Intestinal parasitic infections among school children of the Dhahira Region of Oman

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ABSTRACT

Objective: To determine the prevalence of intestinal parasitic infections among primary school children in Dhahira region of Oman.

Methods: The study took place in the Dhahira region of Oman from September 2004 to March 2005. We randomly recruited 436 students of 9-10 years of age. Their anthropometric measurements were noted. We collected the stool sample of each student and examined for different intestinal parasites. Stereoscopic microscopy and the World Health Organization's approved KATO-KATZ technique were used.

Results: Of the 436 students examined, 65 children (15%) were undernourished (body mass index (BMI) <14 kg/m^2). The prevalence of intestinal parasitic infections was 38.7% (95% CI 33.2 – 42.2). The prevalence of protozoan infection was 36% while helminth infection was 9.4%. The prevalence of *Entamoeba histolytica*/*Entamoeba dispar* was 24%, *Giardia species* 10.5% and *Escherichia coli* 1.4%. The hookworm (*Ancylostoma duodenale, Necator americanus*), *Ascariasis lumbricoides, Trichuris trichiura, Hymenolepiasis nana, Taenia species, Enterobius vermicularis* and *Strongyloides* infections in our study had very low prevalence. Only 29 (6.4%) students had parasitic infection by more than one parasite. The wet zone was significantly associated to the intestinal parasitic infections [Adjusted odds ratio (OR)=3.2 (95% CI 1.9 – 5.2)].

Conclusion: Dhahira region could be classified as low prevalence and low intensity area for soil transmitted helminths infections. However, the magnitude of the protozoan infection was high. The school health program should focus on parasitic infection treatment and addressing the underlying causes of this problem.

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Intestinal parasitic infections are one of the common health problems among school children. It is estimated that some 3.5 billion people are affected, and that 450 million are ill as a result of these infections, the majority of sufferers are children.[1] Protozoan (PTZ) infections like Amoebiasis and Giardiasis are the important causes of childhood morbidity and mortality in developing countries. Intestinal helminths infections are the main causes of disease burden in children 5-14 years of age in developing countries.[2] Intestinal parasitic infections negatively affect the health status of many school-age children in developing countries. They present with general discomfort and acute symptoms such as abdominal pain, nausea and coughing. These symptoms are closely correlated to "worm burden". The greater the worm burden, the more severe will be the symptoms.[3]

Soil transmitted helminths (STH) infections like roundworm (*Ascaris lumbricoides*), hookworm (*Ancylostoma duodenale* and *Necator americanus*) and whipworm (*Trichuris trichiura*) cause morbidity

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and sometimes death by affecting nutritional status, cognitive processes, cause complications that need surgical intervention and granuloma.[4] Global estimates of STH infections are more than 2000 million and these are responsible for significant morbidity and 155,000 deaths annually.[2]

According to World Health Organization (WHO) guidelines, any health program aiming at controlling morbidity of intestinal parasitic infections should have evidence based estimates of this problem. Health planners therefore conducted this study with the aim to find out the prevalence of intestinal parasitic infections among primary school children in Dhahira region.

Methods. The study area, Dhahira region is a landlocked region located in northwestern side of Oman and has Kingdom of Saudi Arabia and United Arab Emirate their border sharing countries. It has a population of 207,015 (census 2003) distributed in five Wilayats (Districts). Forty-five percent of the population is below 15 years of age. The region can be divided into 2 ecologically homogeneous areas – the 'dry'plain zones that do not receive much rain and 'wet' hilly zone that receive occasional rainfall and many wadis (water streams) exist.

There are 102 primary schools in Dhahira region and primary education is free and mandatory. The school health department of Dhahira region is functional since 1992. The staff (doctor and staff nurse) conducts routine screening, immunizations and provides first aids for minor ailments. Health education for safe and healthy life style is a part of the school health and even included in the curriculum of the primary education. During the medical check up if school health doctors suspect parasitic infections, based on the clinical signs and symptom, the child is treated in the school.

This was a school based cross-sectional descriptive study conducted during school academic year 2004-2005. The field part of the study was carried out from September 2004 to March 2005. The study population was primary students aged 9 and 10 years. We divided the entire Dhahira region into 'dry'and 'wet' homogeneous zones/areas. The WHO methodology,[2] in the first stage, from the 102 schools of the region, 7 schools were randomly selected in each zone. In each of these 14 selected schools, classes of minimum 30 children of 9-10 years were listed. From these classes, sequentially children were enrolled for the study to get a sample size of 210-245 children from each zone. From each of the selected school, a minimum of 30 students of 9-10 years were selected randomly.

The school health staff and sanitary inspector of the respective primary health care institution catchment area were the study investigators. A standardization workshop was held prior to the field part of the study. The teams visited the schools and collected the information on height and weight of participating students. Information on the source of drinking water, sanitary toilet facility was also collected. The body mass index (BMI) was calculated using the formula weight (kgs) /height^2 (meters). The height and weight scales were calibrated daily. Weight was recorded to the nearest 50 gms and the height to the nearest 0.5 cms. Each child was asked to collect at least 5 gm of stool in a sterile labeled plastic container. All the collected samples were transported immediately to the laboratory at regional head quarter for examination on the same day. The trained laboratory technicians of Communicable Disease Surveillance and Control (CDSC) examined the stool samples. Presence of all possible intestinal parasites was checked with the help of stereoscopic microscopy and WHO approved KATO-KATZ technique.[2] This technique of stool examination was first described by Kato K in 1954 but only come into sight later in WHO 1966 report. The technique was later modified by Katz N in 1972 hence, the name KATO-KATZ. This technique involves microscopic examination of a fixed amount of fecal material to detect and count helminth eggs. The egg counts give an essential indirect measure of the worm burden. All the children found to be positive were treated by the respective school health doctor with appropriate drugs according to the stool sample results.

The data were collected in a pre-tested school Performa, computed and analyzed using Statistical Package for Social Science (SPSS version 9). The descriptive data on anthropometry are given as mean ± standard deviation (SD). Parametric univariate analysis was carried out to calculate frequencies, proportions and prevalence rates. For statistical validation p value and 95% confidence intervals (CI) were calculated. A p value of <0.05 was considered as significant. Association between the different groups was studied by conducting logistic regression analysis using multi-nominal method. The outcome variable was presence of parasitic infection and dependent variable like age group, gender and district (Wilayat) with step in method. Adjusted odd's ratios were calculated.

The study was conducted with the consent of regional health administrators. The verbal consents of the school principals were also taken to perform this study. The identity of student was kept confidential.

Personal identity was de-linked from the other parameters noted at the time of analysis.

Results. We examined 436 students of 14 schools consisting of 221 students (50.7%) from dry plain zone and 215 (49.3%) from wet hilly zone. Male students were 258 (59.2%) while 178 (40.8%) were female students. The majority of the students (375, 86%) were 9 years old. Approximately 15% of the children were undernourished (BMI<14 kg/m^2). The mean height was 129.4 ± 5.6 cm and mean weight was 27.3 ± 5.9 kg. The well water that students consumed in 12 schools was supplied by water tankers. All the schools had canteen facility and sanitary toilets within the school premises.

The overall prevalence of intestinal parasitic infections was 38.7% (95% CI 33.2-42.4). The protozoan infection accounted 36% and 9.4% for helminths. The frequencies, prevalence with their 95% confidence intervals for different subgroup is given in **Table 1**. *Entamoeba histolytica/ Entamoeba dispar (E. histolytica/E. dispar)* (24.1%), *Giardia species* (10.5%) and *Hymenolepiasis nana (H. nana)* (5.9%) was the most common organisms isolated. The multiple infections are also common with intestinal parasites. Of the 436, 29 (6.4%) students were infected with more than one parasite, 27 (6.1%) with 2 parasites and 2 students had 3 types of parasites.

Among 169 students with parasitic infections, the mean BMI was 26.7 ± 5.5 kg/m^2. In 267 students without parasitic infection, the mean BMI was 27.1 ± 6.3 kg/m^2. Thus, the difference of BMI in students with and without parasitic infection was not statistically significant (actual difference of mean = 0.46, standard error = 0.56).

The association of parasitic infection to different variables was reviewed through logistic regression analysis **Table 2**. Wet zone had significantly higher risk of parasitic infections even after controlling for age, gender and wilayats group.

Discussion. Intestinal parasitic infections in Al Dhahira region in this study were more than one third of 9-10 years old school going children. It is reported that by using the KATO-KATZ method, light infections may be missed and therefore the prevalence in our study could be an underestimate.[2]

The overall prevalence was higher in our study compared to the studies in Turkey (31.8%[1] and 22.4%[5]), Saudi Arabia (10.94%[6] and 24.4%[7]), Gaza

Table 1 - Prevalence of intestinal parasitic infection among study subjects.

Group variables	Examined samples	Parasitic infection N students	Prevalence (%)	95% CI
Gender				
Male	258	100	38.8	32.8 - 44.7
Female	178	69	38.8	31.6 - 45.9
Age group				
9 years	375	138	36.8	31.9 - 41.7
10 years	61	31	50.8	38.3 - 63.4
Zone				
Wet zone	221	61	27.6	21.7 - 33.5
Dry zone	215	108	50.2	43.5 - 56.9
Type of parasites *				
E. histolytica / E. dispar	436	105	24.1	20.1 - 28.1
Giardia species	436	46	10.5	7.6 - 13.4
E. coli	436	6	1.4	0.3 - 2.5
Strongyloides	436	2	0.4	-
A. lumbricoides	436	1	0.2	-
Hookworm	436	0	0	-
H. nana	436	26	5.9	3.8 - 8.2
E. vermicularis	436	2	0.4	-
Taenia species	436	8	1.8	-
T. trichiura	436	2	0.4	-
Dhahira	**436**	**169**	**38.7**	**33.2 - 42.4**

*total number does not correspond to 169 due to multiple infections
E. histolytica/E. dispar - Entamoeba histolytica/Entamoeba dispar, E. coli - Escherichia coli, A. lumbricoides - Ascariasis lumbricoides, T. trichiura - Trichuris trichiura, H. nana - Hymenolepiasis nana, E. vermicularis - Enterobius vermicularis

Table 2 - Intestinal parasitic infection and risk factors

Characteristics (N=436)	Intestinal parasite		Logistic regression		Significance (*P*-value)
	Positive	Negative	Adjusted Odds ratio	95% CI	
Age group			1.1	0.6 - 2	0.76
9 yrs	138	237			
10 yrs	31	30			
Gender			0.7	0.6 - 1.4	0.7
Male	100	158			
Female	69	109			
Zone			3.2	1.9 - 5.2	<0.05
Dry	61	160			
Wet	108	107			
Wilayat					
Ibri	127	185	3.4	1.5 - 7.7	0.003
Yanqul	14	17	5.1	1.6 - 16.4	0.006
Dhank	10	20	8	2.5 - 25.8	<0.001
Buraimi	1	32	40.6	4.8 - 339.9	0.001
Mahdha	17	13	reference		

(24.5%[8] and 27.6%[9]), Tehran[10] (18.4%) and in Cambodia[11] (25.7%). In contrast, it was notably high in studies conducted in Thailand[12] (68.1%), Nigeria[13] (60%) and Nepal[14] (71.2%). A higher rate compared to Middle Eastern countries with similar dietary and socio-cultural habits among children needs further investigation. The magnitude of STH infections in our study was low like in the Cambodian and Izmir studies.[11,15] Different studies have reported higher prevalence of roundworm (21.7, 20.8, 40.7, and 34.9%), hookworm (18.5, 13.0, 4.4, and 19.1%) and whipworm (16.3, 15.3, 4.8, and 25.8%).[12,13,16,17] There were no hookworm infection and only one roundworm and 2 whipworm infections in our study. Thus, low prevalence of STH infections should be noted and intervention strategies of the school health could be modified accordingly.

The *H. nana* infections in our study (5.9%) was lower than Qualyobia[18] (9.9%) and Izmir[15] (10%) study but was higher compared to the studies conducted in Laos[17] (0.2%) and Cambodia[11] (1.3%). Similarly, *Taenia* species infection was higher in Nigeria[13] (2.3%) and Guinea[19] (6.4%) compared to our study (1.8%). It was reported as low as 0.6 % and 0.4% in other studies.[17,18] In a study conducted in Turkey there were no *Taenia* species infections, since the consumption of pork and pork products are forbidden for Muslims, absence of *Taenia solium* cases in Arab population is expected as it was in our study.[1] Health education regarding personal hygiene and proper cooking of meat would further reduce the Taenia species infections among children in Dhahira region.

Similar to Thailand[12] and Egypt[18] study (0.9%), the *Enterobius vermicularis (E. vermicularis)* infections were significantly lower (0.4%) in our study, compared to the 16-45.3% reported in other studies.[1,5,15] This suggests good general hygienic habits among children in Dhahira region. The low prevalence in our study is interpreted cautiously because we did not use the cellulose tape test, which is still the best test to diagnose *E. vermicularis* infections.

The prevalence of STH infections was not associated to different age, gender and BMI in our study. Similar observations were reported in Turkey[1] and Nepal.[14] Low prevalence and intensity of STH infections might have resulted in better nutritional status of our cohort and therefore, perhaps the association of parasitic infection and BMI was not conclusive. Although there was a significant

difference among the wilayat groups in our region it should be viewed with prudence due to the small number of cases in each category except Ibri wilayat. The intensity of STH infection is also important and it was low in our study (<0.1%). The prevalence of parasitic infections was low (6.8%) in undernourished children, which also suggest that perhaps there are other factors responsible for under nutrition, which needs to be studied in Dhahira region.

A similar KATO-KATZ method was used in a study conducted by Gyorkos et al[19] among Guinea primary school children and reported a higher prevalence rate of 43.9% for hookworm, 9.5% for roundworm, 13.5% for whipworm, 6.4 for *Taenia* species and 3.8% *Strongyloides* infections. Dissimilar to our study, there was a significant association between helminth infection and gender (more boys than girls were infected).[19]

The prevalence of *Giardia* species ranged from 2.9-62.2% in literature,[1,5-8,11,15] 10.5% found in our study fitted in this wide range. *Escherichia coli (E. coli)* infections were significantly lower (1.4%) than reported in other studies.[1,6,7,11,12,15] Conversely, the prevalence of *E. histolytica/E. dispar* was higher in our study (24.1%) compared to 4.1%, 0.8%, 1.4%, 6.8% and 7.8% in various studies.[7,11-13,18] Provision of water through pipe system in the houses might be responsible for less contamination of potable water in the study area and therefore infection due to *E. coli* might be less.

The multiple infections are also common with intestinal parasites. Of the 436, Twenty-nine (6.4%) students were infected with more than one parasite, 27 (6.1%) with 2 parasites and 2 students had 3 types of parasites. Okyay et al[1] also reported similar results.

The variation in the prevalence of intestinal parasitic infections in various studies could be due to different study methodology and soil and environmental conditions of the study areas.

In conclusion, the intestinal parasitic infection seems to be a public health problem in school children of Dhahira region of Oman (*E. histolytica/E. dispar* with 24.1% prevalence). According to the study results, Al Dhahira region can be classified as low prevalence and low intensity (<50 and <10%)[2] area for STH infections. Hence, a strategy like targeted treatment among school children in Dhahira region could be applied to manage STH infections. Further studies are needed to know the other risk factors responsible for intestinal parasitic infections in Dhahira region.

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