

Full Length Research Paper

Parasitic infections and anaemia during pregnancy in the Kassena-Nankana district of Northern Ghana

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Anaemia is often an adverse outcome of severe parasitic infections during pregnancy in developing countries. This study examined the association between anaemia and *Plasmodium* and or intestinal helminth infections during pregnancy. A hospital based survey was conducted on 300 pregnant women on their first consultation to antenatal services in the Kassena-Nankana district of Northern Ghana from August-November, 2005. Stool specimens were examined by the concentration method whilst the blood specimens were examined microscopically. One in four women were found to be infected with one or two of the following helminths: *Schistosoma mansoni* (12.3%), hookworm (7.0%), *Strongyloides stercoralis* (2.3%), *Ascaris lumbricoides* (0.7%) and *Trichostrongylus* (0.7%). More than half of the women were found with the *Plasmodium* parasite (58%). Whilst the mean haemoglobin of mothers without any parasite was within the normal range, mothers with co-infections on the other hand, were within the moderately anaemic range. Whereas, *Plasmodium* and *S. mansoni* infections alone cause mild anaemia, hookworm infections alone cause moderate anaemia. However, the anaemia caused by these parasites on a whole, are not severe (Hb < 7.0 g/dl). An integrated programme for the control of these parasites is recommended in order to reduce the degree of anaemia during pregnancies.

Key words: Anaemia, parasitic infection, pregnancy, Northern Ghana.

INTRODUCTION

Intestinal worms occur throughout the developing world, but are most commonly seen in the poorest communities. Of the current estimates of 2 billion people infected with these worms, about 300 million suffer severe and permanent impairments as a result (World bank, 1993; Chan et al., 1994; Chan, 1997; Bundy et al., 2000). While these figures are not reflected in huge numbers of deaths, the consequences for health and development are enormous. Apart from permanent organ damage, worm infections cause anaemia, poor physical growth, poor intellectual development and impaired cognitive function (Crompton et al., 2002). Poor nutrition in general and anaemia in particular are the main underlying causes of poor pregnancy outcomes in the developing world. The

impact of inadequate nutrient intake is amplified by worm and malaria infections which interfere with nutrient uptake and are a major cause of anaemia. Factors such as; bacteria and viral infections, inherited haemoglobinopathies, Glucose 6 phosphate Dehydrogenase (G6PD) and obstetric complications also contribute to the degree of anaemia in the tropics (Cheesbrough, 2002). In anaemic women, the risk of dying during pregnancy or child birth is up to 3.5 times higher than in non-anaemic women (Brabin et al., 2001).

Whilst half of the estimated 10 million pregnant women in Africa alone infected with Schistosomiasis suffer from anaemia (King et al., 2004), an estimated 44.3 million of the developing world's 124.3 million pregnant women harbored hookworm infection alone (WHO, 1994) of which more than 10% suffer worm burdens heavy enough to adversely affect intrauterine growth, prematurity and birth weight. Malaria on the other hand, may result in a range of adverse pregnancy outcomes

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including low birth weight, anaemia, spontaneous abortion and neonatal and maternal deaths (Jilly, 1969; McGregor et al., 1983; Brabin, 1991; Egwunyenga et al., 1997). In areas of Africa with stable malaria transmission, malaria infection during pregnancy is estimated to cause 400,000 cases of severe maternal anaemia and from 75,000 - 200,000 infant deaths each year (Steketee, 2001). Local prevalence of risk factors for iron deficiency and anaemia may vary broadly between populations. While malaria infection or the acquired immunodeficiency syndrome are common in the African continent and are important contributors to anaemia in women of reproductive age (Bouvier et al., 1997; Verhoeff et al., 1997), hookworm infections whose prevalence and intensity vary by geographic region, may also serve as an important cause of anaemia in women of reproduction age (Dreyfuss et al., 2000). Given that the geographical distribution of malaria and helminths infections widely overlap in sub-Saharan Africa, the concurrence of both parasites during pregnancy may contribute significantly to the degree of anaemia in mothers. This study therefore seeks to determine the prevalence of intestinal worms and *Plasmodium* infecting pregnant women in the Kassena-Nankana district and to describe the association between the infections on maternal haemoglobin (Hb) levels.

METHODOLOGY

Study site

The study was conducted in the Kassena-Nankana district (KND) of the Upper East region of Ghana. The district lies within the Sahelian Savannah area and covers about 1,674 km² of landmass with a population of 140,000 people. Navrongo, which is the district capital, has a population of 20,000 people. There are two main seasons: A short wet season from June to October with average rainfall of about 850 mm, almost all of which occurs in the wet months and a long dry season for the rest of the year (Binka et al., 1999). A large reservoir (The Tono dam), in the middle of the district, provides water throughout the year, mainly for irrigational purposes. An open irrigation system floods the fields during the dry seasons. There are also roughly 90 dug out dams in addition to the irrigation project that serve as water sources for the people as well as livestock during the long dry season. Thus, parasitic diseases such as lymphatic filariasis, malaria and schistosomiasis are frequent and high.

Study population

The subjects were recruited at the Navrongo War Memorial Hospital on attendance to antenatal care services. In all, 300 pregnant women on their first consultation to antenatal care services were enrolled into the study.

Specimens examination

The stool specimens were examined microscopically within 24 h following the WHO standard operational procedure of faecal concentration method (WHO, 1994). The 10x objective was used to

examine each slide thoroughly and where the ova or larvae of any parasites were suspected, the 40x objective was used for identification. Counting of the ova or larvae of the helminths was done on the entire slides which gave approximately the number of eggs or larvae per gram faeces. Thick blood films were made from the collection of two or three larger drops of blood from each subject's left, middle finger placed on the middle of the slides. The slides were then stained with Giemsa stain and read microscopically. Parasites densities were estimated by counting the number of trophozoites per 200 white blood cells (WHO, 1994; Cheesbrough, 2002).

Haemoglobin reading

Haemoglobin levels were measured using the HAEMOCUE® (HAEMOCU®, Lee Diagnostic Inc. Switzerland) system. A micro-cuvette preloaded with stable reagents drew in approximately 10 ml of blood from the punctured finger that was used for thick blood films. The micro-cuvette was then immediately placed into a portable spectro-photometric instrument and the digital readings of the haemoglobin of each subject were recorded within 10 - 20 s.

The data were double entered using Microsoft Visual Fox Pro version 6. Analysis was done using STATA 8.2 software for the frequency, and the associations (chi square analysis). Differences in the mean values were tested for statistical significance using the student t-test.

Ethical concerns

Written and verbal informed consents were obtained from all the subjects and ethical clearance for the study was granted by the Navrongo Health Research Centre Institutional Review Board (NHRIRB 046).

RESULTS

Out of the total 300 stool specimens examined, 23.0% (69/300) were infected with one or two of the following helminths: *Schistosoma mansoni* (12.3%), *Ascaris lumbricoides* (0.7%), hookworm (7%), *Strongyloides stercoralis* (2.3%) and *Trichostrongylus* (0.7%). The percentage mixed infection of the helminths was 9.7% with hookworm/*S. stercoralis* having the highest mixed infection of 4.8%.

Blood specimens from each of the 300 subjects examined revealed the prevalence of malaria parasite at 58.3% (175/300). Out of the total number of 69 pregnant women found with at least one helminth infection, 60.9% (42/69) of them were also co-infected with *Plasmodium*. The mean parasite count for *Plasmodium* was 39 trophozoites per 200 WBC, whilst that of *S. mansoni* was 3 eggs per gram faecal preparation and that of hookworm was 11 eggs per gram faecal preparation. Of great importance is the occurrence of *Trichostrongylus*, a parasite of ruminants that is slowly becoming zoonotic. Figure 1 shows the prevalence rates of each of the parasites in the district. The mean Hb level of mothers without any of the parasites (helminth or *Plasmodium*) was 11.25 ± 1.40. However, mothers who had both Helminth/*Plasmodium* co-infections recorded the lowest

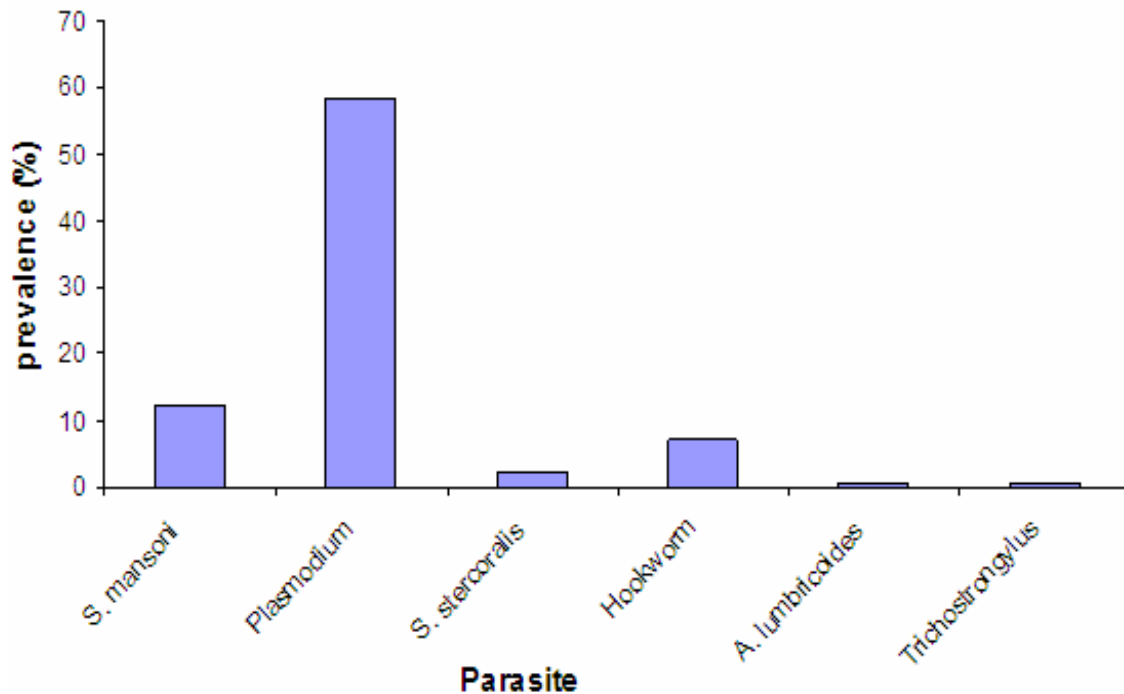


Figure 1. Prevalence of parasitic infections among pregnant women in Kassena Nankana district.

mean Hb levels of 9.30 ± 1.30 and are said to have moderate anaemia. Using the students t-test, there was a statistical significant difference between the mean Hb of mothers with co-infections and that of mothers without any parasitic infection ($p = 0.0001$). Further more, the mean Hb value of mothers with *Plasmodium* infection only (10.49 ± 1.48) differed markedly from that of mothers without parasites. This was equally so for the mean Hb of mothers with helminth infections with $p < 0.05$ in both cases. *Plasmodium* or *S. mansoni* infections have the same level of effect on the mean Hb levels of the mothers, since their mean Hb values do not differ significantly from each other ($p = 0.36$) (Table 1).

DISCUSSION

The mean Haemoglobin level of women without any parasite was 11.25 ± 1.40 g/dl. This value, though low and could be due to physiological fall in levels of about 2 g/100ml due to haemodilution associated with a decreased haematocrit reading during pregnancy (Bennett et al., 1999), is described as normal in pregnant women. Using the definition of anaemia in pregnancy, anaemia is said to be present when the haemoglobin concentration falls below 11.0 g/dl in pregnant women (DeMaeyer et al., 1985; WHO, 1996; Bennett et al., 1999; Cheesbrough, 2002). It is described as mild when the haemoglobin is between 10 - 11g/dl, moderate when it is between 7.0 l- 10.0g/dl and severe when below 7.0 g/dl (Adiels-Tegman, 1985; WHO, 1996).

However, the mean values dropped below the normal range in women infected with *Plasmodium* and or the intestinal worms ($p = 0.0001$). Mothers with worms infections had mild anemia (10.02 ± 1.41), and those with *Plasmodium* only also had mild anaemia (10.49 ± 1.48). The mean Hb of mothers with hookworm infections only (9.21 ± 0.58) however, was statistically significant from those with *Plasmodium* or *S. mansoni* infections. It was therefore observed that the very low mean Hb of mothers with worm infections only (10.02 ± 1.41) was due to hookworm infections. *Plasmodium* and or worm infections have been found to have effect on the Hb levels on their victims. The malaria parasite ingests the haemoglobin in the red blood cells which is digested to release the essential amino acids for the parasite growth (Yayon et al., 1984; Goldberg et al., 1990). Hookworm on the other hand, sustains its life by blood sucking, a process that ruptures the host capillaries and arterioles followed by the release of a battery of pharmacologically active polypeptides which induces intestinal blood loss. This can lead to iron deficiency and protein malnutrition (Hotez et al., 1995; Stoltzfus et al., 1997; Zhan et al., 2002).

In areas of Africa with stable malaria transmission, *Plasmodium falciparum* infection during pregnancy is estimated to cause 400,000 cases of severe maternal anaemia and from 75,000 - 200,000 infant deaths each year (Steketee, 2001). An estimated 10 million African pregnant women are said to be infected with schistosomiasis, and half of these women suffer from anaemia (King, 2004). In addition, 1,298 million people are believed to be infected annually with hookworm, of

Table 1. Mean haemoglobin level (n=300) of mothers with and without Helminth and or *Plasmodium*.

Parasites	Mean Hb (g/dl)	WHO description
No parasite	11.25 ± 1.40	Normal (Hb ≥ 11.0 g/dl)
Co-infection (Helminth and <i>Plasmodium</i>)	9.30 ± 1.26	Moderate (7.0-10.0 g/dl)
<i>Plasmodium</i> only	10.49 ± 1.48	Mild (10.0 - 11.0 g/dl)
Helminths only	10.02 ± 1.41	Mild
i. Hookworm	9.21 ± 0.58	Moderate
ii. <i>S. mansoni</i>	10.38 ± 0.29	Mild

which approximately 100 million are symptomatic infections with accompanying anaemia. In the Kassena-Nankana district, a malaria/anaemia study on young children 6 to 24 months old revealed that 22% of those sampled at the end of the wet season a time corresponding to agriculture and nutritional abundance, had haemoglobin concentrations below 6.0 g/dl (Koram, 1995). In contrast, survey of the same age cohort six months later, at the end of the dry season, and at a time of food scarcity found that only 1% of the children fell into this category of severe anaemia (Koram et al., 2003). It was therefore, reasoned that anaemia trends in this vulnerable age group were primarily influenced by the intensity of malaria transmission (Owusu-Agyei et al., 2001) rather than malnutrition. In all instances of parasitic infections in the women in this study, the mean Hb values were well above 7.0 g/dl and do not suggest the presence of severe anaemia. This was due to the light infections observed with both *Plasmodium* and helminths infections in the study. In a similar study conducted in Uganda, it was found out that helminths have little association with mild-to-moderate anaemia (Muhangi et al., 2007). It was attributed to the infection intensity where light-to-moderate infections with hookworm or *S. mansoni* infections have relatively weak effects on Hb levels. It is however, gratifying to note that while mild anaemia is fared best in maternal and perinatal outcome, severe anaemia (Hb < 7.0 g/dl) is associated with increased low birth weight babies, operative deliveries and prolonged labour (Malhotra et al., 2002; Geelhoed et al., 2006).

This study has not only confirmed the effect of *Plasmodium* on haemoglobin concentration in these women, but also indicated that worm infections have greater impact on the haemoglobin levels of the mothers in the district especially hookworm infections. Since many of the parasitic infections are chronic, and many women enter pregnancies with these as preexisting conditions, parasitic control programmes should be considered well before pregnancy by engaging young, non-pregnant women for preventive health education.

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