

Deterioration of School Performance as a Consequence of Parasitic Infestation in Menoufiya Governorate

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Abstract

Background: Worm infestation is a major problem in children from developing countries due to bad hygienic conditions. It produces nutritional deficiencies and anemia in children, especially when hookworm infestation is present. Infections impair children's growth and development. Studies have shown associations between helminthes infection and under nutrition, iron deficiency anemia, stunted growth, and poor school attendance.

Aim of Study: This study aims to assess the relation between parasitic infestation in primary school children and its effect on school performance.

Patients and Methods: The nutritional state of children was assessed by anthropometric measures, clinical examination and laboratory investigation such as hemoglobin (HB) level. The parasitic infestation was assessed by stool and urine analysis, also school performance was assessed by Intelligence quotient (IQ), school achievement and school attendance. Study done from the end of August 2016 to the end of November 2018 in Shebin El-Kom Center and Berkit Sabaa Village, Menoufiya Governorate.

Results: This study showed high prevalence of parasitic infestation in rural 67.5% than urban 58.5% with high prevalence of entameba histolytica, ascariis, giardia, oxyuris, mixed infection while hymenolepis nana, tricuris tricura, anclystoma duodenale. Strongyloides stercoralis and schistosoma mansoni present only in rural with low incidence. There was no statistical significant difference between urban and rural school children regarding anthropometric measures including (body weight, height and head circumference) and between infected and non infected except for weight, there was statistical significant difference between non infected children compared to infected. Also there was statistically significant difference in hemoglobin level between urban compared to rural and between infected children compared to non infected as the prevalence of anemia was a higher in rural compared to urban and among infected children compared to non infected. There was statistical significant difference in school performance parameters including (I.Q level and school achievement) between urban compared to rural and infected children compared to non infected students.

Conclusions: It is evident that there is correlation between parasitic infestation and poor children cognitive function (school performance) and growth.

Recommendations: All members dealing with children such as, teachers, pediatric clinics and family physician in family health units and centers for eradication and treatment of all affected children with parasite should be integrated to improve children school performance. Programs for prevention and control of parasitic infection and school performance disorders must be prioritized.

Key Words: Parasitic infestation – Cognitive function – School performance – Anthropometric measures – School children.

Introduction

HELMINTHES infestations are widely distributed all over the world especially in the developing countries, Egypt is one of them, it is highly infested by all of the categories of helminthes and especially the primary school aged children [1].

Worms cause hyperactive behavior, learning problems, depression, or attention deficits by making children miserable on the inside. Parasites rob the body of needed nutrients which in-turn affects behavior [2].

Assessing the effect of parasitic infestations on the school children behavior and intelligence and school performance. Heavy worm burdens are associated with impaired cognitive function and delays in psychomotor development. Helminthes infection adversely influences attendance, enrollment, and school completion. The presence of parasites leads to other health-and nutrition-related problems that have adverse consequences for school achievement [3].

In the early phase (4-16d after egg ingestion), respiratory symptoms result from the migration of larvae through the lungs. Classically, these symp-

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toms occur in the setting of eosinophilic pneumonia (Löffler syndrome), fever, non productive cough, dyspnea, wheezing. In the late phase (6-8 wk after egg ingestion), gastrointestinal symptoms occur. Diffuse or epigastric abdominal pain, nausea, vomiting, fever, jaundice (in biliary obstruction), cachexia (due to malnutrition) and mental retardation [4].

Strongyloidiasis can become chronic and then become completely asymptomatic. Giving proton pump inhibitors (PPI), greatly reduces the HCl content of the stomach and allows the strongyloides to thrive. That is why often individuals with strongyloidiasis develop worse epigastric distress when placed on PPI's [5].

Patients are often asymptomatic. Worms may be incidentally discovered when worms are found in the perineal region. If patients are symptomatic, pruritus ani and pruritus vulvae are common presenting symptoms. Restlessness during sleep is noted by the parents of many children. Visual sighting of a worm by a reliable source (e.g., a parent) is usually accepted as evidence of infestation and grounds for treatment [6].

Many individuals do not experience symptoms. The first symptom of the disease may be a general ill feeling. Within twelve hours of infection, an individual may complain of a tingling sensation or light rash, commonly referred to as "swimmer's itch", due to irritation at the point of entrance. Other symptoms can occur two to ten weeks later and can include fever, aching, cough, diarrhea, or gland enlargement [7].

There are no specific symptoms or signs of hookworm infection. Coughing, chest pain, wheezing, and fever will sometimes be experienced by people who have been exposed to very large numbers of larvae. Epigastric pains, indigestion, nausea, vomiting, constipation, and diarrhea can occur early or in later stages as well, although gastrointestinal symptoms tend to improve with time [8].

Asymptomatic infections are common following ingestion of the parasite. *E. dispar* does not cause invasive disease or antibody production. As many as 90% of *E. histolytica* infections are also asymptomatic. The infection is self-limited but may be recurrent. Only antigen detection tests can distinguish between *E. histolytica* and *E. dispar*.

Most individuals with *G. lamblia* are probably asymptomatic. Giardiasis produces symptoms more often in children than in adults. Symptoms develop in an estimated 40-80% of infected children. Clin-

ical signs and symptoms, diarrhea, malaise, weakness, abdominal distention, flatulence, abdominal cramps, nausea, weight loss, vomiting, low-grade fever (infrequent), various neurologic symptoms (eg. irritability, sleep disorder, mental depression, neuroasthenia), urticaria [9].

Most standardized tests are not designed to evaluate the individualized growth and development taking place in the classroom. Children taking these tests are assessed on isolated skills in ways that are unfamiliar to them, and the test results often do not reflect children's personal experiences or knowledge. In recent years, however a new approach to assessment has been gaining acceptance among early childhood and primary grade teachers. Known as "performance" assessment [10].

Benefits of performance assessment:

A system of developmental checklists, portfolios of children's work, and summary reports, when used together, can help you to recognize that children can express what they know and can do in many different ways, to evaluate progress as well as performance, to evaluate the "whole child", to involve children in the process of assessing their own growth, to establish a framework for observing children that is consistent with the principles of child development, to contribute to meaningful curriculum planning and the design of developmentally appropriate educational interventions, to give parents specific, direct, and understandable information about their child and to collaborate with other teachers, thus enhancing your own professional skills [11].

School performance problems:

There are many reasons for teens to underperform at school, lack of motivation to do well, problems at home or with peers, poor work habits or study skills, emotional and behavior problems, learning disabilities (such as dyslexia), attention deficit hyperactivity disorder, mental retardation or below average intelligence, medical problems, including anxiety and depression, children with sleep problems, such as obstructive sleep apnea, or inadequate sleep, can have problems in school, usually secondary to attention problems and daytime sleepiness [12].

Parasitic infection is one of the most common infections in the world. The majority of cases occurs in people living in developing countries and is visually common and most intense among school-aged children. Infections in children affect their health, growth, nutritional status and mental development [13].

Among school aged populations, helminthes infection generates very high levels of morbidity despite of the relatively limited mortality associated with the condition. Severe hookworm infection is associated with impaired mental function as well as such educational outcome measures as absenteeism, under enrollment. Thus, helminthes infection appears to constitute a very real barrier to children progress in school [14].

Infestation with roundworm, hookworm and whipworm often affects the nutritional state of the children and school performance because it can stunt growth, decrease physical activity and cause poor mental development [15].

One third of the world population is infected with one or more species of intestinal helminthes and public health specialists are concerned that these infections impair children growth and development. Studies have shown associations between helminthes infection and under nutrition, iron deficiency anemia, stunted growth, poor school attendance and poor performance in cognition tests [14].

In general, helminthic infection is linked to poor mental function, educational attainment and

learning ability. It is unclear, however, whether the relationship is causal or confounded by intervening socioeconomic variables.

Nevertheless, roundworm, whipworm and hookworm are all considered to exert heavy negative influence on learning attitudes and moderate negative influence on school attendance [16].

Aim of work:

The present study was designed to determine if there is an association between parasitic infestation of school children and their cognitive function or their school performance.

The main objective was: To is to assess the relation between parasitic infestation in primary school children and its effect on school performance in Berkit El Saba center in Menoufiya Governorate.

This will be fulfilled through: (I) Assessing nutritional state of children by anthropometric measures, clinical examination and laboratory investigation hemoglobin (HB) level, (II) Assessing parasite infestation by stool and urine analysis. And (III) Assessing school performance by IQ, assessing school achievement and school attendance.

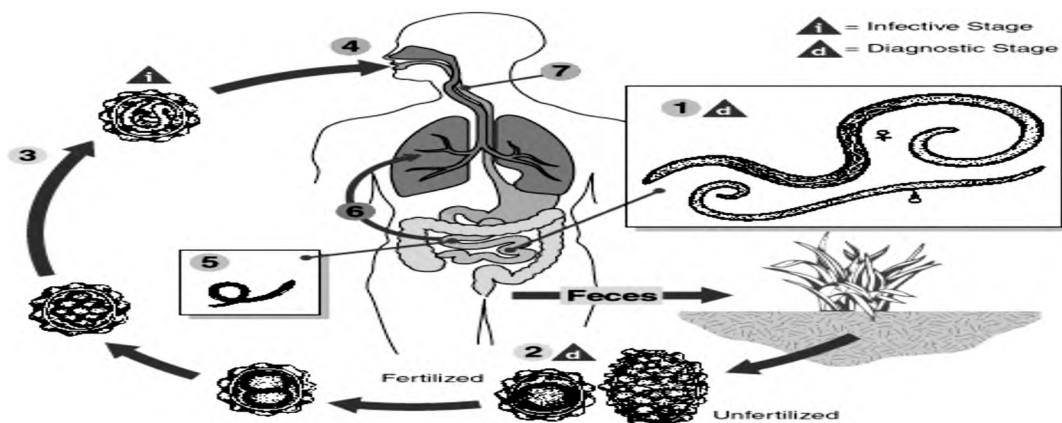


Fig. (1): Life cycle of ascaris (<http://www.dpd.cdc.gov/dpdx>).

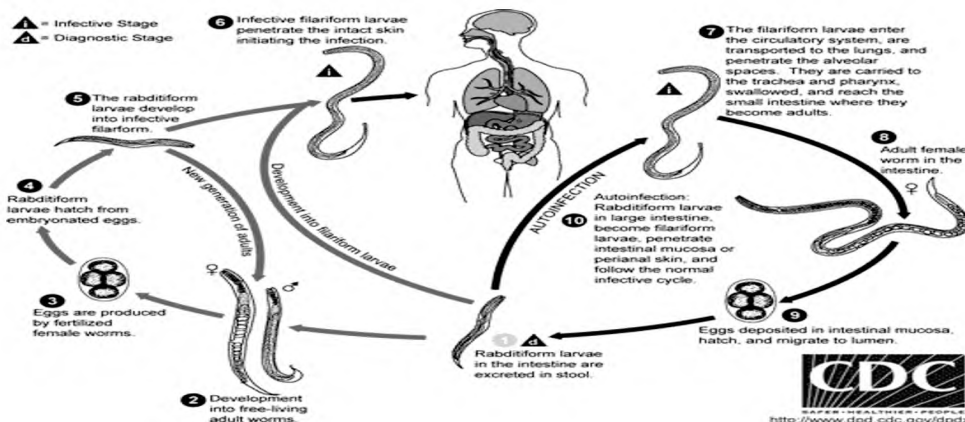


Fig. (2): Life cycle of strongyloide (<http://www.dpd.cdc.gov/dpdx>).

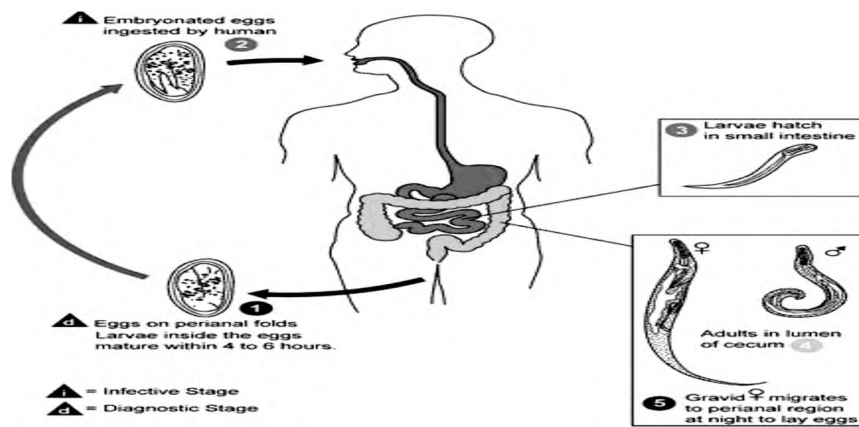


Fig. (3): Life cycle of *E. vermicularis* (<http://www.dpd.cdc.gov/dpdx>)

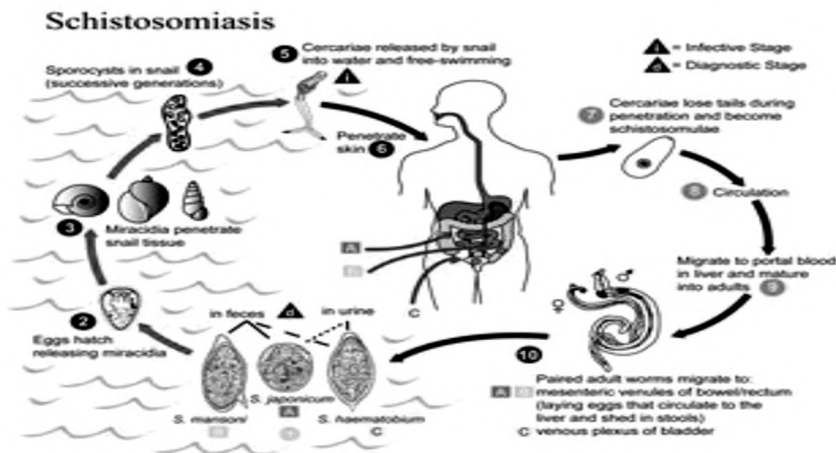


Fig. (4): Life cycle of *Schistosoma mansoni* (<http://www.dpd.cdc.gov/dpdx>).

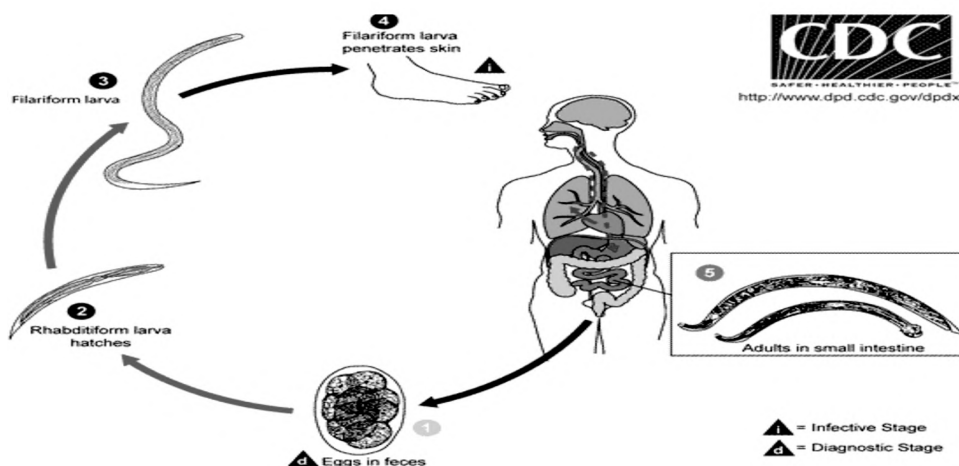


Fig. (5): Life cycle of *Ancylostoma* (<http://www.dpd.cdc.gov/dpdx>).

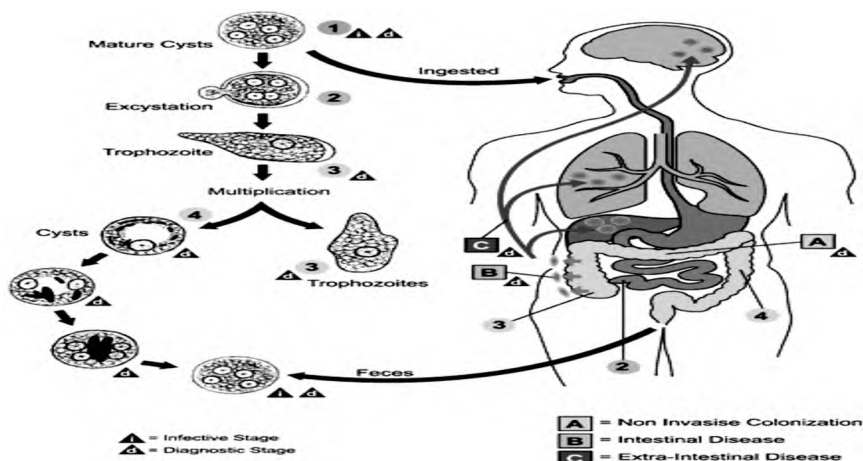


Fig. (6): Life cycle *E. histolytica* (<http://www.dpd.cdc.gov/dpdx>).

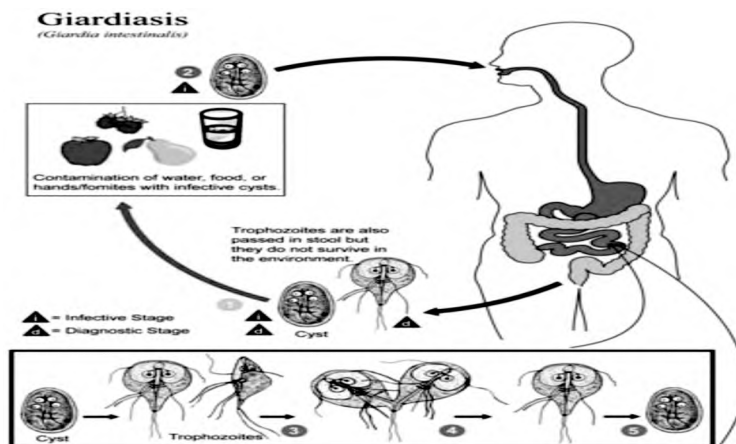


Fig. (7): Life cycle of *giardia lamblia* (<http://www.dpd.cdc.gov/dpdx>).

Patients and Methods

This study was conducted on 1071 apparently healthy children aged from 6-12 years, 512 male and 559 female, who all were borne and living in Menoufiya Governorate, attending the primary schools in Shebin El Kom city from duration between the end of August 2016 to the end of November 2018 in Shebin El-Kom center and Berkit Sabaa village, Menoufiya Governorate. Two schools were selected from Shebin El-Kom city an one school from Berkit Sabaa village (357 students from each school) to show population in the Menoufiya Governorate and considered legible for entry into the study, if they met the following criteria; age between 6-12 years, born and live in Menoufiya Governorate and apparently healthy children. Children below the age 6 years or with any apparent disorders were excluded from the study. Legal permission was taken from the Ministry of education and school managers to collect urine, stool and blood samples and to assess school performance. Each student was subjected to full history taking, clinical examination, growth assess-

ment; weight and height were assessed and were plotted on Egyptian growth charts and lastly laboratory investigations were also done included urine and stool analysis, hemoglobin level, rectal snip when needed. School performance was assessed through I.Q assessment using Arabic version of Stanford-binet intelligence scale the most common widely recommended fourth type of it, this test was done by psychologist, the result were interpreted as follows; child from (68-78) called slow learner, child from (79-88) called below average, child from (89-110) called average, child from (111-120) called above average, child from (121-130) called excellent and lastly child from (131-140) called Jennies [17].

School achievement was assessed taking average of marks of the three months of the first part of the year in which child under 50% called weak (feeble), child from (50%-64%) called acceptable, child from (65%-74) called good, child from (75%-84%) called very good and child from (85% to above) called excellent [18].

Child school attendance taking average of attendance in the first part of year, (by using book of attendance and absence of students in the three months of the first term) ranging from; good attendance (90% to 100%), average attendance (50% to 90%) and bad attendance (below 50%) [19].

Child history was taken which included personal history; a standardized questionnaire to collect information about age, sex and occupation of the parents. Dietary history of the child which was included eating habits and preference of special types of food as fresh vegetables, citrus fruits, canned food, shell fish, meat, take breakfast or not. Special habits of the child like any habits of medical importance such as smoking and drug abuse.

Child clinical examination, in which each child was submitted in complete clinical examination, included general examination, heart, chest and abdominal examination.

Child anthropometric measurement which was included:

Child body weight which is a growth parameter and a good index of acute and chronic nutritional status. Weight is evaluated for age and child height which was measured without the shoes and the child took a breath, relaxed, the shoulders were stretched up to be as tall as possible, then we put each child weight and height measurement of the children on Egyptian growth Charts (20012) which interpreted as followed; child below 3rd Egyptian centile was considered below normal (abnormal), child between 3rd and 97th centile was considered normal and child above 97th Egyptian centile: above normal (abnormal).

Laboratory examination of child blood, stool and urine samples in which all children were subjected to hemoglobin level estimation; which was assessed for every child using hemoglobin spectrophotometer (HemoCue, Sweden). Blood sample was performed on capillary blood from the fingertip of each child after discharge of the first drop by painless sterile safety blood lancets [20].

Child urine analysis was collected into clean plastic disposable cups with lids and was examined using the following method sedimentation method in which the terminal sample of urine was poured in a conical flask and left for 30-60 minutes to sediment; then the supernatant was discarded and a drop of the sediment was put on a slide and examined for the presence of parasites [21].

Child stool analysis in which stool sample was collected into clean dry plastic disposable cups with lids and examined using either direct smear method in which homogenous thin film was prepared on each slide by mixing the stool sample with a drop of normal saline or iodine solution the coarse fibers were removed away from the specimen and a cover glass was put on each preparation. The preparations were examined systematically using the low and high power of the microscope [22], or Sedimentation procedure in which stool sample was allowed to sediment for an hour and then decant the supernatant and resuspended the sediment from the bottom layer, a pipette transfer two drops to a slide and cover with a cover glass and systematically examine the entire preparation. A negative report should not be made until the entire sediment has been examined [22].

Child school performance assessment was divided into three assessments which were child psychometric assessment (assessment of intelligence quotient using Sanford-Binet test), child school attendance assessment (by using book of attendance and absence of students in the three months of the first term) and child school achievement assessment (by assessment of students; marks in the three months of the first term) [19].

Statistical analysis of the data were collected and analyzed using Epi-info version 6 and SPSS (Statistical Package for Social Science) version 22 in which Chi square test was used for qualitative data while student *t*-test was used for quantitative normally distributed and not normally distributed data and for all statistical tests done *p*-value of <0.05, was considered significant.

Results

Total screened children were 1071, 512 (47.8%) were males, 559 (52.2%) were females, 642 (59.9%) from 6-9 years and 429 (40.1%) from 10-12 years. Pallor was found in 375 (35.01%) and anemia was found in 395 (36.9%) of children, 91 (8.5%) of school children suffer from pruritis ani and no one of them had hepatosplenomegally and 668 (62.4%) of them had parasitic infestation. The majority of screened school children were in average and below average sectors of IQ. The majority of children attend about 90-100% of school days, 54 (5.04%) were attend between (50-90%) of school days and the higher percent was for >85% of school achievement and the majority of children were in between 50%-84% sectors of school achievement. In this study it was found that entameba histolytica

is the most prevalent in (6-9y) followed by ascaris while the giardia is the most frequent infestation among the (10-12y) old group followed by Entameba histolytica and oxyuris. There was highly significant prevalence of entameba histolytica in young (6-9y) sector of age while there was highly significant prevalence of giardia and oxyuris in older (10-12y) sector of age, and there was no significant difference between other type of parasite regarding the age.

In this study it was found that the majority of non infected school children were non anemic and the number of anemic school children was significant higher in infected school children compared to non infected school children, and there was highly significance prevalence of pruritus ani in infected school children compared to non infected school children.

There was highly significant prevalence of below average sector (79-88) of IQ in infected children compared to non infected while there was significant prevalence of above average sector (111-120) of IQ in non infected compared to infected and with was no significant difference between infected and non infected in other sectors of IQ. The majority of infected and non infected school children are in the sector (90%-100%) of school attendance. The number of non infected school children in the sector (>85%) of school achievement is significant higher than those of infected in the same sector while the number of infected children in the sector (<50%) of school achievement is significant higher than those of non infected in the same sector with no significant difference between infected and non infected in other sectors of school achievement.

The majority of anemic school children are in the below average sector (79-88) of IQ while the majority of non anemic school children are in the average sector (89-110) of IQ.

There was highly significant prevalence of sector (90-100%) of School attendance in non anemic school children compared to anemic school children while there was highly significant prevalence of sector (50-90%) of School attendance in anemic children compared to non anemic.

The majority of infected anemic school children were in the below average sector of IQ while majority of infected non anemic school children were in the average sector of IQ. The majority of infected anemic and infected non anemic school children are in the sector (90%-100%) of school

attendance and there was no significant difference between infected anemic and infected non anemic children regarding school attendance.

This table showed that there was a highly significance prevalence of non infected school children whom were young age (6-9ys) and female sex compared to infected school children while there was highly significance prevalence of infected school children whom were older age (10-12ys) and male sex compared to non infected school children.

This table showed that the majority of infected school children were in the below average sector of IQ while majority of non infected school children were in the average sector of IQ., there was no significant difference between infected and non infected regarding school attendance and the majority of infected and non infected school children are in the (>85) sector of school achievement.

This table showed that there was highly significant prevalence of above average sector (111-120) of IQ in non anemic children compared to anemic and there was no significant difference between anemic and non anemic in other sectors of IQ. The majority of anemic and non anemic school children are in the sector (90%-100%) of School attendance. The majority of anemic and non anemic school children are in (>85) sector of School achievement. There was significant higher than those of non anemic in the same sector and there was no significant difference between anemic and non anemic in other sectors of School achievement.

This table showed that the most prevalent type of infection in both anemic and non anemic children was entameba histolytica. There is highly significant prevalence of giardia and oxyuris in non anemic compared to anemic school children while there is highly significant prevalence of mixed infection and h nana in anemic compared to non anemic school children and there is no significant difference between non anemic children and anemic regarding other types of parasites.

This table showed that there was highly significant prevalence of below Average sector (79-88) of IQ in infected anemic children compared to infected non anemic while there was significant prevalence of average sector (89-110) of IQ in infected non anemic compared to infected anemic and with was no significant difference between infected anemic and infected non anemic school children in other sectors of IQ.

Table (1): Association between age group and type of parasitic infestation among the studied school children.

Type of parasite	Age in years				p-value
	6-9 (No-344)		10-12 (No-324)		
	N	%	N	%	
Entameba. histolytica	151	43.8	68	20.9	<0.01
Giardia	42	12.2	89	27.4	<0.01
Ascaris	70	20.3	66	20.4	>0.05
Oxyuris	46	13.4	67	20.6	<0.05
H nana	1	0.29	2	0.61	>0.05
Trichuris	2	0.58	1	0.3	>0.05
Anclystoma	0	0.0	2	0.61	>0.05
Stongyloide	0	0.0	2	0.61	>0.05
Schistosoma	0	0.0	1	0.3	>0.05
Mixed infection	32	9.3	26	8.02	>0.05

Table (2): Comparison between infected and non infected school children regarding the demographic and clinical data.

Type of variables	Infected (No-668)		Non infected (No-403)		p-value
	N	%	N	%	
Age (years) X ± SD	9.36±2.45		8.75±2.08		<0.01
<i>Gender:</i>					
Male	379	56.7	133	33.1	<0.01
Female	289	43.3	270	66.99	
<i>Body weight centile:</i>					
<3rd	107	16.01	47	11.6	<0.05
3rd-97th	552	82.6	340	84.4	>0.05
>97th	9	1.3	16	3.9	<0.05
X ± SD	27.34±3.82		29.62±4.13		<0.01
<i>Height centile:</i>					
<3rd	31	4.7	21	5.2	>0.05
3rd-97th	624	93.4	370	91.8	
>97th	13	1.9	12	2.9	
X ± SD	126.04±12.37		127.45±12.85		>0.05
<i>Anemia:</i>					
Present	271	40.5	124	30.8	<0.01
Absent	397	59.5	279	69.2	
<i>Pruritis ani:</i>					
Present	88	13.2	3	0.07	<0.01
Absent	580	86.8	400	99.3	

Table (3): Comparison between infected and non infected school children regarding IQ, school attendance and achievement.

	Infected (No-668)		Non infected (No-403)		p-value
	N	%	N	%	
<i>School children IQ:</i>					
Excellent (121-131)	1	0.14	2	0.4	>0.05
Above average (111-120)	84	12.5	73	18.1	<0.05
Average (89-110)	252	37.7	164	40.6	>0.05
Below average (79-88)	289	43.2	138	34.2	<0.01
Slow learner (68-78)	42	6.2	26	6.4	>0.05
<i>School attendance:</i>					
(90-100%)	631	94.4	386	95.8	>0.05
(50-90%)	37	5.5	17	4.2	
<i>School achievement:</i>					
(>85%)	251	37.5	176	41.4	<0.05
(75%-84%)	175	26.1	104	25.8	>0.05
(65%-74%)	149	22.3	75	18.6	>0.05
(50%-64%)	56	8.3	42	10.4	>0.05
(<50%)	37	5.5	6	1.4	<0.01

Table (4): Comparison between anemic and non anemic school children regarding IQ, school attendance and achievement.

	Anemic (No-395)		Non anemic (No-676)		p-value
	N	%	N	%	
<i>School children IQ:</i>					
Excellent (121-131)	0	0.0	1	0.15	>0.05
Above average (111-120)	15	3.8	53	7.8	<0.01
Average (89-110)	160	40.5	292	43.0	>0.05
Below average (79-88)	179	45.3	271	40.1	<0.05
Slow learner (68-78)	41	10.4	59	8.7	>0.05
<i>School attendance:</i>					
(90-100%)	378	95.7	671	99.3	>0.01
(50-90%)	17	4.3	5	0.7	
<i>School achievement:</i>					
(>85%)	110	27.8	238	35.2	<0.05
(75%-84%)	89	22.5	186	27.5	>0.05
(65%-74%)	102	25.8	140	20.7	>0.05
(50%-64%)	55	13.9	74	10.9	>0.05
(<50%)	39	9.8	38	5.6	<0.01

Table (5): Difference between different types of parasite in relation to Anemia.

	Anemic (No-246)		Non anemic (No-422)		p-value
	N	%	N	%	
Ent. Histo	80	32.5	139	32.9	>0.05
Ascaris	49	19.9	87	20.6	>0.05
Giardia	31	12.6	100	23.7	<0.01
Oxyuris	26	10.6	87	20.6	<0.01
H nana	3	1.2	0	0.0	<0.05
Anclystoma	2	0.8	0	0.0	>0.05
Trichuris .T	2	0.8	1	0.24	>0.05
Strongyloide	2	0.8	0	0.0	>0.05
Schistosoma	1	0.4	0	0.0	>0.05
Mixed	50	20.3	8	1.9	<0.01

Table (6): Comparison between infected anemic and infected non anemic school children regarding IQ, school attendance and achievement.

	Anemic (No-271)		Non anemic (No-397)		p-value
	N	%	N	%	
<i>School children IQ:</i>					
Excellent (121-131)	0	0.0	1	0.02	>0.05
Above average (111-120)	30	11.1	54	13.6	>0.05
Average (89-110)	90	33.2	162	40.8	<0.05
Below average (79-88)	131	48.3	148	37.3	<0.01
Slow learner (68-78)	20	7.4	32	8.1	>0.05
<i>School attendance:</i>					
(90-100%)	215	79.3	328	82.6	>0.05
(50-90%)	56	20.7	69	17.4	

Discussion

The overall average parasitic infestation rate in schools of Shebin El-Kom Menoufiya Governorate could be very high. Given that the 357 children examined per school were randomly selected, an overall average infestation rate of 65.7% in the sample is exceptionally high. Such factors mentioned above that characterize the region are ideal for parasitic prevalence. Ascariasis, and the hookworm diseases are geo-mediated infestations whose endemicity is facilitated by number of factors, such as climatic factors, including high temperatures, and heavy precipitation. These two factors account for high humidity, the single most important parameter that favours the hatchability of geohelminth ova in the soil [23].

The prevalence of the protozoa parasites among the children is seemingly low. This could be explained by the method used to process faecal materials. The majority of the identifiable motile trophozoites could have been destroyed during concentration of the stool samples. The method of direct examination of wet stool would have probably revealed more *E. histolytica* and *G. lamblia* [24].

For *S. mansoni* boys are more affected compared to girls and this could be attributed to swimming in the rivers, a common behavioural risk factor in boys at this age, where they would interact with the infective cercariae. Elsewhere, such activities and situations like swimming, fishing, watering of animals, swamp/wetland rice growing, have been identified as critical in schistosomiasis epidemiology [25,26].

The hookworm infection rate of 2.73 per cent is indicative of lack of footwear amongst the pupils. Indeed, the people are poor and children walk bare-footed through the bush paths from their villages to schools. It is also indicative of the unsanitary fecal disposal methods of the population. The high rate of ingested parasites such as *E. histolytica*, *G. lamblia* and round-worm is a direct result of the unsanitary conditions around the homes of the people since sanitary facilities at the schools were adequate and well used. Sanitary facilities in the homes are inadequate to the majority of the people, particularly in Aluru parish through which Ebihwa River runs, and where latrines are scarce. Similar observations were made by [27] in Tanzania and Nigerian villages, respectively.

Kabatereine et al., (1997) recorded other human intestinal parasites in primary schools of Kampala city, including *Trichuris trichiura*, *Strongyloides stercoralis*, *Taenia* sp. and *Enterobius vermicularis*. These have not been identified in the present study. This could be explained by the fact that Kampala, as a capital city, receives people from various areas, both nationally and internationally searching for different opportunities unlike Moyo, which is relatively localised. Periodic migration of people from Nyanza region of western Kenya to Kampala had earlier been identified as the most important epidemiological factor for persistence of hookworm infestation in Kampala [29]. Also, periodical movement of pupils during school holidays to their western Kenya upcountry homes from Nairobi city were shown to lead to their re-infestation with hookworm and *T. trichiur*ai [30].

There is no distinct reason to account for the differences in parasitic distribution in the different schools, because both environmental and socio-economic and cultural conditions appear similar. Moreover, there is no significant difference in parasitic prevalence in the different schools.

Other studies have shown a functional relationship between sex and parasite infestation [31], sex has been found significant in this study, (p -value <0.01).

The presence of intestinal parasites together affected school performance. A cumulative burden of parasitism meaningfully affected school performance due to their synergistic action. This finding was consistent with a study conducted in the South Gondar Zone of Tach-Gayint Woreda, in Arb-Gebeya Town that the presence of parasites affects academic performance among the junior secondary school children in in Arb-Gebeya Town in Ethiopia during the school year 2007 [32]. Of the 1071 children studied, 65.7% harbored parasites. Children free of parasitic infections obtained higher grades than the infected group. This difference was of statistical significance. The teachers in charge of the treated group noted that a significant improvement in school performance following treatment [32]. Another study in Jamaica had also found similar results. In one school of Jamaican children who were treated for moderate whipworm infections had test scores, that lagged by 15%, up to the level of uninfected children [33]. Another study in Jamaican children aged between 9-12 years showed that treatment of *T. trichiura* infection showed significant improvements in the result of

tests of the auditory, short term memory and scanning and retrieval of long-term memory. Nine weeks after treatment, previously infected children performed as well as uninfected children [33].

Hookworm infection is causally linked to anaemia in humans [34]. The prevalence in this study was 40.5% in presence of parasitic infestation. This rate is higher than that reported by Favour O. and co-authors 2011 among children in Edo State, Nigeria, who reported that 222 (70.2%) out of 316 samples examined were positive for hookworm, but less than that reported by Agbolade et al., 2007, where school children attending public schools in Ijesha-Ijebu and Okun-owa in Ogun State had a prevalence of 90 (17%) out of 1,059 subjects sampled and Nmorsi et al., 2009 where preschool children in Akoko-Edo, Edo state had a prevalence of 65.7%. Whether or not a person with hookworm infection develops anaemia depends on the worm species and load, duration of infection, body iron stores, dietary intake and absorption, and physiological iron requirement. A low hookworm load can cause anaemia in people whose intake of iron is low and whose iron stores are already depleted [38]. In this study, considering hookworm as an independent risk factor for anaemia, there was a significant association between hookworm and anaemia status. This report agrees with previous studies of Stoltzfus et al., 2004, but disagrees with that of Hung et al., 2005 where no association was established between hookworm infection and anaemia among children of ethnic minority of Phan tien village in Vietnam.

Moderate or high intensity *Trichuris* infections are also associated with anaemia [41].

Other studies have used height, weight or haemoglobin concentrations as indices to assess the nutritional status of parasite-infected children and children treated for parasites, and show a remarkable improvement in haemoglobin status in children given iron supplementation, thus reiterating the contribution of worm infestation to childhood malnutrition [42].

Conclusion and recommendations

Socio-economics, topography and climatic factors, like elsewhere, seem to promote the helminthic prevalence than any other factors. In view of their role in causing anaemia and retarding academic performance, comprehensive investigations of intestinal parasites of in the schools of the entire Egypt country need to be carried out.

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تدهور الأداء المدرسي نتيجة الإصابة الطفيلية في محافظة المنوفية

يعد تفشي الديدان مشكلة رئيسية في الأطفال من البلدان النامية بسبب الظروف الصحية السيئة. وينتج عن نقص التغذية وفقير الدم لدى الأطفال، وخاصة عند الإصابة بالديدان الخطافية. إن هذه العدوى تضعف نمو الأطفال وتطورهم. وقد أظهرت الدراسات الارتباط بين عدوى الديدان لطفيلية وسوء التغذية، وفقد الدم بسبب نقص الحديد، وتوقف النمو، وضعف الحضور والأداء في المدارس.

تهدف هذه الدراسة إلى تقييم العلاقة بين الإصابة الطفيلية في أطفال المدارس وتأثيرها على الأداء المدرسي في محافظة المنوفية. حيث تم تقييم الحالة التغذوية للأطفال من خلال التدايير الأنثروبومترية والفحص السريري والتحقيق المختبري مثل مستوى الهيموجلوبين (HB). تم تقييم الإصابة الطفيلية عن طريق تحليل البراز والبول، كما تم تقييم الأداء المدرسي من قبل معامل الذكاء (IQ)، التحصيل المدرسي والمواظبة والحضور إلى المدرسة. أجريت الدراسة من نهاية أغسطس ٢٠١٦ حتى نهاية نوفمبر ٢٠١٨ بمركز شبين الكوم وقرية بركة السبع بمحافظة المنوفية .

وقد أظهرت نتائج هذه الدراسة ارتفاع معدل انتشار الإصابة الطفيلية في المناطق الريفية بنسبة ٦٧.٥٪ مقارنةً بالمناطق الحضرية بنسبة ٥٨.٥٪ مع ارتفاع معدل الإلتواء النسيجي، أسكارس، الجيارديا، الأوكسيرى العدوى المختلطة أثناء النيمنة، تريكورا تريسورا، دواء الإثنا عشرى، توجد سترونغوى فلوس ستيركوراليس و شيستوما مانسونى فقط في المناطق الريفية ذات معدل الإصابة المنخفض. لم يكن هناك فروق ذات دلالة إحصائية بين أطفال المدارس الحضرية والريفية فيما يتعلق بترايير الأنثروبومترية بما في ذلك (وزن الجسم والطول ومحيط الرأس) وبين المصابين وغير المصابين باستثناء الوزن، كما أن هناك فرق إحصائي كبير بين الأطفال غير المصابين مقارنة بالعدوى. كما كان هناك فروق ذات دلالة إحصائية في مستوى الهيموجلوبين بين المناطق الحضرية مقارنة بالريف وبين الأطفال المصابين مقارنة مع غير المصابين حيث كان معدل أنشاز فقر الدم أعلى في المناطق الريفية مقارنة بالحضرية وبين الأطفال المصابين مقارنة مع غير المصابين. كان هناك فروق ذات دلالة إحصائية في معايير الأداء المدرسي بما في ذلك (المستوى الأول والتحصيل المدرسي) بين المناطق الحضرية مقارنةً بالأطفال الريفيين والأطفال المصابين مقارنةً بالطلاب غير المصابين.

وقد أستنتجنا من هذه الدراسة أن هناك علاقة بين الطفيلية والوظائف الإدراكية للأطفال الفقراء (الأداء المدرسي) والنمو. وقد أوصت هذه الدراسة بضرورة دمج جميع الأعضاء الذين يتعاملون مع الأطفال مثل المدرسين وعيادات الأطفال وطبيب الأسرة في وحدات صحة الأسرة ومراكز الأمصال وعلاج جميع الأطفال المصابين بالطفيليات لتحسين أداء الأطفال في المدارس حيث يجب إعطاء الأولوية لبرامج الوقاية من العدوى الطفيلية وأضطرابات الأداء المدرسي ومكافحتها .