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PrevalenceRate of Malaria/ Helminthiasis Co-Infections in Genaid Irrigated Area, Gezira State, Sudan

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ABSTRACT

This study aimed to determine the prevalence rate of malaria/ helminthic infection in irrigated area in central Sudan (Genaid). A cross- sectional study was carried out during the period from December 2008 to June 2009. A total number of 250 students (age between 6-16 years old, mean age was 11 ± 3 years) were included in this study. Blood, urine and stool samples were taken from all subjects. Clinical and parasitological data were obtained and recorded. Seventy one out of 250 (28%) blood samples were found to be positive for *P. falciparum* when stained by Giemsa stain. Moreover, 82 out of 250 (32%) blood samples were found to be positive when examined by immunochromatogrophic test (ICT). On the other hand, 35 out of 250 (14%) stool samples were positive for *S. mansoni* when examined by wet preparation while 41 out of 250 (16%) stool samples were positive for *S. mansoni* when using Kato technique. Eighty out of 250 (31%) urine samples were positive for *S.haematobium.* The study showed that 60 out of 250 (24%)stool samples were positive for other protozoal and helminthic infections. The prevalence rates of malaria/ schistosomiasis co-infection were detected in 31 out of 250 students (12%). This study indicated that the study area is highly endemic for malaria and schistosomiasis as reflected by the high prevalence rate of malaria/ schistosomiasis co-infection.

المستخلص

هدفت هذه الدراسة لتحديد معدل إنتشار الإصابات المشتركة للملاريا وديدان البلهارسيا في منطقة الجنيد المروية فى وسط السودان. هذه الدراسة المستعرضة نفذت خلال الفترة مابين ديسمبر 2008 الي يونيو 2009م وكان مجموع عدد الطلاب الذين تم إشراكهم في الدراسة 250 طالب وكانت أعمارهم مابين 6 إلى 16 عاماً. وكان متوسط العمر 11 سنة.أخذت عينات من الدم، الفسحة والبول من كل طالب كما تم الحصول علي البيانات السريرية والطفيلية لكل طالب. بلغت إصابات الملاريا 71 إصابة من أصل 250 طالب(28%) تم الحصول علي عينات من الدم إيجابية للملاريا للمصورة المنجلية (*P.falciparum*) بإستخدام صباغة جيمسا. إرتفعت النسبة إلي 82 إصابة من أصل 250 (32%) بإستخدام التشخيص المناعي الكروماتغرافي (ICT). ومن ناحية أخري تم تحديد إصابة البلهارسيا(*S. mansoni*) في البراز بواسطة التحضير الرطب في 35 عينة من أصل 250 (14%) وعند إستخدام تقنية كاتو (Kato technique)إرتفعت الإصابة الي 41 من اصل 250 (16%) في البراز. وبلغت إصابات (*S.haematobium*) 80 من أصل 250 (31%) كما

أظهرت الدراسة ان 60 من أصل 250 طالب مصابون بعدوي الديدان وغيرها من الطفيليات الأولية. وعند تحليل النتائج وجد ان هنالك عدوي مشتركة (ملاريا وبلهارسيا) في 31 من أصل 250 (12%).إستنتجت هذه الدراسة ان عدوى الملاريا و البلهارسيا مستوطنة بدرجة عالية فى المنطقة كما وضح بمعدل الإنتشار العالى للمرض المشترك بين الملاريا و البلهارسيا.

KEYWORDS: Immunochromatogrophic test, Prevalence, Co-infections.

INTRODUCTION

Co-infection with multiple parasites is common in malaria endemic area. Although much is known about the epidemiology and immunology of specific parasitic illness, little is known about the interaction of concurrent infections. Mounting evidence suggests an interaction occurring between helminthic and malaria infections, although it is unclear as to whether this effect harms or protects the host. *Plasmodium falciparum* and *Schistosoma spp.* are co-endemic parasitic diseases in certain locations. Revised estimates suggest that *P. falciparum* malaria causes 515 million infections annually [(1)] while schistosomiasis affects nearly 200 million people in 75 countries. Both parasitic diseases predominate in sub-Saharan Africa, but the host impact of dual infection in unknown [(1)].*Plasmodium falciparum* and *Schistosoma haematobium* are co-endemic parasitic diseases with worldwide distribution. Evidence suggests that interactions occur between helminthic and malaria infections, although it is unclear whether this effect is beneficial or harmful to the host. Little was known about the patterns and risk factors of co-infection within communities. The occurrence of co-infection will depend on the overall prevalence of individual species and the degree of association between different species. If infection with *P. falciparum* and helminthes are independent, occurrence of co-infection is simply determined by the relative frequency of individual species. Thus, the age patterns of co-infection will depend on the age-specific prevalence rates as predicted by simple probability. However, if co-infection is either synergistic or antagonistic, occurrence of both parasites would be significantly different from that predicted by individual chance encounters with either infection. Such associations may arise because of biologic associations, whereby the presence of one species promotes or inhibits the establishment and/or survival of the second species, potentially through immune modulation[(2)]. Alternatively, co-infection may reflect concurrence of common socio-economic and/or environmental risk factors promoting survival of both species [(3,4)]. At present, few studies are able to disentangle the relative importance of different risk factors for co-infection and detailed epidemiologic studies are clearly warranted. However, on what we currently know about the epidemiology of co-infection, it is suggested that school-age children, rather than preschool children or adults, are most at risk of *Plasmodium*-helminthes co-infection, and thereby at greatest risk of the consequences of co-infection. The successful resolution of *Plasmodium* infection requires a coordinated succession from a T-helper cell type 1 (Th1) to a Th2 type response, and anything that upsets the timing or balance of this process can lead to chronic or severe infection [(5)]. The Th2-skewed immune profile and profound cellular hypo-responsiveness induced by chronic helminthes

infection [6] might therefore be expected to affect the course of *Plasmodium* infection. This hypothesis has led researchers to study the interactions between *Plasmodium* and helminthes infection. However, limited observational studies thus far have provided conflicting accounts of the effects of chronic helminthes infection on host immune responses to malaria. Early studies suggested that *Ascaris lumbricoides* infection might be protective against malarial disease [7,8] in contrast to several later reports, which suggested that soil- transmitted helminthes (STH) infections may increase the risk of malaria infection [4,9,10]. Conversely, a potential protective effect on malaria of light schistosome infection has been reported in Senegal and Mali [11,12]. Other studies have noted a difference in the development of severe malaria between helminthes-infected and uninfected individuals, with several studies from Thailand suggesting a protective effect for *A. lumbricoides* infection on the risk of cerebral malaria and acute renal failure [9,13] although again this is in contrast to a study in Senegal, which suggested a positive association between infection with *A. lumbricoides* and the occurrence of severe malaria [10]. Thus, epidemiologic observations now suggest a range of scenarios in which helminthes infections may increase susceptibility to *Plasmodium* infection but may also under certain circumstances protect against severe malaria [2]. The main objectives of this study were to determine the prevalence of schistosomiasis and malaria in irrigated area in central Sudan, to study the prevalence of malaria/ schistosomiasis co-infections and to study the prevalence of other protozoan and helminthes parasitic infection in the study area.

MATERIALS and METHODS

Study area

This study was carried out in Genaid area, Gezira State during the period from December 2008 to June 2009. The area is located on the east bank of the Blue Nile river. The area consists of 25 villages with population belonging to different tribes. The study area composed of Genaid irrigated scheme and Genaid sugar factory. The area is surrounded by big and small irrigation canals. The majority of the populations are farmers, and some of the villagers are workers in the sugar factory. The area is considered as endemic for malaria. The peak of the malaria transmission starts in November and continues to March, which coincides with the harvest time of the sugar canes. *Plasmodium falciparum* is considered to be the major malaria species in the area. *S.haematobium* and *S.mansoni* are also endemic in the area.

General characteristics of the studied population and ethical clearance

The study was conducted on 250 students from El Tadamon primary school for girls and El Tadamon primary school for boys with an age ranging between 6-16 years old and the mean age of 11 ± 3 years, 71 of them were males (28.4%) and 179 were females (71.6%). Ethical clearance for this study was obtained from College of Medical Laboratory Science- Sudan University of Science and Technology and after an informed consent was obtained from all children included in this study.

Design of questionnaire

The design of questionnaire considers simple investigative questions or indicators, which include gender, age, observation of blood and mucus in the stool and blood in urine, signs and symptoms of diseases such as fever, headache, vomiting and diarrhea.

Blood examination

For detection of *P. falciparum*, stained blood films were screened using the method described by WHO (1993) [14]and using ICT as recommended by www.7.national academies.Org(2009) [15].

Urine examination

For detection of *S. haematobium*, urine samples were screened using the method described by Fleck and Moody (1993) [16].

Stool examination

S. mansoni was detected in stool samples using wet preparation and Kato method as described by WHO (1993) [14] and Berhe *et al*. (2004) [17] respectively.

Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) under windows, version 15.0. Chi square test statistical analysis was performed and the *p* values of less than 0.05 were considered statistically significant.Data were presented in tables using Excel after analysis using SPSS.

RESULTS

Overall prevalence of *P. falciparum* using blood films (B.F) and ICT according to gender

Out of 250 study subjects, 71 (28%) were found to be harboring *P.falciparum* parasite when using blood films and 80 (32%) when using ICT. From the 71 positive cases, 50 (20%) were males and 21 (8%) were females (Table 1). The differences in prevalence according to gender was found to be statistically significant (p=0.000).

Table 1: Overall prevalence of P. falciparum using blood films and ICT according to gender

P. falciparum	**Gender**		**Total**
	Male	Female	
B.F positive	50	21	71
ICT positive	50	30	80

Overall prevalence of *S. mansoni* infection using wet preparation and Kato technique according to gender

A total of 250 stool samples were examined for *S. mansoni* eggs. Out of these, 35 (14%) were found to be positive when detected by using wet preparation method and 41 (16%) when using Kato technique. From the 35 positive cases, 20 (8%) were males and 15 (6%) were females (Table 2). The differences in prevalence according to gender was found to be statistically significant (p=0.000).

Table 2: Overall prevalence of S. mansoni infection using wet preparation and Kato technique according to gender

S. mansoni	**Gender**		**Total**
	Male	Female	
Wet preparation	20	15	35
Kato technique	25	16	41

Overall prevalence of *S.haematobium* infection using sedimentation technique according to gender

A total of 250 urine samples were examined for *S. haematobium* eggs. Out of these, 78 (31%) were found to be positive when detected by using sedimentation technique. From the 78 positive cases, 60 (24%) were males and 18 (7%) were females (Table 3). The difference in prevalence according to gender was found to be statistically significant (p=0.000).

Table 3: Overall prevalence of S.haematobium infection using sedimentation technique according to gender

	Gender		Total
	Male	Female	
S. haematobium positive	60	18	78

Prevalence of other parasites in the study area using wet preparation

Out of 250 surveyed populations, 23 (9.2%), 13 (5.2%), 17 (6.8%) and 7 (2.8%) samples were found to be positive for *H. nana*, *G. lamblia*, *E. histolytica* and *E. vermicularis* respectively (Table 4).

Table 4: Prevalence of other parasites in the study area by wet preparation

Parasite species	Frequency	Percentage
H.nana	23	9.2%
G.lamblia	13	5.2%
E.histolytica	17	6.8%
E.vermicularis	7	2.8%

Co-infections

The present study indicated that 31 individuals (12%) were infected with more than one parasitic infection (Table 5).

Table 5: Malaria co-infection with helminthes parasitic infection

	S. mansoni	***S.haematobium***	***H.nana***	***E.vermicularis***	**Total**
P.falciparum	10	16	3	2	31

Table 6: Relationship between malaria and symptoms

Symptoms	Malaria positive	Malaria negative
Headache	60	12
Fever	58	11
Vomiting	47	8
Diarrhea	38	28

p=0.000

Table 7: Prevalence of S. mansoni among students with mucus and blood in their stool

		Mucous and blood		Total
		Yes	No	
S.mansoni	+Ve	20	15	35
	-Ve	25	190	215
Total		45	205	250

p=0.000

DISCUSSION

In tropical areas, multiple parasitic infections are common [18,19]. Epidemiological, clinical, or biological outcomes are more often studied considering each parasite separately. Nevertheless, studies on animal models have shown that concurrent infections by two or more parasite species could affect the pathogenesis of each other [20,21]. Malaria and helminthes infections are the major parasitic diseases in developing countries and their epidemiological co existence is frequently observed, particularly in Africa. The implications of concomitant malaria and helminthes infections have been mainly studied in animals under laboratory conditions [22,23]. In human populations, only few studies have been conducted, with contradictory results. Some of them showed a protective role of helminthes [7,24]. For example, Nacher and other [13] found that a helminth infection was associated with a protection from cerebral malaria, and Murray and others [7] showed that treatment of severe ascariasis was accompanied by recrudescence of malarial attacks in children. Conversely, other studies suggested a deleterious effect of co-infection [9,10]. In the present study we have shown that the prevalence of *S.haematobium* was 31% in the study area. This indicated that schistosomiasis is once again becomes a serious health problem in Gezira after a previous control of the disease in the area. The high prevalence of schistosomiasis and malaria in the study area is attributed to the fact that the area is considered to be one of the major sugar plants in Sudan and the irrigation depends on canal systems and this provides a suitable environment for both malaria and schistosomiasis transmission. One of the main purposes of this study was to investigate co-infections with malaria and schistosomiasis in a population of children in El Tadamon School. In addition, the intestinal protozoal and helminthic infections were studied to find the probability of their effect on the malaria course. The results obtained during this study, revealed that schistosomiasis was more prevalent and intense in boys than in girls and in older children. The age and gender factors are well known and are associated with the number and type of water contacts. It has been shown that boys are more exposed than girls because they take more baths [25,26] and that the level of infection increases with age because schistosomiasis is a chronic infection and children have repeated exposures [27]. The prevalence rate of *S.mansoni* was 14% in the study in selected school children. In the present study *S.mansoni* eggs which were not detected in stool samples when using wet preparation, were detected when Kato technique was used, suggesting that Kato method is more sensitive than wet preparation method, this is in agreement with WHO (1993) [14]. All urine samples collected during this study which were positive for eggs of *S.haematobium* had haematuria. The study showed that the prevalence rate of malaria as confirmed by presence of parasite in Giemsa's stained blood smears was 28% while positivity was increased (32%) when using ICT as a diagnostic technique. This might be explained by the fact that ICT detects Histidine Rich Protein2 (HRP2) which remains circulating in the blood for a period of time after treatment. These findings by ICT disagree with Nasir and Saeed (2009) [28] who observed that ICT was equal to microscopical detection of *P. falciparum*. Previous studies showed that, in Sudan, the mortality of malaria was highest in children less than five years, decreasing afterwards. Males and females were affected equally in

all age groups [29]. In this study, no difference in gender was found in relation to malaria infection. Co-infections with multiple parasites are common in malaria endemic areas. Although much is known about the epidemiology and immunology of specific parasitic illnesses, little is known about the interaction of concurrent infections. Mounting evidence suggests that an interaction occurs between helminthes and malaria infections, although it is unclear as to whether this effect harms or protects the host. *P. falciparum* and *Schistosoma* spp. are co-endemic parasitic diseases with world wide distribution. The present study showed that 31 (12.4%) of the children in this study were harboring more than one parasite. Spatial congruence of both *P.falciparum* and different helminthes remains poorly defined. Preliminary analyses, however, suggest that as many as one quarter of African school children may be coincidentally at risk of *P.falciparum* and hook worm [30]. This spatial coincidence of risk between the two parasite populations would suggest that co-infection is extremely common, although the public health significance of poly parasitic infection remains a topic for which there are many unknowns. The high prevalence rate of malaria/ helminthes infections reported in this study indicated that co-infections in Sudan is a common and a serious problem and the impact of this phenomenon on the control of the single infection needs further investigations.

CONCLUSIONS

Co-infection with multiple parasites is common in Genaid area, El Gezira State; the prevalence rate of malaria was 25% while schistosomiasis was 31% and 14% for *S.haematobium* and *S.mansoni* respectively. Schistosomiasis is significantly high among boys compared with girls, which might suggest that boys are exposed to infected water more than girls and they play and swim in the water around their school.

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