The relation between the prevalence of soil transmitted parasites in the soil and among school children in Zagazig district, Sharkyia Governorate, Egypt

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Abstract Soil transmitted helminths are highly prevalent throughout the developing countries of the world and Egypt is categorized as one of the developing countries. This study aimed to detect the relation between the presence and prevalence of STH in the soil and their reflection on the prevalence among school-children living in rural and urban areas in Zagazig district, Egypt. The present study was carried out on (859) school-children aged 6–13 years in Zagazig district all over the year 2013. They were subjected to stool examination. Out of them 100 suspected children were serotested for anti-TES IgG antibodies *Toxocara* spp. Soil samples also were collected from their places and regions. The results showed overall prevalence of parasitic infections was 21.07 % for helminthic infection and 39.46 % for protozoa. The prevalence of parasitic infections was more among children in rural areas (28, 49.2, 11.1 %) than those who live in urban areas (6.4, 18, 2.2 %) for helminths, protozoa and *Toxocara* as the most prevalent helminth respectively. Highly significant association was found between soil-transmitted helminthic infections detected by stool examination of the studied children group and the prevalence of geohelminthes in the examined soil samples, taken from residency areas of those children. This association was missed regarding protozoal infections. According to the results, low level of education and consequently poor socio-

economic and hygienic conditions of families appear to be powerful determinants of infection. Thus, improving environmental sanitation is imperative for the control of soil-transmitted helminths.

Keywords Geohelminthes · Soil · School children · *Toxocara* spp. · Sharkyia · Egypt

Introduction

Soil is an important source of several bacterial, protozoal and helminthic infections. For soil transmitted parasites, soil is not only a reservoir of parasitic infective stages but also an environment where infective stages develop (Sorensen et al. 1994).

The most important soil transmitted parasites are *Trichuris trichiura*, *Ascaris lumbricoides*, *Toxocara canis* and *Toxocara cati*, hookworm infection, *Strongyloides stercoralis*, *Taenia solium* and *Hymenolepis nana*. In addition, soil may transmit protozoal cysts such as, *Entamoeba histolytica*, *Balantidium coli* and *Giardia lamblia* (Kunwar et al. 2006).

The distribution of parasitic infections is determined by several factors as age, poverty, illiteracy, poor hygiene, lack of access to potable water and hot and humid tropical climate (Phiri 2000). So the prevalence of intestinal parasites among school children in rural areas was significantly higher than in urban areas (Abera et al. 2013).

Intestinal parasitic infections are commonly transmitted through ingestion of contaminated food and water or through active penetration of the skin by infective larval stages present in contaminated soil. Pica also is considered one of the most important methods of transmission of soil-borne infection. In some instances, transmission occurs

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through close contact between infected and uninfected individuals especially among school children (Bethony et al. 2006).

School-aged children and preschool children are the most vulnerable group and they harbor the large numbers of intestinal worms. As a result, they experience growth stunting, diminished physical fitness and impaired memory and cognition function as well as impaired school attendance and educational performance (Stephenson et al. 2000). It was estimated that 89.9 million school-aged children were infected with one or more STH species in Africa in 2005 (Brooker et al. 2006). Studies have demonstrated that children may acquire helminth infections early in life (Stothard et al. 2008), which causes initial organ damage that can remain subclinical for years and manifest overtly only later, in adulthood (WHO 2006).

The objective of this study was to detect the relation between geohelminths in the soil and their prevalence among school children living in the studied areas at Zagazig district.

Materials and methods

Study type

This study was designed as a cross sectional prevalence study. The study was conducted from January to December 2013. The practical work was done at the Laboratories of the Medical Parasitology Department of the Faculty of Medicine, Zagazig University, Zagazig, Egypt.

Study area

The current study was performed at Zagazig district, where Zagazig is the capital of Sharkiya Governorate. Sharkiya governorate is located to the east of Nile Delta in Egypt. Zagazig district is located at latitude 30.7°N and longitude 31.63°E with four distinct seasons. The average temperature is 18 °C in winter and 42 °C in summer with high humidity. Zagazig district lies along Muis canal which is a branch of river Nile. The soil of this district is variant (clay, silt, sandy) but most of it is clay. This environment is suitable for both the free living and parasitic mode of life of geohelminths (Akl and Abdel-Aziz 2008).

Collection of soil and stool samples

The present study was carried out on eight hundred and fifty-nine children (859) aged 6–13 years in different schools in Zagazig district. Consent was obtained from both Institutional Review Board (IRB) in the Faculty of Medicine and from school managers who in turn informed

the parents about the purpose of the study. After detailed history from the children and thorough clinical examination, they were subjected to stool examination. Also one hundred suspected children were serotested for anti-TES IgG antibodies of *Toxocara* as they manifested with abdominal pain, fever or allergic symptoms after contact with animals. Soil samples were collected from public places in the same areas where stools samples collected such as public playgrounds, areas around the schools and near the canal banks. We aimed to unify the number of both stool and soil samples to be easier for comparison between percentages. Both stool and soil samples were collected all over the year 2013 in different urban and rural areas of Zagazig district.

Examination of soil and stool samples

Specimens were examined within one hour of collection after detailed history from children: age, sex, residence, complaint (diarrhea, abdominal pain, anorexia, nausea, vomiting and anal itching) by the following methods:

- Direct smear method
Unstained smear and Lugol's iodine stained smear methods (Chessbrough 1987): these are used for identification of eggs or larvae for Helminths, or cyst and Trophozoites for protozoa.
- Concentration technique
Formol- Ether Sedimentation technique: (Chessbrough 2000) to increase the efficacy of centrifugal sedimentation for recovery and concentration of helminths eggs from faeces.
- Special technique for detection of Strongyloides larvae
1- Baermann's technique: (Garcia and Bruckner 1993).
2- Test tube culture (Harada Mori filter paper culture (Gutierrez 2000)).

Blood examination

Collection and preservation of blood samples

Blood was withdrawn and evacuated into tubes without any anticoagulant. The blood was left to be coagulated then serum was separated using centrifuge for 5 min at 1,000 rpm and collected by Pasteur pipette into Eppendorf tubes. The sera were stored at −20 °C until used.

Examination of serum samples (Serodiagnosis)

Detection of *Toxocara* spp. antibodies in the serum of the patients by using the purified excretory secretory antigens coated to a microwell plate. This was done by Enzyme

Linked immunosorbent Assay (ELISA) technique using the RIDASCREEN Toxocara Kit supplied by R-biopharm AG (An der neuen BergstraBe 17, D- 64297 Darmstadt, Germany).

Data collected throughout questionnaires coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data, a specific test was used to test differences for significance. Differences between frequencies (qualitative variables) in groups were compared by Chi square test (X^2). P values were considered as follows:

$P > 0.05$ insignificant

$P < 0.05$ significant

$P < 0.01$ highly significant

$P < 0.001$ very highly significant

Discussion

Infection with soil transmitted helminthes is a major health problem especially among children in developing countries. There are large group of parasites that live in the soil during their development. Contamination of soil with parasite eggs and infective larvae constitutes an important risk factor for parasitic infections (Legesse et al. 2010).

There are many factors which are associated with prevalence of soil transmitted parasites as soil composition, climate, method of transmission, socioeconomic and health conditions, education and beliefs related to traditional health practice, the presence of domestic animals at the home, contamination of water and food. Also, ages as the parasites are very common among children due to bad hygienic measure and decreased health education. Parasites cause many health problems as malnutrition, iron-deficiency anaemia, malabsorption syndrome, intestinal obstruction and mental and physical growth retardation, so control and prevention are very important (Espinoza et al. 2003).

In the present study, the overall prevalence of parasitic infections among school children in Zagazig district was 60.53 %, STH (21.07 %) and protozoa (39.46 %) (Table 1). The prevalence in this study was relatively high due to the fact that in both rural and urban areas, there are bad hygienic measures, reduced health education, warm climate, humid atmosphere, consumption of large quantities of raw vegetables without washing, direct contamination of food and drink by infective flies, lack of central sewage disposable system and home septic tanks, poor water supply and deficiency of primary health care centers for children.

The prevalence was nearly similar to that recorded by Mohammed (2013a) in Sharkiya Governorate who reported

Table 1 Prevalence of parasitic infections among 859 school children in Zagazig district

Parasites	Total examined: 859	
	Positive no.	%
Helminthes		
<i>A. lumbricoides</i>	28	3.26
<i>A. duodenale</i>	0	0
<i>T. trichiura</i>	1	0.11
<i>E. vermicularis</i>	61	7.1
<i>S. stercoralis</i>	2	0.23
<i>H. nana</i>	89	10.4
Total infected	181	21.07
Protozoa		
<i>E. histolytica/dispar</i>	115	13.4
<i>G. lamblia</i>	224	26
Total infected	339	39.46

Results are also shown in Fig. 1

a rate (54.3 %) of parasitic infections among school children in Belbeis district. In another study, Henin (2008) studied the prevalence of parasitic infections among children in Abu El-Reesh Hospital in Cairo and reported that the rate was 64 %. Also Abdel-Rahman (2003) recorded a rate of 66.3 % among school children in a village in west of Alexandria. Mohammed (2013b) carried out a survey among primary school children in Alexandria Governorate; he found that the rate was 64.7 %. In another study, Salem et al. (1990) in Menoufia Governorate which has similar environmental and social conditions like that of Sharkiya governorate reported a rate of 62.3 % among children and adults attending Ministry of Health Hospitals in different sectors.

Also, nearly similar results were recorded by several surveys in different parts of the world, in Ethiopia, Abera et al. (2013) reported a rate of 51.5 % of intestinal parasites among school children. Panda et al. (2012) reported that (55.6 %) of school children were found to be positive for intestinal parasites in Vizianagaram district in India, while Kassem et al. (2007) reported a rate of 56 % among children in Libya.

On the other hand, several surveys showed a lower prevalence rate as reported by Osman et al. (1999) in Cairo, who studied the prevalence of parasitic infections among children suffering from watery diarrhea and recorded a rate of 15.48 %. Also, in other parts of world, many surveys showed a lower prevalence rate such as in Africa, Gelaw et al. (2013) carried out a study on prevalence of intestinal parasites among school children in Ethiopia and reported a rate of 34.2 %. In Asia, Gaza district, Astal (2004) recorded a rate of 34.2 % among children, Also in Thailand Saksirisampant et al. (2006) studied the prevalence of

Fig. 1 Prevalence of parasitic infections among 859 school children in Zagazig district

parasitic infection and reported a rate of 4.24 %. In Europe, Turkey; Okyay et al. (2004) recorded a rate of 31.8 % among school children. These results may be due to improved sanitary measures in these areas, availability of clean water and improved personal habits.

In the present study, out of 859 children, 89 children were infected by *H. nana* (10.4 %) and 61 children were found infected with *Enterobius vermicularis* (7.1 %). These results may be explained by autoinfection transmission; especially the eggs of *E. vermicularis* are light and are carried by air current. So infection spread easily among people living together with bad hygienic and socioeconomic habits.

Nearly similar results were obtained in Sharkiya Governorate by Mohammed (2013a) who recorded a rate of 9.8 % of *H. nana* among school children in Belbeis district. As regard *E. vermicularis*, the prevalence rate was nearly similar to the results obtained by Tawfik (2009) who recorded a rate of 13.3 % among mentally retarded children.

Also, several surveys in different parts of world showed nearly.

Similar prevalence rate, in Africa Gelaw et al. (2013) recorded a rate of *H. nana* infection (13.8 %) among school children in Northwest Ethiopia.

In our study, *A. lumbricoides* was reported with a prevalence rate of (3.26 %). This result was nearly in agreement with the results obtained in Dakahlia Governorate which has similar environmental and social conditions like that of Sharkiya governorate, the study was performed by El-Sherbiny (2013) and recorded a rate of 3.4 %.

In other parts of the world, some studies gave nearly similar results as in Asia; Chandrashekhara et al. (2005) recorded *A. lumbricoides* infection with a rate of 2.1 % among children in Nepal. These results were explained by the authors as a result of using insecticides and chemical fertilizers in agriculture and good health habits among examined cases.

On the other hand, some studies gave nearly low prevalence rate as in Beni Suef Governorate. Mohammed

(2009) recorded a rate of 0.28 %. Also in Asia, India, Kaur et al. (2002) recorded a rate of 0.8 % among children. This low prevalence of infections in these studies were attributed to environmental sanitation, the presence of dry sandy soil which is unsuitable medium for development of eggs and larvae, presence of salty water which did not favor the spread of these infection, dry mild atmosphere and wide use of insecticides and chemical fertilizers in agriculture all over the world.

The prevalence of *T. trichiura* was 0.11 % in this study. This low prevalence of infection may be explained by the fact that eggs of *T. trichiura* are fragile and less resistant to environmental stress such as drying or direct exposure to sun light. So they are easily broken and the cycle can't be completed hence limitation of infection, also improved quality of housing being a town inhabitants with good community hygiene, wide use of insecticides and chemical fertilizers in agriculture are additional factors.

School children examined in the present study are negative for *Ancylostoma duodenale* and also the prevalence of *S. stercoralis* was low about 0.23 %.

These results may be explained by the fact that the infective larval stages of hookworm require appropriate warmth, humidity and UV protection (e.g., facilitated by vegetation coverage providing sufficient shade and moisture of the soil) for their survival, and hence transmission. The low hookworm prevalence is likely also a result of improved socio-economic status leading to behavioral changes (e.g., wearing shoes) and improved hygienic conditions, and hence a reduced risk of infection.

In addition to these environmental and socioeconomic conditions for *S. stercoralis* larvae development, Autoinfection also is considered as a problem for diagnosis. As larvae are not necessarily excreted in the stool, it is exceedingly difficult to identify infected individuals. Hence, the "true" prevalence of *S. stercoralis* in the present study might be considerably high as the use stool culture in this study gives the actual prevalence.

In the present study, the prevalence of *E. histolytica* was 13.4 % and *G. lamblia* was (26 %) in Zagazig district (Table 1). This result may be mainly due to contaminated water supply, Also bad hygienic habits, contaminated food with flies, eating unwashed vegetables and poor sanitation are additional factors.

The present result was more or less similar to the results of the prevalence of *E. histolytica* and *G. lamblia* obtained by Curtale et al. (1998) in Behera Governorate who reported a rate of 17.5 and 24.7 % respectively among school children. These results can be explained by the fact that the comparable researches have the same circumstances being performed on similar categories of patients with consumption of contaminated water, bad hygienic habits and eating unwashed vegetables.

Table 2 Prevalence of parasitic infections among 859 stool samples of school children in Zagazig district classified according to residence

Residence	Urban: 277		Rural: 582		X ²	P value
Parasites	No.	%	No.	%		
Helminthes						
<i>A. lumbricoides</i>	1	0.3	27	4.7	3.8	0.04*
<i>A. duodenale</i>	0	0	0	0	0	1
<i>T. trichura</i>	0	0	1	0.17	0.9	0.38
<i>E. vermicularis</i>	7	2.5	54	9.2	3.9	0.049*
<i>S. stercoralis</i>	0	0	2	0.34	1.2	0.2
<i>H. nana</i>	10	3.6	79	13.5	5.8	0.01*
Total infected	18	6.4	163	28	13.5	0.0002**
Protozoa						
<i>E. histolytica/dispar</i>	10	3.6	105	18	9.6	0.001**
<i>G. lamblia</i>	40	14.44	184	31.61	6.5	0.01*
Total infected	50	18	289	49.2	14.3	0.0001**

P < 0.05 (significant difference with *A. lumbricoides*, *E. vermicularis*, *H. nana* and *G. lamblia*)

P < 0.01 (Highly significant difference with *E. histolytica*)

On the other hand, some studies revealed a lower prevalence rate of *E. histolytica* and *G. lamblia* as reported in Giza Governorate. Abu-Srea (2001) recorded a rate of 4.48 and 3.45 % respectively among children. Also, in some countries, the prevalence was low as in Asia Lebanon, Nassar et al. (2004) reported a rate of 2.3 and 3.1 %, while in Latin America, Peru, Flores et al. (2002) reported a rate of 5.5 and 3.3 % among children and adults. These results were explained by availability of clean water for drinking and irrigation of agricultural areas, improving health education, and raising quality of housing among examined cases being town inhabitants with good community hygiene.

Regarding the residency, in the present study, the prevalence of parasitic infections among rural children (28, 49.2 %) was higher than among urban children (6.4, 18 %) for geohelminthes and protozoa respectively (Table 2). The difference was statistically highly significant (P < 0.01).

Ezzat (1995), Henin (2008) reported a rate of (71, 46.9 %) respectively for rural areas and (29, 31.4 %) respectively for urban areas in Cairo governorate. These results can be explained by similarity of environmental conditions and socioeconomic standard between the studied groups in these researches and the studied children in the present study.

Also in other parts of the world similar results were obtained as Abera et al. (2013) in Ethiopia, revealed that the rate of infection was higher among rural than urban (68.3, 36.2 %) respectively. These results explained by children defecation in open fields and poor hygiene practices, such as having untrimmed fingernails, dirt under the nails, and lack of footwear and also low education level of the mother had a positive association with infection.

In this study there was a difference in the degree of soil contamination with parasites between urban and rural localities. The prevalence of geohelminthes was higher in rural (25 %) than urban areas (17.3 %). Also the prevalence of protozoa was 0.8 and 0 % for rural and urban areas respectively (Table 3). This rural–urban dichotomy can be partly understood by the social and environmental conditions in the unplanned slums of developing countries. The prevalence is directly related with the degree of contamination by feces either as a night-soil or as irrigation sewage with accumulation of organic debris discharged from surrounding houses (Beaver 1952). These explanations are clarified by the findings in Dakahlia Governorate by Hanafi et al. (1987). Dakahlia also identified Helminthes eggs in 1,031 out of 1,114 (92.5 %) soil samples which were collected from four villages in Talkha. El-Beshbeshi et al. (2005) detected also geo parasites in 571 out of 1,070 (53.4 %) soil samples collected from four agricultural villages in the same governorate.

This study revealed that geohelminthes were more prevalent in the soil of the urban areas (17.3 %) when compared to the stools of the resident children at the same areas (6.4 %) while the protozoa were more prevalent in stool (18 %) than soil samples (0 %), (Table 4). The decrease in the prevalence of geo parasites in the stools of children in the urban areas in this study may reflect a positive change in the hygienic behavior with the effectiveness of educational standard in reducing positive rates of STH infections, while increasing protozoa in stool indicating that the main source of infection of protozoa not mainly the soil but other sources as drinking of contaminated water.

On the other hand, there was no difference between soil of the rural areas (25 %) for geohelminthes and stool of the

Table 3 Prevalence of parasitic infections among soil samples in Zagazig district according to residence

Residence	Urban: 277		Rural: 582		X ²	P value
Parasites	No.	%	No.	%		
Helminthes						
<i>A. lumbricoides</i>	10	3.6	33	5.7	0.84	0.43
<i>A. duodenale</i>	0	0	1	0.17	0.9	0.38
<i>T. trichiura</i>	0	0	1	0.17	0.9	0.38
<i>E. vermicularis</i>	15	5.4	16	2.7	0.92	0.36
<i>S. stercoralis</i>	3	1.1	5	0.85	0.02	0.86
<i>H. nana</i>	20	7.2	90	15.5	2.9	0.08
Total infected	48	17.3	146	25	1.5	0.2
Protozoa						
<i>E. histolytica/dispar</i>	0	0	1	0.17	0.9	0.38
<i>G. lamblia</i>	0	0	4	0.68	2.2	0.13
Total infected	0	0	5	0.8	0.7	0.3

P > 0.05 (insignificant difference)

Table 4 Comparison between stool and soil samples in urban area regarding the prevalence of parasitic infections in Zagazig district

Residence	Urban: 277				X ²	P value
Samples parasites	Soil		Stools			
	No	%	No	%		
Helminthes						
<i>A. lumbricoides</i>	10	3.6	1	0.3	7.3	0.006**
<i>A. duodenale</i>	0	0	0	0	0	1
<i>T. trichiura</i>	0	0	0	0	0	1
<i>E. vermicularis</i>	15	5.4	7	2.5	2.9	0.08
<i>S. stercoralis</i>	3	1.1	0	0	0	1
<i>H. nana</i>	20	7.2	10	3.6	3.6	0.05
Total infected	48	17.3	18	6.4	13.6	0.0002**
Protozoa						
<i>E. histolytica/dispar</i>	0	0	10	3.6	9.3	0.0003**
<i>G. lamblia</i>	0	0	40	14.44	37.6	0.0000001**
Total infected	0	0	50	18	41.3	0.0000001**

The prevalence of helminthes was higher in soil than stools samples while the prevalence of Protozoa was higher in stool than soil samples in urban area and the difference was very highly significant (P < 0.001)

resident children at the same areas (28 %), while protozoa were more prevalent in stool (49.2 %) than soil (0.8 %) as in urban areas (Table 5). This was explained by the nature of occupation of individuals resident in rural areas influenced the infection rate. Farmers recorded high positive rates for all STH parasites and this was similarly observed by Phiri (2000). Also Children recorded high rates for STH because of the contaminated environment in which they played as their contaminated hands were dipped into the mouth quite often.

In the present study, the overall seroprevalence of human anti-*Toxocara* IgG antibodies among suspected

children (having a history of abdominal pain, diarrhea, anaemia, eosinophilia and allergic symptoms on contact with animals or fever) was 7 %. In Egypt Khalil et al. (1978) examined soil samples collected from different governorates and they reported the following rates of *Toxocara* contamination: 12.5, 11.5, 10 and 7.5 % in Giza, Cairo, Dakahlia and Qalyoubia respectively. Also, Etewa et al. (2014) reported that, *Toxocara* spp. Eggs were the most widely distributed geo parasites in the soil of Sharkyia governorate.

However, this result is slightly lower than that reported by Antonios et al. (2008), Espinoza et al. (2010).

Table 5 Comparison between stool and soil samples in rural area regarding the prevalence of parasitic infections in Zagazig district

Residence	Rural: 582				X ²	P value
Sample parasites	Soil		Stools			
	No.	%	No.	%		
Helminthes						
<i>A. lumbricoides</i>	33	5.7	27	4.7	0.6	0.4
<i>A. duodenale</i>	1	0.17	0	0	1	0.3
<i>T. trichiura</i>	1	0.17	1	0.17	0	1
<i>E. vermicularis</i>	16	2.74	54	9.2	0.05	0.8
<i>S. stercoralis</i>	5	0.85	2	0.34	1.8	0.13
<i>H. nana</i>	90	15.4	79	13.5	0.71	0.39
Total infected	146	25	163	28	0.9	0.3
Protozoa						
<i>E. histolytica/dispar</i>	1	0.17	105	18	102	0.000
<i>G. lamblia</i>	4	0.68	184	31.61	175	0.000
Total infected	5	0.8	289	49.2	279	0.000

P > 0.05 insignificant difference for geohelminths

P < 0.001 very high significant difference for protozoa

Table 6 Comparison between the prevalence of *Toxocara* infection among suspected school children and its prevalence in soil according to residence

<i>Toxocara</i> samples	Total examined: 100									
	Urban 46				P value	Rural 54				P value
	Serum		Soil			Serum		Soil		
	No	%	No	%		No	%	No	%	
	1	2.2	5	10.88	0.0004	6	11.11	10	18.585	0.16

P < 0.0001 very high significance in urban area

P > 0.05 insignificant in rural area

Difference in prevalence could be as a result of difference in selected target population or the used diagnostic techniques of toxocariasis.

The result of toxocariasis in school children and soil prevalence in this study explained by several risk factors such as geophagia, frequent contact with soil, doing nothing to prevent contamination after contact with puppies, neither washing hands before meals nor washing fruits and vegetables.

There was a significant difference between the results of toxocariasis in the serum (2.2 %) and soil samples (10.8 %) in urban area. While the difference in rural areas between serum (11.1 %) and soil samples (18.5 %) was insignificant (Table 6). This is attributed to the presence of large number of stray dogs and cats in the public places especially in rural areas. Moreover these eggs could have been carried from the livestock by the farmer's shoes from place to place (Kozakiewicz 1980).

A significant association was observed between residence and *Toxocara* seropositivity with the highest prevalence

observed in children who live in rural areas (11.1 %) with low socioeconomic status than those who live in urban areas (2.2 %) (Table 6). In agreement with the work done by Antonios et al. (2008) and Jacob (2012), may be attributed to unhygienic conditions around homes. Low socioeconomic status probably generates some social, cultural and environmental conditions which are more favorable to *Toxocara* spp. infection. Dirty and unfenced homes which allow the wandering of stray dogs as well as the children of these families probably attend schools located in inadequate areas.

In conclusion, the study showed a relatively high prevalence of STH and protozoa among school children in Zagazig district especially in rural areas. As regard association between soil contamination and human parasitic infection, soil contamination has a very important role in transmission of STH in rural areas, on the other hand soil has a minor role in transmission of STH in urban areas. Thus, the environmental pollution, sanitary condition and human behavior play an important role in transmission of

the infection. For protozoal infection, there is no association between soil contamination and human parasitic infection whether in rural or urban areas. So, soil has a limited role in transmission of protozoal infection. This study may contribute to better planning of control and preventive measures to decrease the prevalence of geohelminths. These measures include prohibition of the use of night soil as a fertilizer, environmental sanitation, education and hygienic habits.

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