Malnutrition in relation to some intestinal parasitic infection in children of Kirkuk city-Iraq

Hiro M. Obaid
Medical Laboratory Techniques department / College of Technology / Kirkuk, Iraq.
dr.hirooaid12@yahoo.com

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ABSTRACT

Malnutrition and infection with intestinal parasites are widespread in almost all developing countries, high rate of people in the world are infected with protozoal and helminthes parasites. Most of cases are asymptomatic but some intestinal parasites can cause severe diarrhea and malnutrition problems. Four hundred and thirty children (257 male and 173 female) whom attended the parasitology section of Kirkuk General Pediatric and Azady Teaching Hospitals, were chosen for this study. Their ages were < 1-12 years. The weight and the height of each children were recorded. Stool samples were taken from them and examined microscopically for parasitic finding. The frequency of malnutrition was significantly more in males (29.9%) than in females (15.6%). The most age group which were more malnourished in both males and females were 8-11 years. Although the number of inpatients (336) was higher than outpatients (94), but malnutrition showed no significant differences between them. The total malnourished children were 24%. Most of the normal malnourished children had body mass index (BMI) range of 13-16.9, while most of the moderate malnourished had BMI range of 13-14.9 and the sever malnourished BMI were 8-12.9. The most prevalent parasite in both sexes were Entamoeba histolytica followed by Giardia lamblia, Hymenolepis nana, Enterobius vermicularis and Cryptosporidium parvum, and the lowest rate was for Ascaris lumbricoides. The most malnourished children were infected C. parvum with a rate of 60%, followed by E. histolytica and G. lamblia with rate of 18.7, 10.4% respectively, no malnutrition degree were noted with other parasites. A significantly high rate of malnourished children had parasitic infection (30%) comparing with the total malnourished number (104). Diarrhea was significantly related with malnutrition degree and with parasites. 60% of the total moderately
malnourished children had diarrhea and 84% of them had parasite with diarrhea, while in the total severe malnourished children, 87% had diarrhea and 100% had parasitic infection with diarrhea.

Keywords: Malnutrition, Intestinal parasites, Children, Kirkuk, Iraq.

سوء التغذية وعلاقته بالإصابات الطفيفة المعوية في أطفال مدينة كركوك - العراق

هيرو محمد عبيد
قسم تقنية التحليلات المرضية / الكلية التقنية / كركوك

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الملخص

سوء التغذية والإصابة بالطفيليات المعوية منتشرة في اغلب الدول النامية، نسبة كبيرة من سكان العالم مصابون بالطفيليات الإبتدائية والديدان. الغالبية العظمى من المصابين لا يعانون من اية اعراض ولكن بعض الطفيليات المعوية بإمكانها التسبب بمشاكل الاسيال وسوء التغذية. لتلك الدراسة تم اختيار أربعمائة وثلاثون طفل (752 ذكر و321 أنثى) الذين راجعوا قسم الأمراض الطفيمية في مستشفى كركوك العام وأزادي التعليمي، تراوحت اعمارهم بين 6-12 سنة. تم قياس الطول والوزن لكل طفل، اخذ عينات براز من الاطفال لفحص المجيري لمبحث عن الطفيليات المعوية. تردد حالات سوء التغذية في الذكور كان اعمى معنويًا (7494%) منو في الاناث (3591%). المرحلة العمرية الذي عانى من سوء التغذية في كلا الجنسين كان 8-11 سنة بالرغم من ان اعداد المرضى الراقدين (336) كان أعلى من المرضى المراجعين (94) ولكن لم يظهر اختلافات معنوية لسوء التغذية بين الفتيين. النسبة الكلية للاطفال سوء التغذية كان 24% والغالبية من الاطفال الذين كان سوء التغذية لديهم طبيعي كان لهم نسبة كتلة الجسم (BMI) 13-16.9، بينما الذين عانوا من سوء تغذية متوسطة كان لهم (BMI) 13-14.9، أما الذين عانوا من سوء التغذية شديدة فان (BMI) لهم كان 8-12.9. الطفيلي الأكثر انتشارا في كلا الجنسين كان المتحولة النسيجية (Entamoeba histolytica) والدودة القزمة (Giardia lamblia) وتبعا الجيارديا (Entamoeba histolytica)
**C. Cryptosporidium, Enterobius vermicularis, Hymenolepis nana**

The most common intestinal parasites were Enterobius vermicularis (肠道小虫), Hymenolepis nana (肠道小虫), Ascaris lumbricoides (肠道小虫), and Cryptosporidium parvum (肠道小虫). The intestinal parasites were the most common (60%) and the lowest were (10.4%) on the nutritional level. Among the children, the lowest were the cases of Cryptosporidium (16%). The highest were the mixed intestinal parasites (33.92%) and the second highest were the intestinal parasites (36.99%). No cases of nutritional disturbance were found in the other intestinal parasites. A high percentage of children suffering from nutritional disturbance (36.9) had intestinal parasites. The association between nutritional disturbance and intestinal parasites was 16%. In children suffering from moderate nutritional disturbance, the percentage was 39% and in children suffering from severe nutritional disturbance, the percentage was 36.6%. The association between intestinal parasites and nutritional disturbance was 32% in children suffering from moderate nutritional disturbance, and 32% in children suffering from severe nutritional disturbance.

**1. INTRODUCTION**

Malnutrition is a major contributor to child morbidity and mortality. It may be due to improper or inadequate food intake and absorption, insufficient food supply and poor dietary habits [1]. Malnutrition and infection are widespread in almost all developing countries. The endemic nature of malnutrition and infection is probably also at the root of additional health problems that impede learning among school-aged children [2]. Parasites are one of the most common infections in the world, the majority of cases occur in people living in developing countries and is usually common and most intense among children. Infections in children have been shown to affect their health, growth, nutritional status and cognitive development [3]. Children (5-14 years old) are most likely to have the heaviest infections within a population and therefore be most severely diseased. In developing countries, intestinal parasitism is a major public health problem that is often neglected. In these less developed countries, poor environmental and personal hygiene, poor nutrition, overcrowding and climatic conditions that favor the development and survival of these parasites are some of the factors contributing to the high level of intestinal parasites transmission [3,4]. Children carry the heaviest burden of the associated morbidity, due to their dirty habits of playing or handling of infested soils, eating with...
soiled hands, unhygienic toilet practices, drinking and eating of contaminated water and food [5]. There are documented reports implicating intestinal parasitic infection with poor nutritional status in children of age 6-10 years [4,5]. Amoebiasis, Giardiasis, Acarasis, hookworm infection, and Trichuriasis are among the most common intestinal parasitic infection worldwide. These infections are associated with decreased child growth, low plasma vitamin A, loss of weight, chronic blood loss, iron deficiency anemia, diarrhea, and stunted growth [4,5,6,7]. Alteration of the normal gastro-intestinal flora by intestinal parasites has been found to be associated with diarrhea, a major cause of childhood morbidity and mortality in developing countries [8]. One of the important caused of malnutrition is diarrhea. This is because patients with diarrhea eat less and their ability to absorb nutrients is reduced. Moreover, their nutrient requirements are increased as a result of infection [9]. Malnutrition occurring after repeated episodes of diarrhea can make diarrhea more severe, prolonged, frequent and have a higher case fatality rate compared with diarrhea in well nourished children [3,10]. On the other hand malnutrition cause impairment of physical growth and physiologic function, immune response changes. These immune response changes are predisposing children to opportunistic and other typical childhood infections. This study is designed to investigate the relation of some intestinal parasitic infections with malnutrition in children suffering from abdominal pain, diarrhea and vomiting.

2.METHODOLOGY

2.1.Population study

Four hundred and thirty children (257 male and 173 female) were chosen for this study, whom attended the parasitology section in Kirkuk General Pediatric and Azady Teaching Hospitals. The patients were suffered from abdominal pain or/and diarrhea and vomiting. Their ages were > 1-12 years.
2.2. Anthropometric measurement

Anthropometric measurements of height for age (HA), weight for age (WA) and weight for height (WH) were used to assess the nutritional status of the children. The weight of children were measured by electronic balance with minimal clothing and height of the children were measured to the nearest 0.1 units using standard measuring device and methods. The Z-scores of HA, WA and WH were calculated using the EPINFO version 3.3 computer program according to World Health Organization (WHO) reference standards [11]. Based on the WHO reference standards, those children with Z-scores below 2SD for HA, WA and WH were identified as stunted, underweight and wasted, respectively. For those children whose height was taller than or equal to 140 cm, a body mass index (BMI) with a cut-off value of 18.5 kg/m2 was used instead of Z-score of WH, and those children below this cut-off value were identified as wasted [12].

2.3. Stool sample collection and examination

Each enrolled child was asked to provide a fresh fecal sample in cleaned and dried specimen bottles provided. Each fecal sample was examined as a smear stained with Lugol’s iodine, as a direct wet smear in physiological normal saline. Diagnosis was based on the identification of helminth ova and protozoan trophozoite and cyst in the sample during microscopic analysis. The adhesive cellophane tape (Graham) method was used to diagnose oxyuriasis (pinworm infection). Fecal smears were prepared from the sediment and stained by the modified Ziehl-Neelsen method for the recovery of acid-fast oocysts of Cryptosporidium [13]. \( \chi^2 \) (chi-square) test in style of independent and in style of homogeneous. Duncans multiple - range test style of comparison between the levels of the factors. The significant level used was P< 0.05.

3. RESULTS

The results Tables.(1,2) had showed that malnutrition was significantly (p>0.05) higher in males (29.9 %) than in females (15.6 %). Number of moderately malnourished children was more in both males (17.1%) and females (8.7 %) comparing with sever malnourished one (12.8, 6.9 %) for males and females respectively. In males malnutrition was more frequent in <7 - 10 and >1.1 years old, while in females <10.12 years were more malnourished.
Table.(1): Male malnutrition degree in relation to age group.

| Age in years | Examined No. | Malnutrition degree | Total M+S % |
|--------------|--------------|---------------------|-------------|
|              | N  %        | M  %                | S  %        |             |
| > 1-1        | 106 65.8    | 27 16.8             | 28 17.4     | 55 34.1     |
| <1-4         | 51 80.9     | 8 12.7              | 4 6.34      | 12 19.0     |
| <4-7         | 16 88.9     | 2 11.1              | 0 0.0       | 2 11.1      |
| <7-10        | 5 41.7      | 6 50                | 1 8.33      | 7 58.3      |
| <10-12       | 2 66.6      | 1 33.3              | 0 0.0       | 1 33.3      |
| Total        | 180 84.8    | 44 17.1             | 33 12.8     | 77 29.9     |

N= normal, M= moderate, S= sever

Table.(2): Female malnutrition degree in relation to age group.

| Age in years | Examined No. | Malnutrition degree | Total M+S % |
|--------------|--------------|---------------------|-------------|
|              | N  %        | M  %                | S  %        |             |
| > 1-1        | 85 85       | 7 7.0               | 8 8.0       | 15 15.0     |
| <1-4         | 41 84       | 5 10.2              | 3 6.22      | 8 16.3      |
| <4-7         | 12 92       | 1 7.7               | 0 0.0       | 1 7.7       |
| <7-10        | 6 75        | 1 12.5              | 1 12.5      | 2 25        |
| <10-12       | 2 67        | 1 33.3              | 0 0.0       | 1 33.3      |
| Total        | 146 84.4    | 15 8.7              | 12 6.9      | 27 15.6     |

N= normal, M= moderate, S= sever

Although the number of inpatients (336) was higher than outpatients (94) as shown in Table.(3), but the malnutrition was more prevalent among outpatients (28.7%) comparing with those of inpatients (22.9%) with no significant differences between them. The total malnourished children were 24%.
Table (3): Malnutrition among out and in patients.

| Patient | Total % | Type of malnutrition |
|---------|---------|----------------------|
|         | N  %    | M  %    | S  %    | M+S  % |
| Out     | 94 21.9 | 67 71.3 | 17 18.0 | 10 10.6 | 27 28.7 |
| In      | 336 78.1| 259 77.0| 42 12.5 | 35 10.4 | 77 22.9 |
| Total   | 430 75.8| 326 75.8| 59 13.7 | 45 10.5 | 104 24.2 |

N= normal, M= moderate, S= severe

The range of weight in males was 2.5-46 kg and in females was 3.7-56 kg, and the height were 56-153, 54-157 cm for both males and females respectively, according to their ages.

Table (4): Rate of patients weight and height according to their ages.

| Ages in years | Males | Females |
|---------------|-------|---------|
|               | Weight rates in kg | Height rates in cm | Weight rates in kg | Height rates in cm |
| > 1-1         | 2.5-10 | 56-75   | 3.7-8.3 | 54-76   |
| <1-4          | 8-18.5 | 73-105  | 6.0-14  | 65-98  |
| <4-7          | 13-24.6| 101-124 | 13.4-20 | 96-117 |
| <7-10         | 17.8-28| 123-137 | 17.9-23 | 123-127|
| <10-12        | 24-46  | 129-153 | 30-56  | 131-157|
However the body mass index (BMI) was not indicator for malnutrition degree, but most of the normal malnourished children had BMI range of 13-16.9, while most of the moderate malnourished had BMI range of 13-14.9 and the sever malnourished BMI were 8-12.9 Table.(5).

**Table.(5): Malnutrition in relation to BMI rates.**

| Degree of malnutrition | BMI ranges | Patient number |
|------------------------|------------|----------------|
| Normal                 | 8.89-12.9  | 16             |
|                        | 13.0-16.9  | 224            |
|                        | 17.0-20.9  | 81             |
|                        | 21-28.5    | 5 total =326   |
| Moderate               | 10.7-12.9  | 11             |
|                        | 13-14.9    | 37             |
|                        | 15-19.3    | 11 total =59   |
| Severe                 | 8.6-10.9   | 19             |
|                        | 11-12.9    | 19             |
|                        | 13-15.2    | 7 total =45    |

Regarding the intestinal parasitic finding which is clear in Table.(6), the highest parasitic infection recorded was *Entamoeba histolytica* in both sexes with rates of (26, 32%) for males and females respectively, followed by *Giardia lamblia, Hymenolepis nana, Enterobius vermicularis, Cryptosporidium parvum* and *Ascaris lumbricoides*. The females had *E. histolytica* and *G. lamblia* infection more than males, generally females significantly were more infected with intestinal parasite than males.
Table (6): Frequency of intestinal parasites.

| Patients No. | Type of parasites | E. histolytica | G. lamblia | H. nana | E. vermiculars | A. lumbricoids | C. parvum |
|--------------|-------------------|---------------|------------|---------|----------------|----------------|-----------|
| Males 257    |                   | 67            | 23         | 6       | 3              | 1              | 4         |
|              |                   | 8.9           | 2.3        | 1.2     | 1.2            | 1.56           |           |
| Female 173   |                   | 59            | 25         | 2       | 2              | 0              | 1         |
|              |                   | 14            | 2.7        | 1.2     | 0.0            | 0.58           |           |
| Total 430    |                   | 123           | 48         | 8       | 5              | 1              | 5         |
|              |                   | 11            | 1.9        | 1.2     | 0.23           | 1.16           |           |

Table (7) revealed that the C. parvum were more related with malnutrition in both moderate (20%) and sever (40%) malnourished children, with total malnutrition effect of 60%. Followed by E. histolytica and G. lamblia. The other recorded parasites were not related with malnutrition. From the total number (104) of malnourished children Table (3), the number of malnourished one which had parasitic infection was 31 with percentage of 30%.

Table (7): Malnutrition degree in relation to parasite types.

| Parasite     | Total +ve | Malnutrition degree | Total M+S |
|--------------|-----------|---------------------|-----------|
|              | N         | M       | S      | %     | %     | %    |
| E. histolytica| 123       | 100     | 81.3  | 19    | 15.4 | 3.3  | 23    | 18.7 |
| G. lamblia   | 48        | 43      | 89.6  | 5     | 10.4 | 0    | 0     | 5     | 10.4 |
| C. parvum    | 5         | 2       | 40    | 1     | 20   | 2    | 40    | 3     | 60   |
| Total        | 176       | 145     | 81.3  | 25    | 14.2 | 6    | 3.4   | 31    | 17.6 |

N= normal, M= moderate, S= sever

Diarrhea was significantly related with malnutrition degree and with parasites Table (8). 60% of the moderately malnourished children had diarrhea, while in the sever malnourished children 87% had diarrhea. Among the moderately malnourished children which had parasitic infection
84% of them had diarrhea, and all the severely malnourished children which had parasitic infection had diarrhea (100%).

**Table (8):** Malnutrition degree in relation to diarrhea and parasitic infections.

| Malnutrition degree | Total No. | Total diarrhea no. | M | S |
|---------------------|-----------|--------------------|---|---|
|                     |           |                    | M+D % | M- D % | S+D % | S- D % |
| With parasite       | 176       | 155                | 25 | 21 | 84 | 4 | 16 | 6 | 6 | 100 | 0 | 0 |
| Without parasite    | 254       | 47                 | 34 | 12 | 35 | 22 | 65 | 39 | 33 | 85 | 6 | 15 |
| With or without parasite | 430 | 202              | 59 | 33 | 60 | 26 | 44 | 45 | 39 | 87 | 6 | 13 |

M = moderate, S = severe, D = diarrhea.

**4. DISCUSSION**

Malnutrition among children is a serious public health problem, especially in developing countries [9, 10]. The total malnourished children in this study was 24% which somehow agree with the overall prevalence of malnutrition which was 21.2% in Reji et al. study in Adama, Ethiopia [14]. Malnutrition is associated with chronic conditions such as prolonged food shortage, therefore the observed result in the present study could be due to a prolonged shortage of balanced meals, especially amongst children from poor families. The frequency of malnutrition in the present study was significantly more in males (29.9%) than in females (15.6%), this was in agreement with a study concluded that boys tended to be more undernourished than the girls [15], but disagree with another study that showed higher severe malnutrition in girls (23.8%) than in boys (22.3%), while moderate malnutrition was higher in boys (93.1%) than in girls (86.7%) with no significant difference between them [16]. This could be attributed to limited food supply in many households and traditional feeding practices.
Most of the normal malnourished children in this study had body mass index (BMI) range of 13-16.9, while most of the moderate malnourished had BMI range of 13-14.9 and the severe malnourished BMI were 8-12.9. Cole et al., has stated that undernutrition is better assessed as thinness (low body mass index for age) than as wasting (low weight for height). They have suggested that these new cut-off points should encourage direct comparison of trends in child and adolescent thinness worldwide. These cut-offs provide a classification of thinness for public health purposes [17]. Nutrition plays a major role in maintaining health and malnutrition appears to generate vulnerability to a wide variety of disease and general ill health. The most age group which were more malnourished in our study in both males and females were 8-11 years. Similar result showed that the prevalence rate for malnutrition, based on students aged 9-10 years, was higher than other groups [15], malnutrition was prevalent in the children of all ages (6-15 years) and significantly different in the different age groups and different divisions of the region. Children of the ages 15 years and below appear to be more predisposed to malnutrition than the older ones [16]. The results in this study revealed that the most prevalent parasite in both sexes were E. histolytica followed by G. lamblia, H. nana, E. vermicularis and C. parvum, and the lowest rate was for A. lumbricoïdes. The most malnourished children were infected C. parvum with a rate of 60%, followed by E. histolytica and G. lamblia with rate of 18.7, 10.4% respectively, no malnutrition degree were noted with other parasites. A significantly high rate of malnourished children in the present study had parasitic infection (30%) comparing with the total malnourished one (104). In identical study the most frequent parasite identified was E. histolytica/dispar (12.6%), followed by H. nana (8.9%) and G. lamblia (3.4%). Out of the total number of children investigated, 18.2% tested positive for different helminthic infections and 16% tested positive for cysts of G. lamblia and E. histolytica/dispar. H. nana was the most frequently encountered parasite amongst helminths (8.9%), whilst the least was S. mansoni (0.3%) [14]. The low prevalence of A. lumbricoides (0.23%) noted in study was somehow similar to the low prevalence (2.5%), (1.5%) of geo-helminths, A. lumbricoides, in other studies which was attributable to the fact that geo-helminths require hot and humid weather and wet soil. Because the study area have dry weather and soil, environmental factors can affect the survival of the ova of these parasites in the external environment so that transmission can be hindered[14,18]
A high rate of parasitic infections including cryptosporidiosis was found in malnourished children with diarrhea (67.02%) followed by malnourished children without diarrhea (53%) [19]. Amebiasis, on the other hand is a potentially fatal enteric infection caused by the parasite *Entamoeba histolytica*, is exacerbated by malnutrition [20, 21]. Giardiasis may be a predictor of wasting indicated by lower weight for age Z scores [22]. Previous studies have demonstrated that there is higher prevalence of *G. lamblia* infection in malnourished patients. This may be due to the parasite interfering with intestinal absorption leading to malnutrition [23, 24]. According to Assis et al. the social, economic and physical environment in which an individual lives are major determinant of the degree of association between intestinal parasites and nutritional status [25]. These factors might be responsible for the difference observed in different studies. Although causes of malnutrition are multifactorial, intestinal parasitic infections have been associated with impaired growth and stunting in diverse population [25, 26]. There are several mechanisms by which intestinal parasitism may cause or aggravate malnutrition including impaired nutrient absorption resulting from infection and reduced appetite [27]. Intestinal parasites residing in the small intestine are in an excellent position to interfere with their host nutrition and can induce damage to the intestinal mucosa that may reduce a person’s ability to extract and absorb nutrient from food [28]. Intestinal parasitic infections can cause vomiting, diarrhea, anorexia, abdominal pain and nausea that may result in reduced food intake, thereby further reducing nutrient availability [29]. The most significant cause of nutritional stress resulting from helminth infection is hookworm associated iron-deficiency anemia. It is documented that light hookworm infections of 20 – 50 adults worms can result in significant iron losses [30]. Even mild to moderate intensity helminth infection during childhood have been associated with undernutrition and reduced physical fitness [30,31]. The malnutrition observed among non-infected children may be due to inadequate food intake that led to poor appetite, metabolic and clinical disturbances as well as their socioeconomic status.

Diarrhea in our study was significantly related with malnutrition degree and with parasites. 60% of the total moderately malnourished children had diarrhea and 84% of them had parasite with diarrhea, while in the total sever malnourished children, 87% had diarrhea and 100% had parasitic infection with diarrhea. In comparison the prevalence of malnutrition among Pakistani
children as reported by the WHO in its annual “state of the world children” is consistent with the already established fact that diarrhoeal diseases reduce the growth rate of young children thus making it an important cause of malnutrition [32]. The number of diarrhoeal episodes among Bangladeshi children with variable nutrition revealed that better nourished children experienced significantly fewer diarrhoeal episodes compared with malnourished and/or stunted children [33].

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**AUTHOR**

**Hiro Mohammed Obaid Al-Salhi**: B.Sc. Education College / Mosul University 1991 , M. Sc. In Entomology, Tikrit University 2000. Ph.D. In Medical Parasitology, Tikrit University 2012. Now she's lecturer at Kirkuk Technical College, Medical Laboratory Techniques Department, she's interest in medical parasitology subjects. She has attended a number of conferences, and has published about nine researches in International and Arabic and public scientific journals.