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PARASITIC INFECTIONS: IS MALE AND FEMALE DIFFERENCE FOR ANEMIA AND GROWTH RETARDATION EVIDENT?

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Abstract

Parasitoses are the commonest health problem among school age children, which impair children's growth and development and causing anemia.

To detect the role of parasitic infections and both anemia and growth affection, on one hand, and if so the common complications among males and females on the other hand, a cross sectional descriptive study was carried out among the outpatient attended the Pediatrics Clinic, Al-Fayoum University's Hospitals. A total of 314 children aged from 1 to 13 years were subjected to clinical examination as well as stool analysis and CBC examination.

The detected parasites were *Entameba histolytica, Giardia lamblia* (Protozoa) and *Enterobius vermicularis, Hymenolepis nana, Ascaris lambricoides* and *Ancylostoma duodenale* (Helminthes). There was significance difference (P<0.05) between males and females regarding *E. histolytica* in females (60%) as to *G. lamblia* and *H. nana* in males (16.1%, & 11.5% respect-tively). Also, there was significance difference (P<0.05) between males and females regarding to hemoglobin level, and weight percentiles with anemia (92%) and underweight& borderline weight (34.5%) in males. The overall anemia was 89.8%. However, there was no significance difference (P<0.05) regarding to height percentiles.

Keywords: Al-Fayoum, Parasitic infected children, Males, Females, Growth retardation, Anemia

Introduction

Generally, the nutrition is one of the most important factors affecting pubertal development. Puberty entails a progressive non-linear process starting from prepubescent to full sexual maturity through the interaction and cooperation of biological, physical, and psychological changes. Consuming an adequate and balanced healthy diet during all phases of growth (infancy, childhood and puberty) appears necessary both for proper growth and normal pubertal development. Girls begin puberty at an earlier age compared to past decades (Soliman *et al*, 2014). On the other hand, LaBeaud *et al*. (2015) in Kenya stated that parasitic infections, which are among the most common infections worldwide, disproportionately affect children. They reported that an under-recognized burden of parasitism in the first three years of childhood were common, and were associated with a range of significant growth impairment in terms of weight, length and/or head circumference.

The parasite is an organism that depends on another organism, known as a host, for food and shelter. As an example, tapeworms live in the digestive system of a large variety of animals. The tapeworms have no digestive system of their own, but absorb nutrients through their skin from partially digested food as it passes through the host. They usually gain all the benefits of this relationship. In contrast, the host may suffer from various diseases, infections, and discomforts as a result of the parasitic attack. In some cases, however, the host may show no signs at all of infection by the parasite (Louder *et al*, 2015).

The correlation between anemia and parasitoses is well documented, particularly significant in hookworms (Periago and Bethony, 2012) and malignant malaria (Latif andJamal, 2015).

In Egypt, in all governorates endoparasites were identified among infants, pre-school and school aged children (Mansour *et al*, 2013) as well as ectoparasites (Morsy, 2014) sting allergy (Abdel-Rahman *et al*, 2015), arthropod-dermatosis (Morsy, 2012), particularly in rural areas (Hassan *et al*, 2015).

This study aimed to evaluate the efficacy of parasitosis on anemia and growth of infected children, on one hand, and if so, whom patients are much affected males and females?

Subjects, Materials and Methods

A cross sectional descriptive study was carried out from February2015 to July 2015, in the outpatient pediatrics clinic of Fayoum University's Hospitals. A total of 314 children aged from 1 year to 13 years were enrolled in the study.

Inclusion criteria: Patients with parasites as *Entameba histolytica, Entrobius vermicularis, Giardia lamblia, Hymenopelis nana, Ascaris lumbricoides, and Ancylostoma doudenale.* Exclusion criteria: Patients with normal stool analysis even in past history or symptoms of suggestive parasitic infections.

Medical sheets were filled out on each child containing name, age, sex, school grade, source of food and water, personal hygiene, type of house, toilet facilities, past history of diarrhea and/or dysentery in last six months was filled by verbal interview with the parents.

All children were subjected to physical examination and anthropometric measurements. Fecal samples were collected in clean and dry plastic containers and examined macroscopically for consistency, color and odor, pin-worms, gravid segments, larvae as well as for blood and mucus. Microscopic Examination: Stools were collected in clean labeled plastic cups. Each sample was given the same numerical number of the medical sheet. Each stool sample was subjected to the direct wet smear method and the concentration technique (El- Nagger *et al*, 2006). The stains were Iron hematoxylin, phosphortungstic acid as well as Modified Ziehl-Nelsen for cryptosporidiosis (Helmy *et al*, 2004), Also aseptic venous blood samples were collected for CBC examination.

Statistical analysis: Data was collected, coded, translated to English to facilitate data manipulation and double entered into Microsoft Access and data analysis was performed using SPSS software version 18 under windows 7. Simple descriptive analysis in the form of numbers and percentages for qualitative data, and arithmetic means as central tendency measurement, standard deviations as measure of dispersion for quantitative parametric data, and inferential statistic test: In-depended student t-Test compared measures of two independent groups of quantitative data; also Chi square test compared two of more than two qualitative groups. $P \leq 0.05$ was considered cut-off value for significance.

Ethical consideration: All the included subjects were treated according to the Helsinki Declaration of biomedical ethics (World Medical Association Declaration of Helsinki, 2000). Verbal consent was obtained after proper orientation of the children and their caregivers regarding the objectives of the study. The study received ethical approval by the Institutional Review Board of Department of Pediatrics, Al-Fayoum University.

Results

The results are shown in tables (1, 2, 3, 4, & 5) and figures (1, 2 & 3).

Table 1: Demographic characters of study group

Variables (n=314)	Mean ± SD	Range
Age (days)	4.5 ± 3.1	1-13
Weight (kg)	15.8 ± 6	6-43
Height (cm)	84.6 ± 18.6	53-144
Hemoglobin level	10.8 ±1.1	7.2-13.4
Male	140 (44.6%)	
Female	174 (55.4%)	

Of 314 children 55.4% were females, means of age (4.5±3.1yr.), weight (15.8±6Kg.), height (84.6±18.6 cm) and hemoglobin level (10.8±1.1gm/dl)

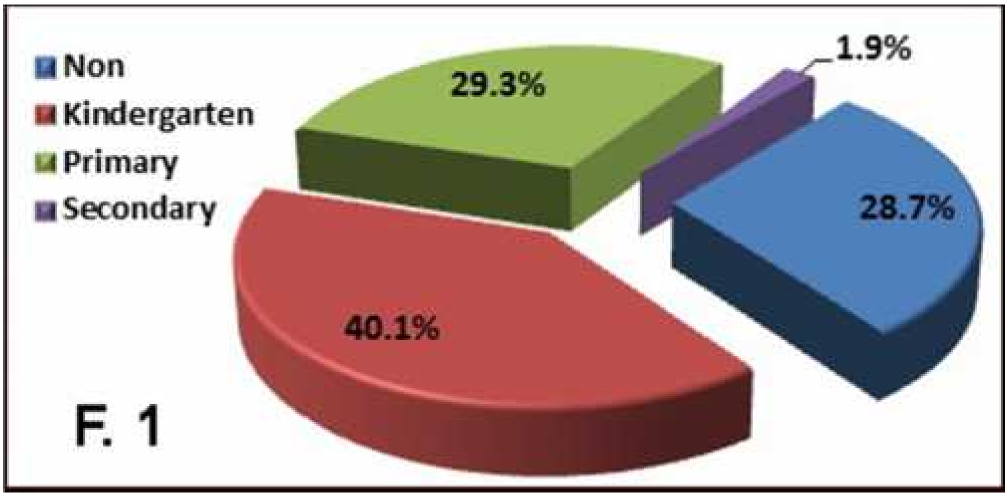

Fig. 1: Frequency of educational level among group.

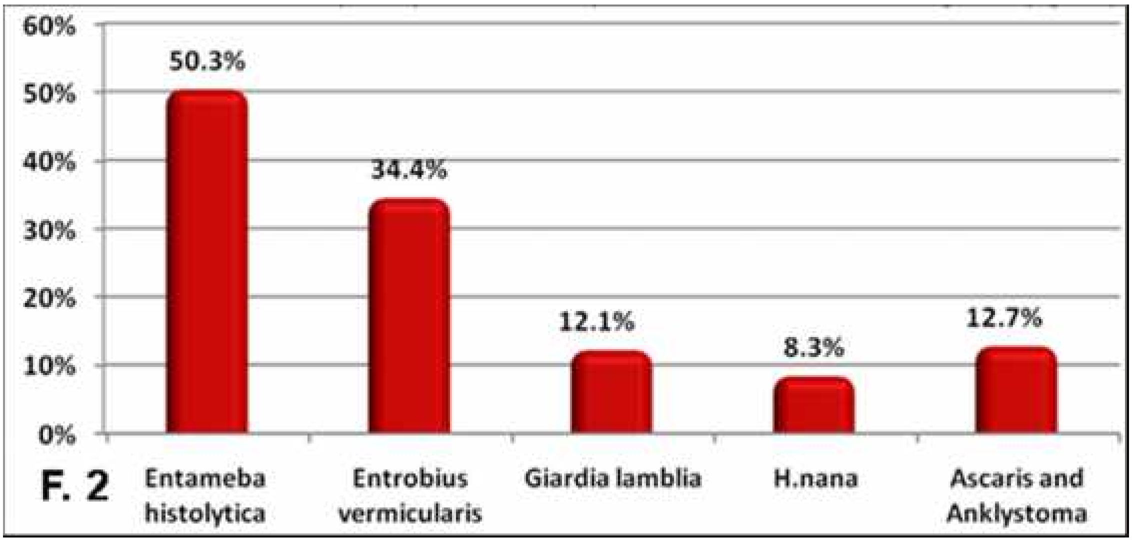

Fig.2: frequency of different parasitic infections among group.

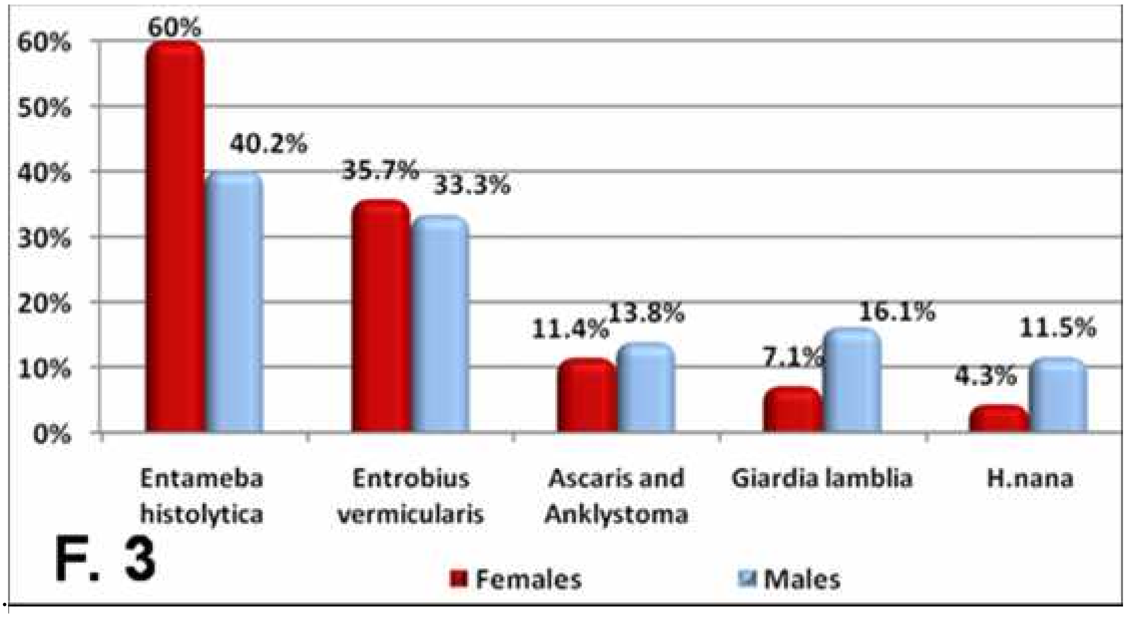

Fig. 3: Comparison of different parasitic infections among sexes.

Table 2: Comparison of hemoglobin level and anthropometric measurements in males and females.

Variables (n=314)	Female (n=140)		Males (n=174)		p-value	Sig.
	No	%	No	%		
Hemoglobin level: Anemic	118	84.3%	160	92%	0.04	S
Hemoglobin level: Normal	22	15.7%	14	8%		
Weight percentile						
Underweight & borderline "≤5^{th} "	32	22.9%	60	34.5%	0.03	S
Normal ">5^{th}–97^{th}"	108	77.1%	114	65.5%		
Height percentile						
Stunted &borderline "≤5^{th} "	38	27.1%	50	28.7%	0.8	NS
Normal ">5^{th}–97^{th}"	102	72.9%	124	71.3%		

There was significance difference (P<0.05) between males and females as to hemoglobin level, and weight percentiles with anemia (92%) and underweight& borderline weight (34.5%) among males, but, without significance difference (P>0.05) as regards height percentiles. Overall anemia was 89.8%.

Table 3: Comparison of hemoglobin level between different parasites.

Variables (n=314)	Anemic		Normal		p-value	Sig.
	No.	%	No.	%		
Entameba histolytica	136	86.1 %	22	13.9%	0.1	NS
Giardia lamblia	30	78.9%	8	21.1%	0.06	NS
E. vermicularis	100	92.6%	8	7.4%	0.07	NS
H. nana	20	76.9%	6	23.1%	0.09	NS
Anclystoma and Ascaris	36	90%	4	10%	0.9	NS

There was no significance difference (P>0.05) between different parasitic infections as regards hemoglobin level. For impact of sex difference in each parasitic infection on hemoglobin level showed no significance difference (P >0.05).

Table 4: Comparison of weight percentile between different parasites.

Variables (n=314)	Underweight and borderline	Normal	p-value	Sig.
	No. (%)	No. (%)		
Entameba histolytica (n=158)	26(28.3%)	132(59.5%)	<0.0001	HS
Giardia lamblia (n=38)	12(13%)	26(11.7%)	0.7	NS
E. vermicularis (n=108)	28(30.4%)	80(36%)	0.3	NS
H. nana (n=26)	14(15.2%)	12(5.4%)	0.006	HS
Anclystoma and *Ascaris* (n=40)	24(26.1%)	16(7.2%)	<0.0001	HS

There was significance difference (P<0.05) between different parasites as regards to weight percentile among children infected with *E. histolytica, H. nana* and both *A. lumbricoides* and *A. doudenale* (28.3%, 15.2%, & 26.1% respectively) of them were underweight and borderline weight growth (≤5^{th} percentile). There were no significance difference (P >0.05) as regards to *G. lamblia*, and *E. vermicularis*. For impact of male and female difference in each parasitic infection on weight growth showed no significance difference (P >0.05).

Table 5: Comparison of height percentile between different parasites.

Variables (n=314)	Stunted and borderline	Normal	p-value	Sig.
	No. (%)	No. (%)		
Entameba histolytica (n=158)	32(36.4%)	126(55.8%)	0.002	HS
Giardia lamblia (n=38)	14(15.9%)	24(10.6%)	0.2	NS
E. vermicularis (n=108)	28(31.8%)	80(35.4%)	0.6	NS
H. nana(n=26)	12(13.6%)	14(6.2%)	0.04	S
Anklystoma and Ascaris (n=40)	20(22.7%)	20(8.8%)	0.002	HS

There was significance difference (P<0.05) between different parasites as regards height percentile among children infected with *E. histolytica, H. nana* and both *Ascaris* and *Anclystoma* (36.4%, 13.6%, & 22.7% respectively) of them were stunted and borderline height growth ($\leq 5^{th}$ percentile). There was no s significance difference with p-value >0.05 as regards to infection with *G. lamblia*, and *E. vermicularis*. For impact of male and female difference in each parasite on height growth there was no significance difference (P >0.05).

Discussion

In Al-Fayoum Governorate, El Baz *et al.* (2003) in Tatoon (Etsa Center) reported *Schistosoma haematobium* among preschool and school aged children the majority of whom suffered from haematuria, dysuria, abdominal pains and severe anemia. Also, Abo-Madyan *et al.* (2004) in a field survey in Ezbet El-Bakly (Tamiya Center) reported *S. haematobium* (4.2%), *S. mansoni* (2.4%), *E. vermicularis* (2%), *Fasciola gigantica* (1.7%), *A. lumbricoides* (1.7%), *H. nana* (1.7%), *Trichostrongylus colibriformis* (1.1%) and *Taenia saginata* (0.3%). They added that all the children with *S. haematobium, S. mansoni and F. gigantica* were anemic.

In the present study, *E. histolytica* was the commonest organism (50.3%) followed by *E. vermicularis* (34.4%), *G. lamblia* (12.1%), then *H. nana* (8.3%). Both *A. lumbricoides* and *A. doudenale* were (12.7%). The commonest parasitic infections were among the kindergarten educational level study group. In contrast, Sehgal *et al.* (2010) found that *G. lamblia* was the commonest protozoa found in the stool (10%).they reported cyst of *G. lamblia* and cyst of *E. histolytica* as the commonest isolate among school children. Next in the sequence was *E. coli* (5.7%), only 3.6% each of *A. lumbricoides* & *A. duodenale*.

In the present study, *E. histolytica* was found with high percentage among females (60%); *G. lamblia* and *H. nana* were found with high percentage among males (16.1%, & 11.5% respectively). In the present study, the overall prevalence of anemia was 89.8%, which in some children rose up (92%) and underweight, borderline weight children (34.5%) among males with significant difference. On the other hand, there was no significant difference between males and females regarding height percentiles.

Oluwafemi and Oguntibeju (2003) reported relationship between parasitoses and alterations in hematological indices resulting into anemia. They added that there was connection between parasitic infection and nutrient deficiencies and that the sexual difference in the prevalence rates of the various parasites could probably reflect the exposure frequencies of the individual subjects. Friedman *et al.* (2005) found boys (5–6 years) were more likely to be anemic and iron deficiency was typically considered the most common etiology of acquired anemia. However, in rural areas, other mechanisms must be considered, particularly those mechanisms related to inflammation caused by endemic parasite infections. Bustinduy *et al.* (2013) measured prevalence of *S. haematobium, W. bancrofti, Plasmodium falciparum*, hookworm, and other geohelminthes among school-aged children in four endemic villages in Kenya and explored the relationship between multiparasite burden, malnutrition, and anemia. They found that more than 50% of children were anemic, with high rates of acute and chronic malnutrition, and associations with infection status that showed significant age and sex differences. For boys, young age, low socioeconomic standing (SES), *S. haematobium*, and/or malaria infections were associated with greater odds of anemia, wasting, and/or stunting; for girls, heavy *S. haematobium* infection and age were the significant cofactors for anemia, whereas low SES and older age were linked to stunting. They concluded that broad overlap of infection-related causes for anemia and malnutrition and the high frequency of polyparasitic infections recommended significant advantages to integrated parasite control. Moreover, Gao *et al*. (2015) stated that hookworms infect nearly 700 million people, causing anemia and developmental stunting in heavy infections and that little is still known about the genomic structure or gene regulation in hookworms. Seidelman *et al*. (2015) reported that hookworm infection caused Iron-deficiency anemia.

On the other hand, the sex differences in parasite infection rates, intensities, or population patterns are common in a wide range of taxa. These differences are usually attributed to 1 of 2 causes: (1) ecological (sociological in humans); and (2) physiological, usually hormonal in origin. Examples of the first cause included differential exposure to pathogens because of sex-specific behavior or morphology. The second cause might stem from the well-documented association between testosterone and the immune system; sexually mature male vertebrates are often more susceptible to infection and carry higher parasite burdens in the field (Zuk *et al,* 1996).

Rijal *et al.* (2001) in Nepal rural school adolescent children studied the awareness and its association in parasites in boys and girls. They found that the prevalence of worm infection was significantly higher in female children than male ($p \leq 0.05$). However, females possessed significantly higher levels of awareness about parasitic infections. Out of 119 males 99 (83.2%) and 61 (96.8%) of 63 females ($p \leq 0.05$) knew that worms suck food from host body. Similarly, 62.2% of males and 96.85 of females ($p \leq 0.05$) knew that parasites suck blood from human body. Munis and Ferreira (2002) stated that the public health authorities were concerned that the parasitic infections impair children's growth and development. Abdallah *et al.* (2013) in Saudi Arabia found that the majority of the second-year medical students preferred multimodality in terms of learning preferences, with a significant difference between male and female students; female students tended to favor the multiple modes of information presentation more compared with male students.

In the present study, there was no significant difference between each parasite and hemoglobin level, and vice was versa. This could be attributed to concomitant infection found in (17.8%) of the children that prone to cause anemia rather than single infection. Anemia can be a cause of growth retardation (Stoltzfus *et al*, 1997). *H. nana* showed a significant difference in height for age Z score (HAZ). Khalil *et al.* (1991) reported that *H. nana* was associated with growth retardation in Egypt.

In the present study, the parasitic infected group had significantly lower weight and serum iron. This agreed with Abou-Shady *et al*. (2011). Ogbondah andDouglas (2013) reported that the de-worming intervention significantly reduced the parasitic worm load and improved the packed cell volume of the pupils. They recommended that school age children must be routinely dewormed as part of the school health program.

Bailey *et al.* (2015) stated that the micronutrients are essential to sustain life and for optimal physiological function. Widespread global micronutrient deficiencies (MNDs) exist, with pregnant women and their children less than 5 years at the highest risk. Iron, iodine, folate, vitamin A, and zinc deficiencies are the most widespread MNDs, and all these MNDs are common contributors to poor growth, intellectual impairments, perinatal complications, and increased risk of morbidity and mortality. They added that Iron deficiency is the most common MND worldwide and leads to microcytic anemia, decreased capacity for work, as well as impaired immune and endocrine function. Iodine deficiency disorder is also widespread and results in goiter, mental retardation, or reduced cognitive function. Adequate zinc is necessary for optimal immune function, and deficiency is associated with an increased incidence of diarrhea and acute respiratory infections, major causes of death in those <5 years of age. Folic acid taken in early pregnancy can prevent neural tube defects. Folate is essential for DNA synthesis and repair, and deficiency results in macrocytic anemia. Vitamin A deficiency is the leading cause of blindness worldwide and also impairs immune function and cell differentiation. Single MNDs rarely occur alone; often, multiple MNDs coexist. They concluded that understanding the epidemiology of MNDs is critical to understand what intervention strategies will work best under different conditions. Bicakci (2015) in USA stated that Vitamin B12 (cobalamin, Cbl) deficiency can cause metabolic, hematological, and neurological abnormalities. Adequate levels of succinyl-coenzyme A (CoA) cannot be synthesized from methylmalonyl-CoA because of the decreased activity of the methylmalonyl-CoA mutase enzyme that uses Cbl as the cofactor. Succinyl-CoA synthesis deficiency leads to decreased heme synthesis and gluconeogenesis. The reason of growth retardation can be gluconeogenesis deficiency together with heme synthesis deficiency whereas the reason of the neurological abnormalities can be glycine increase in the tissue due to decreased heme synthesis.

In the present study, showed significant difference between different parasitic infection as regards to weight, height percentiles among children infected with *E. histolytica, H. nana*, and both *A. lumbricoides* and *A. duodenale* with underweight and borderline weight and height growth ($\leq 5^{th}$ percentile). This indicated that the impact of these parasites on weight, height growth of children had no relation with the sex of the patient. Hegazy *et al.* (2014) found significantly lower weight for age z-score (WAZ) and weight for height z-score (WHZ) among infected children compared to non-infected ones (P<0.05). Prevalence of anemia in all population was 39%; 48.6% in infected children as compared to 28.8% in non-infected ones. Improper hand washing, and playing in the street bare footed, together with playing with pet or street animals and family history of parasitic infection were considered the independent predictors of the parasitic infections.

Recommendation

The following items were developed and given by the present authors:

A well designed training intervention program were carried out with their parents mainly mother on protecting their children from parasites emphasizing on hand-washing, not eating not well washed rows vegetables and fruits following healthy hygiene practices, and importance of basic nutrition. Besides, the parasitic infected children were further counseled to be admitted for treatment and follow-up.

Conclusion

Children with intestinal parasitosis become an infection focus for the community. If left untreated serious complications may occur due to these intestinal parasitic infections. Therefore, it is recommended that local health officers should visit the school regularly for routine deworming and health education to improve conditions. People should be also informed about the signs, symptoms and prevention methods of these parasitic diseases. There is sex difference in outcome of parasitic infestations in the two aspects, anemia and weight percentiles. Males are more prone for these complications than females and they need special care. On the other hand, no sex difference for height percentiles. Three strategies can be adopted for prevention of iron deficiency anemia, namely, iron supplementation, fortification of a staple food with iron, and the control of hookworm and other helminth infections.

There is sex difference in outcome of parasitic infestations in the two aspects, anemia and weight percentiles. Males are more prone for these complications than females and they need special care. On the other hand, no sex difference for height percentiles.

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