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Full Length Research Paper

Plasmodium and intestinal helminths distribution among pregnant women in the Kassena-Nankana District of Northern Ghana

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Parasitic infection during pregnancy is a major cause of anaemia in Africa. Social and environmental risk factors for the transmission of human parasites vary according to geographical location. Knowledge of the geographical distribution of parasitic helminths and malaria parasites is key to any interventional programme. Thus, in August-November 2005, a hospital-based study was conducted on 300 pregnant women at their first attendance to antenatal health care. This was to determine the distribution of helminth/*Plasmodium* infections among pregnant women in the Kassena-Nankana District of Northern Ghana. Stool specimens were examined by the concentration method whilst blood specimens were examined microscopically. The district was divided into three micro- ecological zones; the irrigated-rural area, the non- irrigated-rural area and the township. The participants were allocated to a zone according to their place of residence. Prevalence of intestinal helminths in gravid women from the irrigated-rural area was 41.2% (28/68), followed by the non-irrigated area of 15.64% (28/178) and then the township of 11.32% (6/53). There was a significant difference in the prevalence of intestinal helminths by micro-ecological zone (p=0.0001, X^2=23.02), and in the prevalence of Plasmodium by micro-ecological zone (p=0.0001, X^2=42.30). The prevalence of Plasmodium infection in irrigated- rural area was 80.9% (55/68) , followed by the non-irrigated area of 60.7% (108/178) and the township of 22.64% (12/53). Out of the total 62 women infected with the intestinal helminths, 67.7% (42/62) were also co-infected with the *Plasmodium* parasite. The participant's age had no significant association with intestinal helminth infestation or *Plasmodium* infection. Knowledge of the geographical distribution of intestinal helminths and malaria infection in this district will assist public health policy formulation and direction of health promotion activities. The high prevalence of parasites found in pregnant women from rural-irrigated areas requires interventions to reduce transmission of malaria and intestinal helminths.

Key words: Plasmodium, intestinal helminths, pregnant women.

INTRODUCTION

It is estimated that 70% of the worm population is har-boured by 15% of the human-host population. These heavily infected individuals are at risk of developing se-vere diseases. The major source of transmission is environmental contamination (Bundy, 1995) . Several factors contribute to the wide spread of these worms in each geographical location. However, susceptibility to heavy infections has genetic, immunological, socio-cul-tural and behavioural components. The greatest single predictor of heavy worm burden is age. Worm infection during pregnancy does not only adversely affect the mother but the unborn child as well (Beer et al., 1978, McGregor et al., 1983) . Whilst an estimated 44 million of the developing world's 124 million pregnant women har-bour hookworm infections (WHO 1994), 10 million preg-nant women in Africa are infected with schistosomiasis (King, 2004).

Malaria, on the other hand, accounts for about 10% of

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the total disease burden in many sub-Saharan Africa countries, and over 30% of hospital admissions (WHO, 1996). The distribution of helminths and *Plasmodium* widely overlap on the African continent. However, reports on parasitic infections are usually solely made on malaria or helminths alone. The concurrence of *Plasmodium* and intestinal helminth infection may have a synergistic and deleterious effect on haemoglobin concentration and iron stores, but the evidence to date is contradictory (*Mwangi et al., 2006). Pregnant women (and the foetus) are at particular risk of anaemia. As hookworm infestation and malaria can cause anaemia by different mechanisms it is possible their effective is synergistic (additive or multiplicative). A study in East African schoolchildren found an additive effect of hookworm and malaria infection on anaemia (*Brooker et al., 2006). Furthermore, a Nigerian study found lower birth- weights of infants from women co-infected with malaria and intestinal helminths compared to women with malaria only (Egwunyenga et al., 2001) . However, Muhangi and others found no significant adverse effect of helminths on anaemia in pregnant women in Uganda, but found a significant effect of malaria on anaemia (Muhangi et al., 2007). They did not report on a synergistic effect. Knowledge of the distribution pattern of the parasites in any location is essential for policy formulation and facilitates implementation of public health interventions. This paper examines the concurrence of *Plasmodium* and helminth infections among pregnant women in the Kassena-Nankana district of Northern Ghana. Figure 1

METHODOLOGY

Study site

A cross-sectional 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 sq km of landmass with a population of 140,000 people. Virtually all the inhabitants are rural subsistence farmers of millet and livestock.

Navrongo, which is the district capital, has a population of 20,000 people. Most people live in residential compounds with an average of 10 inhabitants each. 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 irrigation purposes. The reservoir spans over 1860 ha with maximum storage capacity of 93 × 10^6 m^3, and serves 32 km of main canals. 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. The average annual temperature ranges from 18-45°C (Appawu et al., 2004).

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. Screening could take place during any trimester in pregnancy, and the participants were chosen sequentially. Consent was obtained and the participants were interviewed and provided a blood and stool sample. Those that were found positive for helminths or Plasmodium were treated

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 slide and quantified as the number of eggs or larvae per gram faeces (Cheerbrough 2003) . 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. They were then stained with Giemsa stain and read microscopically. Parasites densities were estimated by counting the number of trophozoites per 200 white blood cells (WHO1994; Cheerbrough 2003).

The data was double entered using Microsoft Visual Fox Pro version 6. Analysis was done using STATA 8.2. The odd ratios were calculated using Epi Info version 7.0 software.A p- value of < 0.05 was defined as being statistically significant. Age was converted into a categorical variable.

Ethical concerns

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

RESULTS

Parasites prevalence

Out of the total 300 stool specimens examined, 20.6% (62/300) were infected with one or two of the following helminths: *Schistosoma mansoni* (12.22%), *Ascaris lumbricoides* (0.7%), hookworm (7.0%), *Strongyloides stercoralis* (2.3%) and *Trichostrongylus* (0.7%). The proportion of mixed infection of helminths was 9.7% with hookworm/*Strongyloides stercoralis* having the highest mixed infection of 4.8%.

The overall prevalence of malaria was 58.3% (175/300). Out of the total number of 62 pregnant women found with at least one helminth infection, 67.7% (42/62) of them were also co-infected with *Plasmodium*. 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 study population.

Parasites distribution

Community distribution of parasites

Plasmodium infection was highest in the irrigated-rural area, 80.88% (58/68), followed by the non-irrigated area, 60.3% (108/179), and then the township, 22.6% (12/53).

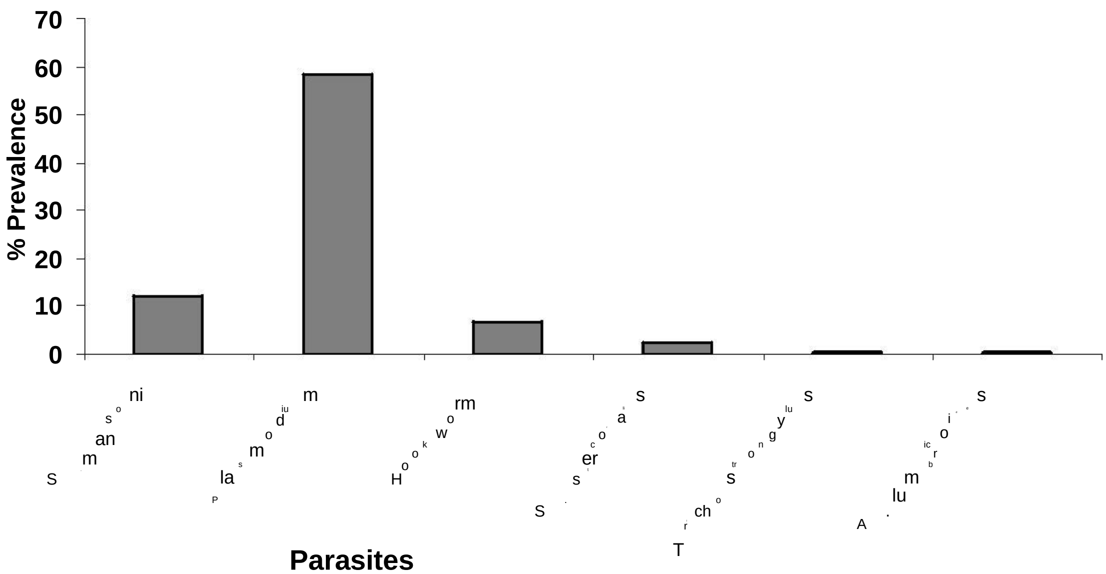

Figure 1. Prevalence of parasitic infections among pregnant women in the district.

Table 1. Parasites distribution in the three micro-ecological zones in the district.

Parasites	MICRO-ECOLOGICAL ZONES					
	Irrigated-rural area (68)		Non-irrigated (179)		Town (53)	
	No. infected	% prevalence	No. infected	% prevalence	No. infected	% prevalence
Plasmodium	55	80.88	108	60.34	12	22.64
S. mansoni	22	32.35	14	7.82	1	1.89
Hookworm	5	7.35	12	6.70	4	7.55
S. stercoralis	1	1.47	4	2.33	2	3.77
A. lumbricoides	1	1.47	1	0.56	0	0
Trichostrongylus	2	2.94	0	0	0	0

®= number of subjects in location.

Using the Pearson chi square (X^2) test, there was statistically significant difference in *Plasmodium* prevalence between the microhabitats (X^2 = 42.30, P = 0.0001). In addition, the distribution of the helminths varied significantly according to the microhabitats. The irrigated-rural area recorded 41.2% (28/68), the non-irrigated rural area 15.6% (28/179) and then the township area 11.3% (6/53). There was a statistically significant difference in helminth prevalence between the micro- ecological zones (Thu(X^2 = 23.03, P = 0.0001).Thus, the risk of exposure to helminth infections in the irrigated rural area is about four times higher than in the non- irrigated area (Odds Ratio = 3.78, 95% CI) . Comparing the irrigated area to the township, the risk of infection of helminths was 5 times higher in the former (Odds ratio = 5.48, 95% CI) whilst the non-irrigated rural area against the township had odds ratio of 1.45. The distribution of each parasite in each micro-ecological zone is shown in Table 1.

Parasite Prevalence by Age of Participants

The ages of the subjects ranged from 17- 45 years. The participants were grouped into four year class intervals and the prevalence of parasites in each age group is summarized in Table 2.

Although the ages below 20 years (72.41%) and those above 40 years (80%), reported high prevalence of *Plasmodium* infections, there was no statistically significant difference (X^2 = 10.611, P= 0.060) across the age groups. The 16-30 year age group had higher rates of helminth infections than those above 30 years although the difference was not significant across all age groups (X^2 = 1.511, P= 0.912). Age, therefore seems not to play

Table 2. Parasite prevalence by age of participant

Age group (years)	Helminth No. (%)	*Plasmodium* No. (%)
16-20	15 (24.19)	42 (72.41)
21-25	19 (30.65)	57 (60.00)
26-30	15 (24.19)	40 (50.63)
31-35	9 (14.52)	24 (55.81)
36-40	3 (4.84)	8 (40.00)
41-45	1 (1.62)	4 (80.00)
	P = 0.912	P = 0.060
	x^2 = 1.511	x^2 = 10.611

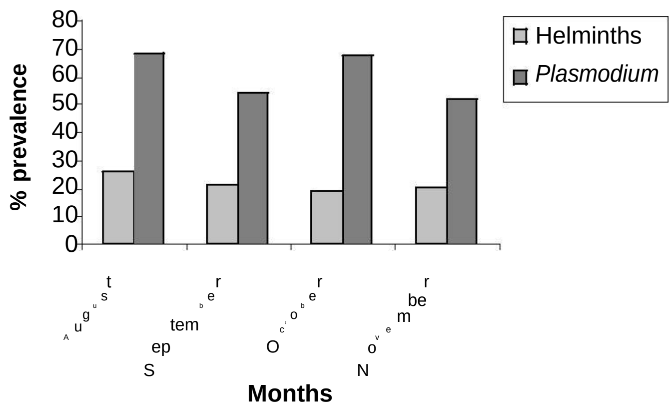

Figure 2. Prevalence of the parasites by month.

to play any significant role in the prevalence of *Plasmodium*/intestinal helminth infections in this study.

Monthly distribution of parasites

The stool and blood specimens were collected and examined from August to November 2005. The months of August to October are within the wet season in the district and November marks the beginning of the dry season. Figure 2 shows the monthly distribution of the parasites in the district. The percentage prevalence of *Plasmodium* infection in each of the months was above 50%. Although there was a reduction in *Plasmodium* prevalence in November, the difference was not significant from each of the other months. Even though the month of November signifies the beginning of the dry season, pools of water were still visible and there was no distinct difference in the weather conditions, with continued mosquito breeding.

Helminth infection was highest in August (26.32%) but remained constant for the rest of the months, with September recording 21.3%, October, 19.10% and November, 20.14%. There was no statistically significant difference in helminth infection among the months.

DISCUSSION

The study has identified five types of intestinal helminths infecting pregnant women in the district. They include; *S. mansoni*, hookworm, *S. stercoralis*, *Ascaris lumbricoides* and *Trichostrongylus*. The overall prevalence of the worms in the district was 20.7%. With the exception of *Trichostrongylus (0.7%)*, the presence of the other four helminths identified in this study, have been documented in several African countries. A Similar study in Nigeria, (Egwunyenga et al., 2001), has found a prevalence of hookworm infection in pregnant women of 14.3%, A*. lumbricoides* 19.1% and *S. mansoni*, 3.4%. A recent cross-sectional study in Northern Ghana, (Ziem et al., 2004), found a prevalence rate of hookworm infection of 75.5%. National surveys from Cameroun (Retard et al., 1992), Uganda (Kabatereine et al., 2001) and Zambia (Wenlock, 1979) indicated that, prevalence rates of hookworm varied considerably and ranged from 10-100%. In Kassena-Nankana district, an estimated 86% of the district population is rural subsistence farmers of millet and livestock (Binka et al., 1999) . These farmers rarely wear boots for farming and with the high faecal deposits on farmlands, due to lack of toilet facilities, hookworm, and *Strongyloides* infections are expected.

In the African continent schistosomiasis, has been estimated to infect some 10 million pregnant women (King, 2004). In southern Ghana, a study conducted in the Greater Accra region (Bosompem et al., 1996), found a prevalence rate of schistosomiasis of 47.6%. Faeces, carried or deposited into the water bodies that are used by women and children enhance the transmission of schistosomiasis. An interesting findings in this study, was the identification of *Trichostrongylus*, a parasite of ruminants that is slowly becoming a human parasite. In rural northern Ghana, ruminants are reared much closed to human habitation and women sometimes use animal deposits for fuel and plastering of walls. These could be possible reasons for human infection of *Trichostrongylus.* Human infections with this parasite have also been reported in other parts of Africa and South East Asia (Cheesbrough, 2003).

The very low prevalence of *Ascaris lumbricoides* (0.68%) and the absence of *Trichura trichiura* can be attributed to the very low average annual rainfall of 850 mm and the extreme average annual temperature range (18-45°C) in the district. The eggs of both species require an optimal temperature of about 31°C (Seaster, 1950) for embryonation whilst temperature of 38°C is lethal (WHO, 1967). Areas where the average annual rainfall falls below 1400 mm, usually demonstrate absence of transmission (Brooker et al., 2000). Several studies in Sahalean countries; Mali (De Clerq et al., 1995), Mauritania (Urbani et al., 1997), Niger (Develoux et al., 1986) and Sudan (Magambo et al., 1998) have demonstrated absence of transmission of these two parasites. This study has found a prevalence of *Plasmodium* in pregnant women in the district of 58.3%. Data collection for the study was conducted from August to November 2005. August to October are the peak months of the rainy season, whilst November signifies the beginning of the dry season. Several studies have indicated the seasonality of malaria transmission in this far northern part of Ghana, because the disease is dependent on rainfall, partly by providing breeding habitats and also by maintaining relative humidity above (60-70%) which increases the longevity of the mosquitoes. In this district, previous malaria prevalence surveys in children (Binka et al., 1994) documented rates ranging from 53.3 – 76.5% at the end of the dry season to a peak of 84.5 – 94.2% during the wet season. This demonstrates that malaria, although with seasonal variations, is endemic to this part of Ghana. Thus, this would support the high prevalence rate (58.3%) found in this. In addition, this study found that 42 of 62 women (67.7%) found with helminth infections, were also co-infected with the malaria. Thus, the study has shown that one in five pregnant women (20.67%) in the district had at least one helminth infection and that almost two thirds were infected with *Plasmodium*. Furthermore, the prevalence is highest for both helminths and malaria in rural irrigated areas, as compared to non-irrigated areas and towns. Urban areas seem to have much lower transmission rates of both malaria and schistosomiasis. This suggests that an integrated interventional programme to combat both malaria and helminths in the district can have a significant health impact, and that these interventions should prioritise rural zones under irrigation.

Further research on the distribution of *Trichostrongylus* is highly recommended to establish its epidemiology as an emerging zoonotic infection.

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