GASTROINTESTINAL PROTOZOAN PARASITES AMONGST SCHOOLCHILDREN IN INANAM, SABAH

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ABSTRACT. *Intestinal parasitosis is still an important public health problem. The aim of this study was to determine the prevalence of gastrointestinal protozoan parasites (GIP) in schoolchilden and its association with socio-economic and environmental factors. A series of sample collections for stool was carried out in Sekolah Kebangsaan Inanam II, Kota Kinabalu, Sabah. Samples from 100 schoolchildren were examined by direct smear and formol-ether concentration techniques. The modified Kato-Katz technique was performed to estimate the parasitic burden, expressed in the number of protozoa per gram of stool. The proportion of overall infected samples was 31%. When ranked by proportion, parasite loads were found as follows: Entamoeba histolytica (83.87%), Giardia lamblia (35.48%), Entamoeba coli (22.58%), Entamoeba hartmanni (25.81%), Iodamoeba butschlii (19.35%) and Endolimax nana (6.45%). Both single and double infections in the study had equal percentages (35.48%), followed triple infection (29.03%). There were no significant effects of protozoan infection on weight, height, attendance to school and examination results of the schoolchildren (Independent Group t-Test; $p > 0.05$). No significant association were found between the protozoan infection and the socio-economic and environmental factors (gender, age, occupation status of mother, house area category and the degree of household crowding). We conclude that the parasitic burden amongst the schoolchildren of Sekolah Kebangsaan Inanam II is minimal and is of less concerned.*

KEYWORDS. *gastrointestinal, protozoan infection, Entamoeba histolytica, Entamoeba coli, Giardia lamblia*

INTRODUCTION

Intestinal parasitic infection is still an important public health problem in underdeveloped or developing countries. It is known to be affected by several factors including personal hygiene, dietary habits, education levels of the community, socioeconomic status, climate and other environmental factors. Intestinal parasites are more frequently encountered during schooling age, most likely linked to relatively less developed hygienic habits. When burden in children is pronounced intestinal parasites might cause serious health conditions and problems notably diarrhea, malnutrition, malabsorption, mental retardation and even death.

Parasitic helminths and protozoans are still a public health concern in Malaysia, although are well controlled and only sporadically limited to specific areas or within certain population groups e.g. the aboriginal settlements and amongst people living in remote areas (MOH Malaysia, 2008). The studies on the prevalence of protozoan parasites have been carried out mainly amongst schoolchildren in Peninsular Malaysia (Noorhayati *et al.*, 1981; Hamimah *et al.*, 1982; Sinniah & Rajeswari, 1988). Little or no work has been done in Malaysian Borneo.

The main purpose of this study was to determine the prevalence of gastrointestinal protozoan parasites (GIP) among schoolchilden and to see its impacts on physical and their learning abilities. Acknowledging that gastrointestinal infections by endoparasites are common, the levels infections that retrogressively affect the mental and physical growth of children must not be taken lightly. We present here the case study in Sekolah Kebangsaan Inanam II, a sub-urban school immidiately outside the Kota Kinabalu City.

MATERIALS AND METHODS

This study was performed in SK Inanam II, which is located in Inanam about 15 kilometers from Kota Kinabalu, capital city of Sabah, Malaysia. Sabah has a tropical climate where the temperature arise around 30-40^{o}C. Sanitary conditions are sufficient in large parts of the city. The stool samples of 100 children aged 7 – 9 years (51% female and 49% male) were obtained through consent from September 2005 to January 2006.

The stool samples were firstly examined through direct smear or saline-iodine method. The size of the detected parasite was evaluated by ocular micrometric method. Formol – ether concentration method was then performed to enhance detections of cysts. Amoeba trophozoites were observed in fresh smears. To estimate the protozoa burden, modified Kato-Katz procedure was performed by calculating the number of cysts or trophozoites in a gram of stool.

Variables used to measure the mental and physical impacts of infections were weight, height, attendance to school, and academic achievements (here translated as the results of examinations). The following parameters were recorded through questionnaires to evaluate the associations of socio-economic and the environmental factors with infection rates: gender, age, occupation status of mother, house area category and degree of crowding. Consent was obtained from parents prior to sample collections.

The independence groups t-test was used to examine the difference between infected and uninfected group of schoolchildren. The association between any two types of variables in this study were examined through chi-square test. Data were evaluated by SPSS for Windows (version 12.0) and all statistics were set to the significance level of $p<0.05$.

RESULTS

Out of the 100 stool samples examined, 31 of them (31%) were positive for GIP. Among those infected with GIP (see Table 1), 83.87% of the schoolchildren were infected with *Entamoeba histolytica*, followed by *Giardia lamblia* (35.48%), *Entamoeba hartmanni* (25.81%), *Entamoeba coli* (22.58), *Iodamoeba butschlii* (19.35%) and *Endolimax nana* (6.45%).

Table 1. Distribution of positive cases according to the parasites species.

Parasites	N=100	%
Entamoeba histolytica	26	83.87
Giardia lamblia	11	35.48
Entamoeba hartmanni	8	25.81
Entamoeba coli	7	22.58
Iodamoeba butschlii	6	19.35
Endolimax nana	2	6.45

More than a third of the schoolchildren were infected with both single species and double species infection of protozoa (35.48%), followed by the triple infection (29.03%). Table 2 shows that among the protozoa infectants, infection with *Entamoeba histolytica* was the commonest type of infection among infected subjects followed by *Entamoeba coli* and *Iodamoeba butschlii*. Oddly, triple infections by protozoa species were proportionally high in the infected group i.e. 29.03% (Table 2).

Table 2. Distribution of positive cases according to the parasites species.

GIP parasites species	No. +ve	%
Single infection	**11**	**35.48**
Entamoeba histolytica	7	22.58
Entamoeba coli	2	6.45
Iodamoeba butschlii	2	6.45
Double infections	**11**	**35.48**
Entamoeba histolytica + *Entamoeba hartmanni*	4	12.90
Entamoeba histolytica + *Giardia lamblia*	4	12.90
Entamoeba histolytica + *Entamoeba coli*	1	3.23
Entamoeba histolytica + *Iodamoeba butschlii*	1	3.23
Entamoeba histolytica + *Endolimax nana*	1	3.23
Triple infections	**9**	**29.03**
Entamoeba histolytica + *Giardia lamblia* + *Entamoeba coli*	3	9.68
Entamoeba histolytica + *Giardia lamblia* + *Iodamoeba butschlii*	3	9.68
Entamoeba histolytica + *Entamoeba hartmanni* + *Endolimax nana*	1	3.23
Entamoeba histolytica + *Entamoeba hartmanni* + *Entamoeba coli*	1	3.23
Entamoeba histolytica + *Entamoeba hartmanni* + *Giardia lamblia*	1	3.23
Total positive for GIP parasites	**31**	**100.00**

The quantitative method of discriminating GIP infections in this study was performed with modifications to the procedure for helminth as suggested in Suzuki, 1975 and Belizario *et al.*, 2001. This method calculated the number of protozoa (cysts or trophozoites) that are present in a gram of stool sample. Infection burdens were classified as light (1 to 100), moderate (101 to 1000) and heavy (>1000) protozoa in a gram of stool. No heavy infections were observed in this study; the number of moderately burdened children dropped steeply from the number of the ligthly burdened group by a factor of 4 (see Table 3).

Table 3 Level of GIP infection/burden among schoolchildren.

GIP burden	No. of samples	Percentage
Light	25	80.65%
Medium	6	19.35%
Heavy	-	-
Total	31	100.00%

The association of Gender and Age to GIP infection

Infection was higher in females (Table 4) despite the very close similarity of the gender proportions.

Table 4. The GIP infection between gender.

	GIP Infection					
	Positive		Negative		Total	
Gender	Count	Percentage	Count	Percentage	Count	Percentage
Male	11	35.5%	38	55.1%	49	49.0%
Female	20	64.5%	31	44.9%	51	51.0%
Total	31	100.0%	69	100.0%	100	100.0%

There was no difference between infection burdens between age, the results demonstrated stable rates between age. Table 5 shows the distribution of GIP infection among schoolchildren aged 7, 8, and 9 years old.

Table 5. The GIP infection among ages.

	GIP Infection					
	Positive		Negative		Total	
Age	Count	Percentage	Count	Percentage	Count	Percentage
7	11	35.5%	22	31.9%	33	33.0%
8	9	29.0%	25	36.2%	34	34.0%
9	11	35.5%	22	31.9%	33	33.0%
Total	31	100.0%	69	100.0%	100	100.0%

The statistical analysis result showed that there was no significant association between GIP infection and gender ($\chi^2 = 3.284$, df = 1, $p > 0.05$). There was also no significant association between GIP infection and age ($\chi^2 = 0.494$, df = 2, $p > 0.05$).

Effect of GIP infection on mental and physical factors

Infections, in general, have no impact on the mental and physical conditions of the schoolchildren involved in this study. The descriptive statistics of GIP infection (Table 6) shows that the means of negative infection were lower than positive infection in all variables.

Table 6. The GIP infection on weight, height, attendance to school and examination result.

Factors	GIP Infection	N	Mean	Std. Deviation	Std. Error Mean
Weight	Positive	31	21.0	6.0	1.0
	Negative	69	20.8	4.9	0.5
Height	Positive	31	121.6	7.6	1.3
	Negative	69	121.9	6.7	0.8
Attendance to school	Positive	31	94.7	4.2	0.7
	Negative	69	93.6	5.5	0.6
Examination result	Positive	31	53.7	24.2	4.3
	Negative	69	48.1	23.9	2.8

The results showed no significant difference for the means of GIP infections on weight of schoolchildren ($t = 0.208$, $df = 98$, $p > 0.05$), height ($t = -0.230$, $df = 98$, $p > 0.05$), attendance to school ($t = 1.009$, $df = 98$, dan $p > 0.05$), examination result ($t = 1.072$, $df = 98$, $p > 0.05$). Thus suggests that the infections are within the tolerable levels by the children.

The association between GIP infection and other factors (socio-economic and the environmental factors)

The crosstabulation tables details for other factors (socio-economic and the environmental factors) are shown in Table 7. The was no observably significant association between GIP infection and other factors. The value obtained for occupation status of mother ($\chi^2 = 1.185$, $df = 1$, $p > 0.05$), house area category ($\chi^2 = 5.168$, $df = 2$, $p > 0.05$), and degree of crowding ($\chi^2 = 0.817$, $df = 2$, $p > 0.05$).

Table 7. The crosstabulation tables of: a) occupation status of mother, b) house area category, and c) degree of crowding, with GIP infection.

a) Occupation status of mother * GIP Infection Crosstabulation

Occupation status of mother	GIP Infection				Total	
	Positive		Negative			
	Count	Percentage	Count	Percentage	Count	Percentage
Work	5	17.2%	18	27.7%	23	24.5%
Housewife	24	82.8%	47	72.3%	71	75.5%
Total	29	100.0%	65	100.0%	94	100.0%

b) House area category * GIP Infection Crosstabulation

House area Category	GIP Infection				Total	
	Positive		Negative			
	Count	Percentage	Count	Percentage	Count	Percentage
Rural	15	53.6%	34	50.0%	49	51.0%
Sub-rural	9	32.1%	11	16.2%	20	20.8%
Urban	4	14.3%	23	33.8%	27	28.1%
Total	28	100.0%	68	100.0%	96	100.0%

c) Degree of crowding * GIP Infection Crosstabulation

Degree of crowding	GIP Infection				Total	
	Positive		Negative			
	Count	Percentage	Count	Percentage	Count	Percentage
4-6	14	45.2%	22	35.5%	36	38.7%
7-9	9	29.0%	21	33.9%	30	32.3%
10 >	8	25.8%	19	30.6%	27	29.0%
Jumlah	31	100.0%	62	100.0%	93	100.0%

DISCUSSION

Apparently, the number of infected schoolchildren in this study was not small taking into account the location of this school which is close to the State Capital. However, the infecting species are common and are well documented i.e. *Entamoeba histolytica*, *Giardia lamblia*, *Entamoeba hartmanni*, *Entamoeba coli*, *Iodamoeba butschlii* and *Endolimax nana* (Hamimah *et al.,* 1982; Noorhayati *et al.*, 1981; Sinniah & Rajeswari, 1988). *Entamoeba histolytica* represented the highest proportion similar to the findings of previous workers e.g. Noorhayati *et al.* (1981) and Sinniah & Rajeswari (1988).

The levels of infection or GIP burden only showed light and moderate groups with the heavy group absent; mostly were single and infection, followed by triple infection. The result was similar to Hamimah *et al.* (1982) in Hospital Kuala Lumpur which stated that the amount of single and double infection was higher than triple infection. The triple infection group was, nevertheless, higher as compared to previous studies. In theory there should be smaller number of children harboring three or more species of endoparasites, acknowledging the natural tolerance of human being to parasites or the natural difference of surviving rates of different species parasites in human alimentary tracts. What this suggests would either be that there were higher possibilities of exposures to multiple species infections or that the natural tolerance of schoolchildren in this study was somewhat compromised by unknown factors.

The school environment can potentially be the medium in the spreading protozoa, which include water, food, and mouth-to-anus cycle – the last medium is known to be a common habit of young children (Boreham *et al.*, 1990) especially in a less sanitarily-trained children (Pang, 1989). Protozoan cysts may infect human through drinking of contaminated water and through eating improperly-prepared foods.

Especially pronounced infection rates have been proven to have affected children's growth and mental development (Pang, 1989; Thomas, 1983). This was not seen in this study, demonstrating that infections rates observed here were still within the

natural tolerance levels by the children. Interestingly, we have not obseved outstanding differences career and non-career mothers but the rates of infection did not reflect the common opinion. Therefore, the common perception that working mothers give less attention to their children and consequently increases potentials for schoolchildren to get infected is not exactly true. Infection can be prevented as long as the career mothers care about their children's hygiene. Schoolchildren, either in rural or urban areas, regardless the number of members in their families, still carry risks of infection if hygienic awareness are neglected (Boreham *et al.*, 1990; Parmar, 1995).

GIP, clearly, has not been eradicated, even in sub-urban areas – in this case in a community living close to a state capital. This case showed that although eradication has not taken place, the standard of living and the awareness on hygene are not in apalling states. Nevertheless, it should never become as an excuse not to provide proper public facilities to reduce the infection rates further.

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