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Impact of Socioeconomic Conditions and Parasitic Infection on Hemoglobin Level among Children in Um-Unnasser Village, Gaza Strip

Bassam F. AL-ZAIN

DAI-Quds Open University,
North Gaza,
Gaza strip - PALESTINE

Aims: A cross-sectional study was conducted to examine the impact of socioeconomic conditions and intestinal parasitic infection (IPI) on hemoglobin level among children aged 2-15 years in Um-Unnasser village, North Gaza, Palestine.

Materials and Methods: The data were collected using structured questionnaire and laboratory analysis of blood and fecal samples.

Results: Of 256 children, 25% were anemic and prevalence was higher in children aged below six years. Overall prevalence of IPI was 46.9%. *Ascaris lumbricoides* (11.3%), *Giardia lamblia* (8.2%), *Hymenolepis nana* (6.2%), *Entamoeba histolytica* (5.1%), *Strongyloides stercoralis* (2.0%), *Enterobius vermicularis* (2.7%), and *Trichuris trichiura* (0.3%) were the most frequently found, whereas 10.9% of children had multiple parasitic infection. An association was determined between some socioeconomic conditions and parasitic infection and anemia. These socioeconomic factors included age group of the studied children, father's educational level and work status.

Conclusions: It was found that children with double parasitic infection had lower hemoglobin level than those who had single parasitic infections except in cases of *A. lumbricoides* and *G. lamblia*.

Key Words: Hemoglobin level, parasitic, socioeconomic conditions, children, anemia

Gaza Bölgesi Um-Unnasver Köyünde Yaşayan Çocukların Hemoglobin Düzeylerine Sosyoekonomik Durum ve Parazit Enfestasyonlarının Etkisi

Amaç: Filistin, kuzey Gazzede Um-Unnasver köyünde yaşayan 2-15yaş arası çocukların hemoglobin düzeylerine sosyoekonomik durum ve parazit enfestasyonlarının etkisini araştırmak

Yöntem ve Gereç: Veriler yapılandırılmış bir anket yanında kan ve dışkı örneklerinden eldedilen sonuçların analiz edilmesi ile toplandı.

Bulgular: 256 çocuğun % 25'i anemikti ve prevalans 6 yaşından küçüklerde daha yüksekti. Barsak paraziti prevalansı % 46.9'du. *Ascaris lumbricoides* (%11.3), *Giardia lamblia* (% 8.2), *Hymenolepis nana* (% 6.2), *Entamoeba histolytica* (% 5.1), *Strongyloides stercoralis* (% 2.0), *Enterobius vermicularis* (% 2.7), ve *Trichuris trichiura* (%0.3) sırasıyla en sık görülen parazitlerdi ve çocukların %10.9' unda birden çok parazit mevcuttu. Çocukların yaşı, babanın eğitim düzeyi ve iş durumu parazit enfestasyonları ve anemi ile birliktelik gösteren sosyoekonomik faktörler olarak bulundu.

Sonuç: *A. lumbricoides* and *G. lamblia* gibi parazitler dışında kalan olgularda iki parazit enfestayonu olan çocukların hemoglobin düzeyi tek parazit enfestasyonu olanlardan daha düşüktü.

Anahtar Sözcükler: Hemoglobin, sosyoekonomik durum, parazit enfestasyonu, anemi, çocuklar

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Correspondence

Bassam F. AL-ZAIN
Al-Quds Open University
North Gaza,
Gaza strip - PALESTINE

bassam_99_1999@ yahoo.com

Introduction

Parasitic infections have a worldwide distribution and constitute considerable public health problems, especially in developing countries, and may be considered as the cancers of developing nations. The World Health Organization (WHO) reported that intestinal parasitic infections (IPI) are prevalent where poverty prevails, where sanitation is inadequate or non-existent and where more health awareness and care are needed. All these factors are present in most developing countries, particularly in rural communities (1). Anemia is a result of insufficient iron intake in the diet (due to either consumption of foods with insufficient or limited dietary iron availability) and presence of IPI. The

latter is considered an important contributing factor for anemia especially among school-aged children and adolescents, who usually suffer from parasitic infections more than adults (2). These factors often operate concurrently, varying from region to region. In the Eastern Mediterranean region (EMR), more than 140 million people are estimated to have anemia according to WHO (3).

It is estimated that up to half of school-aged children in developing countries are anemic (4). Anemia in infants and children is associated with increased morbidity and mortality (5), growth retardation (6), delayed motor development, poor cognitive abilities (7), reduced school performance (8), and an impaired immune system (9). Establishment of a reference range for the relationship between low hemoglobin value and parasitic infection in Palestine populations, especially in north Gaza children, is lacking despite some reports (10-12).

This study aimed to examine the impact of socioeconomic conditions and IPI on hemoglobin level among children aged between 2-15 years in Um-Unnasser village North Gaza, Palestine.

Material and Methods

Study Protocol

The study was conducted during a three-month period (February – April 2004) in Um Unnasser village. It is located in the far north of the Gaza strip and bordered by Beit Lahia town from the southwest, Beit Hanon town from the east and Israel from the north. Um Unnasser village is 800,000 m^2, with 50% of the total area inside the sewage pools. The population is approximately 5000, 95% are refugees, and most of the population work in farming and cattle raising; some are government employees.

The study data was collected during house-to-house visits. Data were collected using structured questionnaire and laboratory analysis of blood and fecal samples. The parents of subjects received oral and written notification of test results. Children diagnosed with IPI and/or iron deficiency anemia were given the appropriate anti-parasitic treatment or iron supplements. These medications and services were provided without cost to the families.

Data Collection

The study sample comprised 256 children randomly chosen ranging from 2-15 years old; both sexes were included and evaluated for their hemoglobin level and presence of parasites in the stool. A structured questionnaire with open- and close-ended questions collected information from the parents of the subjects regarding sociodemographic, housing, water and sanitation characteristics. These included subject's age, sex, parental education and work status, family size, and house construction, water, sanitation, and the type and number of domestic animals living in and around the home.

Fecal Analysis

Stool containers were distributed the day before the survey to obtain a fecal sample. Samples were fixed the same day with 10% formalin, and microscopical examination was done by direct smear method with physiological saline and Lugol's iodine staining. A minimum of one negative specimen from several samples was taken randomly and examined by formal ether concentration method. The samples were covered with a cover slip and systematically observed at low (10) and high magnifications (40) with a light microscopy in order to identify the presence of mature parasites, cysts or eggs. Children who had at least one stool sample in which an IPI was identified were classified as positive for that parasite. All children found to be infected with parasites and/or to have anemia were treated according to WHO guidelines. Children and parents were provided with reports about the study with an explanatory note about prevention of anemia and parasitic infections.

Blood Analysis

Hemoglobin was determined by the cyanmethemoglobin method, using a spectrophotometer on samples of finger blood (13). Anemia was considered to be present if the hemoglobin value was less than 11 g/dl (14).

Data Analysis

The collected data and results of the work were analyzed by using SPSS. Descriptive data are reported as means with standard deviation and percentages. Children T-test and one-way analysis of variance were used to test mean differences. A P-value of ≤ 0.05 was considered statistically significant. The preliminary analysis examined

the impact of socioeconomic conditions and IPI on hemoglobin level among children.

Results

Two hundred fifty-six children were enrolled for stool and blood examination. The age distribution was 2 to 15 years. One hundred thirty-one children were under 6 years old, 78 were 7-9 years old, 40 were 10-13 years and 7 were over 13 years old. One hundred forty-eight (57.8%) were male and 108 (42.2%) female (Table 1).

Table 1 demonstrates subject demographics and socioeconomic characteristics and concurrent presence of anemia. Most household water was reported to come from the wells, municipality or other unprotected sources. Nearly 34 of the subjects' households had cats, sheep, dogs, or cows as domestic animals living inside or in close proximity to the family's living quarters.

There was no significant association identified between anemia and gender, other parental characteristics, housing, water and sanitation, family size, type of domestic animals and other household indicators.

Table 1. Subject demographics and socioeconomic characteristics and the relation with anemia.

Characteristics		Total number	Anemia	%	P-value
Age	<6	131	45	34.4	0.00024**
	6-9	78	11	14.1	
	10-13	40	7	17.5	
	>13	7	1	14.3	
Gender	Male	148	34	23	0.38
	Female	108	30	27.8	
Father's education	≤6	132	33	25	0.05 *
	7-9	55	13	23.6	
	10-12	51	11	21.6	
	>12	18	7	38.9	
Mother's education	≤6	175	41	23.4	0.5
	7-9	48	15	31.3	
	10-12	30	8	26.7	
	>12	3	0	0	
Father's work status	Yes	110	22	20	
	No	146	42	28.8	0.01 *
Mother's work status	Yes	2	1	50	0.41
	No	254	63	24.8	
House floor	Sand	180	42	23.3	0.38
	Tiles	51	13	25.5	
	Other	25	9	36	
Water	Municipality	79	23	29.1	0.3
	Wells	177	41	23.2	
Presence of animal	Yes	121	34	28.1	0.27
	No	135	30	22.2	
Animal type	No animal	135	34	25.2	0.46
	Cat	3	0	0	
	Sheep	65	24	36.9	
	Cows	43	3	0.06	
	Dogs	10	3	0.3	
Stool analysis	Positive	120	37	30.8	0.14
	Negative	136	27	19.9	

*,** Significant at 5% and 1% level, respectively.

Anemia prevalence rate was highest in the age group below 6 years old (p=0.00024). The highest prevalence rate of anemia (34.4%; 45/131) was observed in children under 6 years old, followed by those aged between 10-13 years, with a prevalence rate of 17.5% (7/40).

Table 2 shows that 60% (3/5) of children with *Strongyloides stercoralis* had hemoglobin concentration below 11 g/dl, 38.5% (5/13) with *Entamoeba histolytica*, 37.5% (6/16) with *Hymenolepis nana*, 14.3% (1/17, 3/21) with *Enterobius vermicularis* and *Giardia lamblia,* and 10.3% (3/29) with *Ascaris lumbricoides*. A statistically significant association was shown between anemia and double parasitic infection (p<0.0005), whereas no significant associations were identified between single parasitic infection in the study and low hemoglobin level except in *A. lumbricoides* and *G. lamblia* (p=0.006, 0.05, respectively).

The most common pathogenic species identified were: *A. lumbricoides* (29/256) 11.3%, followed by *G. lamblia* (21/256) 8.2%, *H. nana* (16/256) 6.2%, *E. histolytica* (13/256) 5.1%, *E. vermicularis* (7/256) 2.7%, *S. stercoralis* (5/256) 2.0%, and *Trichuris trichiura (*1/256) 0.3%.

Children infected with *S. stercoralis* had a significantly reduced serum hemoglobin level compared with others. Iron deficiency anemia was detected in 25% (64/256) of the total sample. The mean (SD) hemoglobin was 1.13 g/dl with a range between 9.2 g/dl and 14.4 g/dl. Although 60% of *S. stercoralis*-infected children had iron deficiency anemia, the association did not reach a level of statistical significance. Moreover, no significant associations were identified between IPI and the sociodemographic and other indicators measured in the study. None of the indicators measured in the study predicted the risk for hookworm infection, and this is due to insufficient statistical contrast related to frequency of hookworm infections.

In general, the prevalence of anemia among infected children (30.8%) was greater than among those non-infected (19.9%), and that pattern appeared in all age groups (Table 3).

Discussion

This study examined the impact of socioeconomic conditions and IPI on hemoglobin level among children in rural North Gaza. The observed relationship between *A. lumbricoides*, *G. lamblia* and hemoglobin is consistent with authors who linked the parasite with significantly reduced iron status in children living in Gaza (15) and Egypt (16). The present study shows only 64 (25%) had anemia and 192 (75%) had normal hemoglobin. This result is considered low compared to other local areas in Gaza (10-11). The prevalence of anemia among infected children was higher than among non-infected children, which demonstrates the impact of parasitic infection on hemoglobin blood level among children, but this did not reach statistical significance. In contrast to these findings, other authors have reported that Brazilian children with

Table 2. Association between intestinal parasitic infection and child hemoglobin status.

Parasite	Infection	%	Anemic	%	P-value
Strongyloides stercoralis	5	2	3	60	0.1
Ascaris lumbricoides	29	11.3	3	10.3	0.006*
Enterobius vermicularis	7	2.7	1	14.3	0.3
Hymenolepis nana	16	6.2	6	37.5	0.5
Trichuris trichiura	1	0.3	…	…	0.5
Entamoeba histolytica	13	5.1	5	38.5	0.5
Giardia lamblia	21	8.2	3	14.3	0.05*
Total single infection	92	35.7	21	22.8	
Double parasite	28	10.9	16	57.1	0.0005*
Total	120	46.8	37	30.8	

* Significant at 5% level.

Table 3. Relationship between intestinal parasitic patients and anemia and age group.

	Infected (N=120)		Non-infected (N=136)	
	Anemia No.	Anemia %	Anemia No.	Anemia %
<6 (N=131)	23	19.2	22	16.2
6-9 (N=78)	8	6.7	3	2.2
10-13 (N=40)	6	5	1	0.7
>13 (N=7)	0	0	1	0.7
Total	37	30.8	27	19.9

asymptomatic infection showed no evidence of reduced hemoglobin levels compared to non-infected children (17). On the other hand, most of the risk for anemia found in children with IPI appeared to be attributable to the robust contribution of double parasitic infection rather than other species. It has been suggested that parasitic helminth infection may cause nutrient malabsorption and other diverse changes (18). This result is similar to the study among Nepalese children on the association of anemia with intestinal helminth infection (19). However, the low prevalence of anemia and parasitic infection among the study population shows the benefit of the multiple education programs about treatment of anemia in the study area compared to other local areas in North Gaza (10). There is an increase in prevalence of anemia in the age group below 6 years old. Similarly, lower levels of hemoglobin in young children had been reported (20), and this is consistent with the study results, which indicated that the prevalence of anemia among the age group of 6 years was the highest among the study population of the children. Other age groups showed slight variations in prevalence of anemia. This finding indicates that there is a need for evaluation of the current routine iron supplementation program by the Ministry of Health in primary health care centers and non-governmental organizations (NGOs). Moreover, the prevalence of parasitic infection among study cases is lower compared with other studies in different areas in Gaza strip, which ranged from 24.5% to 34.2% (21).

The prevalence of anemia among males was higher than females, but gender difference was not statistically significant. The father's work status had an important impact on prevalence of anemia (p=0.05), i.e. high socioeconomic status decreases the prevalence of anemia. Presence of animals is associated with increased anemia attributed to the common parasitic infection, which results in anemia. Sheep, cats, dogs, and cows have been identified as possible reservoirs for intestinal parasites (22). A study done in Gaza (24) showed a significant relationship of anemia with parasitic infestation, especially helminth parasites, in schoolchildren. This is similar to the results of earlier studies elsewhere (19).

In the Um-Unnasser group study, contribution of parasitic infection to anemia may occur due to contamination of the children's drinking water, their home environment, objects they play with, and via blowing dust, which can contains parasite eggs, cysts and mature forms.

A similar study in Gaza found that high prevalence of IPI was associated with anemia (15,24), and most studies done in the Gaza Strip showed a higher prevalence of anemia compared to our study (23). The probable reason for the low prevalence rate of anemia among children with IPI in our study is the presence of extensive educational health programs and services provided by the government and NGOs in the target area. The results of this study cannot be generalized to the overall prevalence rate of anemia in this region.

In conclusion, there is an association between age group of the infected child, low economic income, presence of parasitic infection and anemia. Prevalence rate of anemia was highest in children aged below 6 years. This could be attributed to low self-hygiene awareness in that age group. Low economic income (fathers not working) was significantly associated with increased prevalence rate of anemia among the studied children. The prevalence rate of anemia associated with parasitic infection among study cases is low compared with other studies conducted in different areas in the Gaza Strip. This could be attributed to the health programs conducted in the study area by both governmental and NGO sectors.

References

1. Hesham MS, Edariah AB, Norhayati M. Intestinal parasites infections and micronutrient deficiency. Med J Malaysia 2003; 58: 2.
2. Stephenson LS. The impact of helminths infection on human nutrition: schistosomes and soil transmitted helminths. London: Taylor and Francis; 1987.
3. Vaster A, van der pols JC. Anemia in the Eastern Mediterranean Region. Eastern Mediterranean Health Journal 1995; 1: 64-79.
4. De Macyer EM, Dallman P, Gurney JM. Preventing and controlling iron deficiency anemia through primary health care. Geneva: World Health Organization; 1989.
5. Stoltzfus RJ. Rethinking anemia surveillance. Lancet 1997; 349: 1764-6.
6. Angeles IT, Schultink WJ, Matulessi P, Gross R, Sastroamidjojo S. Decreased rate of stunting among anemia Indonesian pre-school children through iron supplementation. Am J Clin Nutr 1993; 58: 339-42.
7. Watkins WE, Pollittt E. Nutrition, Health, and Child Development. Washington: Pan-American Health Organization/World Health Organization/World Bank/Tropical Metabolism Research Unit, University of the West Indies, 1998.
8. Lozoff B, Jimenez E, Wolf AW. Long term developmental outcome of infants with iron deficiency. N Engl J Med 1991; 325: 687-94.
9. Dallman PR. Iron deficiency and the immune response. Am J Clin Nutr 1987; 46: 324-9.
10. Abed YA. An epidemiological study of the prevalence of intestinal parasites and their effect on Hb and growth and development in children of Jabalia village. MSC Dissertation, Hadassah Medical School, Jerusalem, 1979; 94 pp.
11. Alzain BF. Study on the statues of prevalence of parasitic infection, total protein and hemoglobin level among school children of diapers (India) and Gaza strip, Palestine. PhD Thesis submitted to Mohanlal Sukhadia University, India, 2000.
12. Abed YA. Risk factors associated with prevalence of anemia among Arab children in Gaza strip. A dissertation submitted to the Johns Hopkins University in conformity with the requirements for the degree of Doctor of Public Health, 1993.
13. Beaton GH, Bengoa JM. Nutrition in preventive medicine: the major deficiency syndromes, epidemiology and approaches to control: edited by Geneva, World Health Organization, 1976.
14. Nutritional anemia. Report of a WHO Scientific Group. Gerona, World Health Organization, 1968.
15. Shubair ME, Yassin MM, Al-Hindi A, Al-Wahaidi AA, Jadallah SY, Abu Shaaban N al-D. Intestinal parasites in relation to hemoglobin level and nutritional status of school children in Gaza. J Egypt Soc Parasitol 2000; 30(2): 365-75.
16. Curtale F, Nabil M, El Wakeel A, Shamy MY, and the Behera Survey Team. Anemia and intestinal parasitic infections among school children in Behera Governorate, Egypt. J Trop Pediatr 1998; 44: 323-8.
17. De Morais MB, Suzuki HU, Corral JN, Macgado NL, Neto U. Asymptomatic giardiasis does not affect iron absorption in children with iron deficiency anemia. J Am Coll Nutr 1996; 15: 434-8.
18. Stephenson LS, Latham MC, Ottesen EA. Malnutrition and parasitic helminth infections. Parasitology 2000; 121: S23-38.
19. Curtale F, Tilden R, Muhilal, Vaidya Y, Pokhrel RP, Guerra R. Intestinal helminths and risk of anemia among Nepalese children. Panminerva Med 1993; 35(3): 159-66.
20. Fraser D, Bilenko N, Deckelbaum RJ, Dagan R, El-On J, Naggan L. Giardia lamblia carriage in Israeli Bedouin infants: risk factors and consequences. Clin Infect Dis 2000; 30: 419-24.
21. Asta Z, I. Epidemiological survey of the prevalence of parasites among children in Kan Younis governorate, Palestine. Parasitology. Informatik. Uni- wuerg.de / login/n/h/j 2004; 436_004_1234-1. linked.
22. Mahmud MA, Chappell C, Hossain MM, Habib M, Dupont HL. Risk factors for development of first symptomatic Giardia infection among infants of a birth cohort in rural Egypt. Am J Trop Med Hyg 1995; 53: 84-8.
23. Al-Agha R, Teodoresc I. Intestinal parasites infestation and anemia in primary school children in Gaza governorate, Palestine. Roum Arch Microbial Immunol 2000; 59(1-2): 131-43.
24. Alzain B, Sharma PN. Survey of protozoan infection in school children in Udaipur (India) Gaza Strip (Palestine). J Parasitic Dis 1999; 23: 11-14.