

# Malaria and intestinal parasitosis among children presenting to the Paediatric Centre in Sana'a, Yemen

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المالاريا والطفيليات المعوية في الأطفال الذين يراجعون مستشفى الأطفال المركزي في صنعاء، اليمن  
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**الخلاصة:** تصف هذه الدراسة مُرْتَسَمَ المالاريا والطفيليات المعوية في الأطفال الذين يراجعون مستشفى الأطفال المركزي في صنعاء في اليمن خلال الفترة من كانون الثاني/يناير 1998 إلى كانون الأول ديسمبر 2000. وقد كان أكثر الطفيليات شيوعاً لدى دراسة عينات برازية جمعت من 9014 طفلاً هي الأسكاريس الخراطيني، والمتحولة الزحارية، والجياردية المملبية، والمسلكة الدقيقة الذيل. وقد كانت العدوى بالطفيليات ذات دورة الحياة المباشرة متساوية بين الجنسين، أما العدوى بداء البلهارسيات فقد كانت أعلى بشكل واضح لدى الذكور منه لدى الإناث، في حين كان الإناث أكثر إصابة بالعدوى بديدان الأسكاريس. وقد كان النوع الوحيد من طفيليات المالاريا الذي كشف في عينات الدم المأخوذة من 753 من الأطفال الذين اشتبه بإصابتهم بالمالاريا هو المتصورة المنجلية، وأعلى معدلات الكشف كانت في أشهر نيسان/أبريل، وأيار/مايو، وحزيران/يونيو. وقد كانت معظم الحالات من الأطفال اليمنيين، إلا أن 10.8% من تلك الحالات كانت لدى أطفال من السودان أو أثيوبيا.

**ABSTRACT** We studied the profile of malaria and intestinal parasitosis among children presenting to the Paediatric Health Centre in Sana'a from January 1998 to December 2000. In stool samples from 9014 children, *Ascaris lumbricoides*, *Entamoeba histolytica*, *Giardia lamblia* and *Trichuris trichiura* were the most common. Infection with parasites of direct life-cycle were similar in boys and girls. Schistosome infection was significantly higher in boys than girls, but girls were more infected with ascariasis. The only species of malaria parasite found in blood samples from 753 children with suspected malaria was *Plasmodium falciparum*, with the highest rates in April–June. The majority of positive cases were Yemeni children, but 10.8% were Sudanese or Ethiopian.

## Le paludisme et la parasitose intestinale chez les enfants consultant au centre pédiatrique de Sanaa (République du Yémen)

**RESUME** Nous avons étudié le profil du paludisme et de la parasitose intestinale chez des enfants amenés en consultation au centre pédiatrique de Sanaa de janvier 1998 à décembre 2000. *Ascaris lumbricoides*, *Entamoeba histolytica*, *Giardia lamblia* et *Trichuris trichiura* étaient les parasites les plus courants. L'infestation par des parasites qui ont un cycle de vie direct était similaire chez les garçons et les filles. L'infestation par des schistosomes était significativement plus élevée chez les garçons que chez les filles, tandis que les filles étaient davantage touchées par l'ascaridiase. *Plasmodium falciparum* était la seule espèce de parasite du paludisme trouvée dans les échantillons sanguins de 753 enfants suspects de paludisme, les taux les plus élevés entre avril et juin. La majorité des cas positifs étaient des enfants yéménites, mais 10,8 % étaient des Soudanais ou des Ethiopiens.

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Received: 14/08/02; accepted: 16/03/03

## Introduction

The highest rates of protozoa and helminth infections worldwide occur in the tropics. The distribution of these infections depends on conditions such as a suitable climate and human activities such as population movements and poor sanitation.

Malaria is the major public health problem in Yemen [1], and has the typical afro-tropical pattern in which the predominant species is *Plasmodium falciparum* [2,3]. A previous study found that the incidence of *P. falciparum* infection among Yemeni returnees in Al-Hodeidah governorate was 13.9%, with some seasonal variations [3].

Transmission of ascariasis and trichuriasis takes place throughout the year in regions with a temperate climate. The soil-transmitted parasites, mainly *Ascaris lumbricoides* and *Trichuris trichiura*, are usually more prevalent where there is favourable soil, warmth and moisture together with poor sanitation. Studies in different parts of Yemen have reported prevalence rates of ascariasis ranging from 16%–68% [4–6]. Meanwhile, trichuriasis was reported, mostly from the same areas, in 1%–21% of the population [6,7].

Parasites with a direct life-cycle spread more easily among children and within the household. Various studies in Yemen have been conducted on the different parasites with a direct life-cycle. For example, the prevalence of *Entamoeba histolytica* has been reported to range from 1.7%–36% [4,7], while for *Giardia lamblia* it was 9.0%–20.5% and for *Hymenolepis nana* 2%–8.3% [6,8]. The lowest prevalence was 0%–2% for *Enterobius vermicularis* [4,6].

The most prevalent water-borne parasite in Yemen is the schistosome. Schistosomiasis is second to malaria in the list of major public health problems in the country

[1] and intestinal schistosomiasis has been reported in a number of different surveys [6–12]. Very low rates of infection have been reported for *Fasciola hepatica*, from 0.5%–2.0% [4,7]. Low prevalence rates of 0.1%–0.3% were reported for *Taenia* spp. [4,7].

With the exception of Farag's study in 1985 [4], all other published works from Yemen have focused on schoolchildren and children in the community. None of the studies focused on children at the hospital level and none has investigated malaria transmission in Sana'a, the city capital of the country. The current study therefore aimed to determine the profile of malaria and intestinal parasitic infections among children attending the Paediatric Health Centre in Sana'a.

## Methods

The Paediatric Health Centre in Sana'a provides services to the community through outpatient clinics and admissions. The centre receives patients from Sana'a city, surrounding areas and sometimes from other governorates, as well as referred cases from private clinics. Children with suspected infections are referred to the laboratory unit for investigation. In a record-based descriptive study, we reviewed the results of 9014 stool samples from Yemeni children and 753 blood samples from Yemeni and other nationality children who had been referred to the laboratory unit during the period January 1998 to December 2000. For malaria, additional questions about residence, nationality and travel history to known endemic areas were investigated and recorded in the laboratory notes. All stool and blood samples were examined in the centre's laboratory.

Children being investigated for intestinal protozoa or helminth infections provided a stool sample. A normal saline sedimentation technique was adopted for stool examination. Formal ethyl acetate sedimentation or direct smear methods were also used when necessary. For children who complained of pruritis ani or nocturnal enuresis, transparent adhesive tape was used to take anal swabs.

Children suffering febrile illnesses and suspected of having malaria were asked to give a blood sample. Thick and a thin blood films were prepared for each case. Thin films were fixed with absolute methanol and stained with 3% Giemsa diluted in pH 7.2 buffered water for 30 minutes. Thick films were stained unfixed.

The data were analysed using *Epi-Info*, version 6.

## Results

The age of the children ranged from 2 months to 14 years.

### Malaria

Of 753 children examined for suspected malaria (484 boys and 269 girls), 130 (17.3%) were positive for malaria. The only species of malaria parasite identified was *P. falciparum*. The distribution of infection among the cases by age group, sex and nationality is shown in Table 1. Twice as many boys (66.9%) as girls (33.1%) were infected. The highest rate of infection was in the age group 6–10 years. The majority of children testing positive (89.2%) were Yemeni, but 8.5% were Sudanese and 2.3% were Ethiopian. Most of the positive cases lived in Hezyaz, 25 km south of Sana'a, but some came from Arrowdhah on the opposite side of the city; some positive cases had never been out of the Sana'a area.

**Table 1 Sex, age and nationality distribution of 130 children with a diagnosis of *Plasmodium falciparum* infection**

Variable	Children infected (n = 130)	
	No.	%
Sex		
Male	87	66.9
Female	43	33.1
Age (years)		
0–5	15	11.5
6–10	89	68.5
11–14	26	20.0
Nationality		
Yemeni	116	89.2
Sudanese	11	8.5
Ethiopian	3	2.3

n = total number of infected children.

The highest seasonal rates of infection were recorded in the months June, May and April respectively (Figure 1).

### Intestinal parasites

Of 9014 children examined, 2477 (27.5%) positive tests for intestinal parasites were found. The intestinal parasites detected among infected children are shown in Table 2. With the exception of *Schistosoma mansoni* and *Taenia saginata*, most of the intestinal parasites were those with a feco-oral route of transmission. Four different parasites, *A. lumbricoides*, *E. histolytica*, *G. lamblia* and *T. trichiura*, had the highest rates.

Overall, the infection rate was significantly higher among girls (1192, 31.5%) than boys (1285, 24.6%) ( $P < 0.001$ ). Parasites with a direct life-cycle showed a similar sex distribution. However, the rate of *A. lumbricoides* infection among girls was significantly higher than that among boys. In contrast, the infection rate with *E. histolytica* was significantly higher among boys than that among girls ( $P < 0.001$ ).

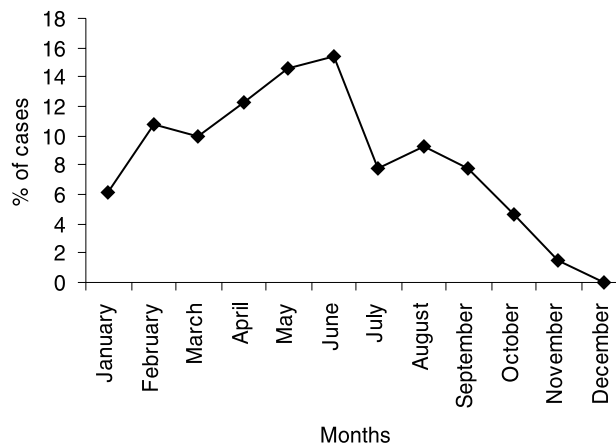


Figure 1 Monthly distribution of cases among 130 children diagnosed with *Plasmodium falciparum* infection

## Discussion

Our study revealed a parasite infection rate of 17.3% among children tested for malaria. The species of malaria found was exclusively *P. falciparum*. This is consistent with the documented pattern of malaria in Yemen, which is classified as afro-tropical with *P. falciparum* as the predominant species. Previous studies in Yemen have found that *P. falciparum* constitutes 90%–95% of all diagnosed malaria cases [2,3]. The infection rates were highest in June, May and April respectively. This finding indicates that malaria in Sana'a city may have its own pattern of seasonality that is different from Al-Hodiedah governorate.

The present study revealed that 10.8% of the malaria cases were children from Sudan and Ethiopia who may be either immigrants or indiginous. Interestingly, some positive cases in our study had never been out of the Sana'a area, which is supposed to be a non-malarial area due to its high altitude (2400 m above sea level). Most of the positive cases were children living in an area called Hezyaz, about 25 km to the

south of Sana'a, which lies on the road that connects the capital with two endemic areas, Taiz and Hodeidah cities. The main activity of the population in Hezyaz, beside agriculture, is serving food for travellers. Therefore, it can be hypothesized that infected mosquitoes hidden in vehicles are responsible for transmission of the disease. Another possibility is that transmission of malaria is taking place in Sana'a city itself. This is backed up by the fact that some cases also came from another area on the opposite side of the city called Arrowdhah.

With the exception of *S. mansoni* and *Taenia saginata*, the intestinal parasites diagnosed in the current study are those with a feco-oral route of transmission. It was expected that the infection rate with intestinal parasites would be similar among boys and girls. Surprisingly, however, the infection rate among girls was greater than that among boys. Parasites with a direct life-cycle were found to have a similar sex distribution. This was not the case with *S. mansoni*, where the rate among boys was higher than that among girls. This can be

Table 2 Pattern of intestinal parasites detected in 9014 tests for parasitic infections among children

Parasite	Boys (n = 1285)		Girls (n = 1192)		Total (n = 2477)		$\chi^2$	P-value
	No.	%	No.	%	No.	%		
<i>Ascaris lumbricoides</i>	235	18.3	286	23.9	521	21.0	42.0	< 0.001
<i>Entamoeba coli</i>	258	20.0	248	20.8	506	20.4	0.83	0.36
<i>Giardia lamblia</i>	226	17.6	188	15.8	414	16.7	5.14	0.023
<i>Trichuris trichiura</i>	201	15.6	180	15.0	381	15.4	0.68	0.44
<i>Entamoeba histolytica</i>	160	12.5	129	10.8	289	11.7	6.15	0.013
<i>Hymenolepis nana</i>	149	11.6	123	10.3	272	11.0	3.84	0.05
<i>Schistosoma mansoni</i>	37	2.9	16	1.3	53	2.1	26.1	< 0.001
<i>Enterobius vermicularis</i>	13	1.2	20	1.7	33	1.3	3.78	0.052
<i>Fasciola hepatica</i>	4	0.3	2	0.2	6	0.2	1.95	0.16
<i>Taenia saginata</i>	2	0.2	0	0	2	0.1	NA	NA
Total	1285	24.6	1192	31.5	2477	27.5	52.5	< 0.001

n = total number of tests.

NA = not applicable.

attributed to boys having more activities involving contact with water than girls through swimming and ablutions. As for ascariasis, the rate of infection was higher among girls than that among boys. This can be explained by girls being involved more with food preparation than boys, exposing them to raw foods contaminated with larvated eggs.

## Conclusions

High rates of infection with protozoa and helminth parasites denote high levels of pol-

lution in the environment of the study area. More efforts are needed to improve environmental sanitation in Sana'a in order to reduce the rate of infection with intestinal parasites. To our knowledge, this is the first report that shows some evidence that malaria is being transmitted in Sana'a city. A special study to confirm or refute the suggestion that the vector for malaria is breeding in Sana'a is urgently needed.

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