0
Jaundice	10.6	5.0

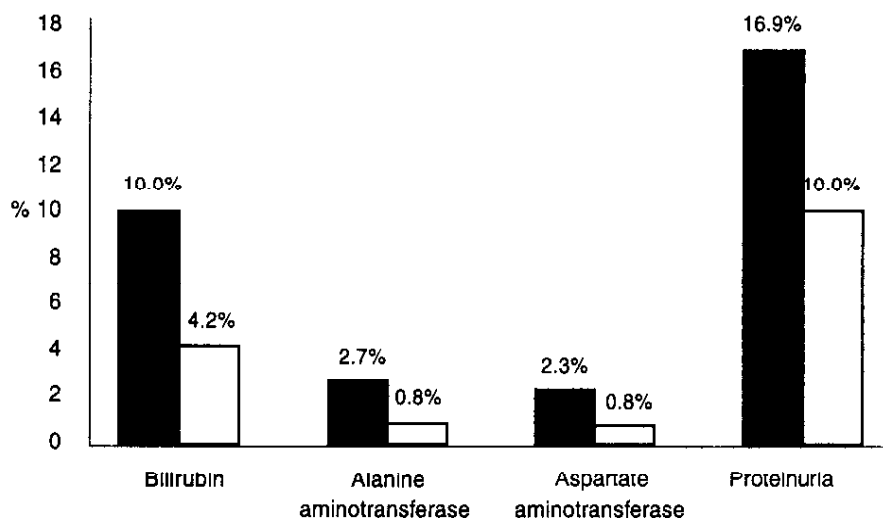


Figure 3 Abnormal liver function and proteinuria tests among the women with malaria

lower among malaria-infected pregnant women than among malaria-infected non-pregnant women ( $P < 0.001$ ;  $t$ -test = 18.169). Our findings are similar to many other studies [8,9,11,23–26].

To conclude, our study showed that the prevalence of malaria was higher among pregnant than non-pregnant women. Also anaemia was more prevalent among infected pregnant women than among non-infected pregnant women.

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### **EMRO's Roll Back Malaria website**

We would like to draw our readers' attention to the Roll Back Malaria website of the WHO Regional Office for the Eastern Mediterranean. The site provides a wealth of information on malaria, which continues to be one of the world's worst health problems. It includes information on: the epidemiology of the disease; regional and global activities in training and research; country activities; EMRO meetings; and malaria days and events. It also contains a useful bibliography and list of publications. The site can be accessed at: <http://www.emro.who.int/rbm/>