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

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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 8-11years. 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

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
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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.

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

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

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الملخص

سوء التغذية والإصابة بالطفيليات المعوية منتشرة في اغلب الدول النامية، نسبة كبيرة من سكان العالم مصابون بالطفيليات الابتدائية والديدان. الغالبية العظمى من المصابين لا يعانون من اية اعراض ولكن بعض الطفيليات المعوية بامكانها التسبب بمشاكل الاسهال وسوء التغذية. لهذه الدراسة تم اختيار أربعمائة وثلاثون طفل (257ذكر و173أنثى) الذين راجعوا قسم الامراض الطفيلية في مستشفى كركوك العام وآزادي التعليمي، تراوحت اعمارهم بين <1–12سنة. تم قياس الطول والوزن لكل طفل.اخذ عينات براز من الاطفال للفحص المجهري للبحث عن الطفيليات المعوية. تردد حالات سوء التغذية في الذكور كان اعلى معنويا (29,9%) منه في الاناث (15,6%).المرحلة العمرية الذي عانى من سوء التغذية في كلا الجنسين كان 8–11سنة بالرغم من ان اعداد المرضى الراقدين (336) كان اعلى من المرضى المراجعين (94) ولكن لم يظهر اختلافات معنوية لسوء التغذية بين الفئتين. النسبة الكلية لاطفال سوء التغذية كان 24% والغالبية من الاطفال الذين كان سوء التغذية لديهم طبيعي كان لهم نسبة كتلة الجسم (BM1) 13–16,9 ، بينما الذين عانوا من سوء تغذية متوسطة كان لهم (BM1) 13–14,9 ، اما الذين عانوا من سوء التغذية شديدة فان (BM1) لهم كان 8–12,9. الطفيلي الاكثر انتشارا في كلا الجنسين كان المتحولة النسيجية(*Entamoeba hitolytica*) وتبعها الجيارديا(*Giardia lamblia*)،الدودة القزمة

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

(*Hymenolepis nana*) ، الدودة الدبوسية(*Enterobius vermicularis*) والبويغات الخبيئة(*Cryptosporidium parvum*). النسبة الاقل كان لدودة الاسكارس(*Ascaris lumbricoids*).الاطفال الاكثر سوءا للتغذية كان لديهم طفيلي البويغات الخبيئة بنسبة 60% وتبع بطفيلي المتحولة النسيجية والجارديا بنسبة 18,7و10,4% على التوالي. لم يلاحظ حالات سوء تغذية للاصابات الطفيلية الاخرى. نسبة عالية معنويا من الاطفال الذين كانوا يعانون من سوء التغذية (104) كان لهم اصابات طفيلية وبنسبة 30% . الاسهال ارتبط معنويا مع سوء التغذية ومع الاصابات الطفيلية. 60% من المجموع الكلي لاطفال سوء التغذية متوسطة كانوا يعانون من الاسهال، ونسبة 84% منهم كان لهم اسهال مع اصابات طفيلية. بينما المجموع الكلي لاطفال شديدي سوء التغذية 87% كانوا يعانون من الاسهال، ونسبة 100% منهم كان لهم اصابات طفيلية مع اسهال.

الكلمات الدالة: سوء التغذية، الطفيليات المعوية، الاطفال، كركوك، العراق.

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

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

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, *Acariasis*, 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 pine, 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.

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

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]. χ^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_1years old, while in females <10_12 years were more malnourished.

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

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	161	106	65.8	27	16.8	28	17.4	55	34.1
<1-4	63	51	80.9	8	12.7	4	6.34	12	19.0
<4-7	18	16	88.9	2	11.1	0	0.0	2	11.1
<7-10	12	5	41.7	6	50	1	8.33	7	58.3
<10-12	3	2	66.6	1	33.3	0	0.0	1	33.3
Total	257	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	100	85	85	7	7.0	8	8.0	15	15.0
<1-4	49	41	84	5	10.2	3	6.22	8	16.3
<4-7	13	12	92	1	7.7	0	0.0	1	7.7
<7-10	8	6	75	1	12.5	1	12.5	2	25
<10-12	3	2	67	1	33.3	0	0.0	1	33.3
Total	173	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%.

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

Table.(3): Malnutrition among out and in patients.

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

N= normal, M= moderate, S= sever

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).

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

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

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.o-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.

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

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	26	23 8.9	6 2.3	3 1.2	1 0.4	4 1.56
Female 173	59	32	25 14	2 2.7	2 1.2	0 0.0	1 0.58
Total 430	123	29	48 11	8 1.9	5 1.2	1 0.23	5 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	4	3.3	23	18.7
G. lamblia	48	43	89.6	5	10.4	0	0.0	5	10.4
C. parvum	5	2	40	1	20	2	40	3	60
Total	176	145		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

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

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.

Total No.	Total diarrhea no.	Malnutrition degree							
		M				S			
		Total	M^{+D}	%	M^{-D} %	Total	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= sever, 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.

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

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 sever 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 8-11years. 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. 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 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. lumbricoids* (0.23%) noted in study was somehow similar to the low prevalence (2.5%), (1.5%) of geo-helminths, *A. lumbricoids*, 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]

Kirkuk University Journal /Scientific Studies (KUJSS)
Volume 10, Issue 1, March 2015 , p.p(191-206)
ISSN 1992 - 0849

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].

REFERENCES

[1] J.S, Curran, L.A, Barness. Nutrition. In: ***Bhrman RE, Kliegman RM, Jenson HB. NelsonTextbook of Pediatrics, 16th ed. WB Saunders Co., Philadelphia. 2000***, pp. 138-88.

[2] World Health Organization reports. ***Manual on malnutrition, management of child with a serious infection or severe malnutrition, Geneva. 2000***, pp.80.

[3] J. Nematian, E.Nematian, A. Gholamrezanezhad, ***Asgari AA. Prevalence of intestinal parasitic infections and their relation with socio-economic factors and hygiene habits in Tehran primary school students. Acta Tropica. 2004, 92(3):***179-186.

[4] L. Adekunle, ***Intestinal parasites and nutritional status of Nigerian children***. Afr. J. Biomed. Res. 2002, 5:115-119.

[5] L .Quihui-Cota, ME .Valencia, ***Crompton DWT, Phillips S, Hagan P, Diaz-Camacho SP, Tejas AT. Prevalence and intensity of intestinal parasitic infections in relation to nutritional status in Mexican School Children. Transaction of the Royal Society of Trop. Med. Hyg. 2004,*** 98:653-659.

[6] L.D,Edungbola, AA. Obi, ***A Review of human intestinal parasites in Nigeria***: ***challenges and prospects for integrated control.*** Nig. J. Parasitol. 1992, 13:27-37.

[7] M .Casapia, S.A Joseph, C .Nunez, E. Rahme, Gyorkos TW. ***Parasite risk factors for stunting in grade 5 students in a community of extreme poverty in Peru. Inter. J. Parasitol. 2006***, 36:741-747.

[8] M.A Adedoyin, I.A Awogun, T. Juergensen. ***Prevalence of intestinal parasitoses in relationship to diarrhea among children in Ilorin. West Afr. J. Med. 1990***, 9:83-88.

[9] A.R El-Ghannam. ***The global problems of child malnutrition and mortality in different orld regions. J. Health Soc. Policy. 2003***, 16: 1-26.

[10] D.M Staton and M.H Harding. Protecting child health worldwide. ***Implementation is the biggest challenge slowing efforts to reduce childhood morbidity and mortality in developing countries. Pediatr. Ann. 2004***, 33: 647-655.

[11] J .Gerstein, K .Sullivan, R .Yip, M .Onis, F .Trowbridge, P .Fajans. ***Issues in the assessment of nutritional status using anthropometry. WHO Bull. 1994***, 72:273–283.

[12] S. Rosalind, Principle of nutritional assessment. ***New York: Oxford University Press; 1993.***

[13] World Health Organization (WHO). ***Basic Laboratory Methods in Medical Parasitology. Geneva, Switzerland. World Health Organization. 1991***.

[14] P .Reji, G .Belay, B .Erko, M .Legesse, M. Belay. ***Intestinal parasitic infections and malnutrition amongst first-cycle primary schoolchildren in Adama, Ethiopia. Afr J Prm Health Care Fam Med. 2011***, 3 (1).

[15] S.A.A Azad, N .Nourjah, F .Shahbazi. ***Relationship of intestinal parasitic infections to malnutrition among schoolchildren near Tehran, Iran. Southeast Asian J. Trop. Med. Pub. Heal. 2004***,35 (1).

[16] C.M.G Garba and C.M.F Mbofung . ***Relationship between malnutrition and parasitic infection among school children in the Adamawa region of Cameroon. Pak. J. Nutr. 2010,*** 9 (11): 1094-1099.

[17] T.J Cole, K.M Flegal, D. Nicholls and A.A Jackson. ***Body mass index cut offs to define thinness in children and adolescents: International survey. BMJ. 2007***, 335: 194.

[18] Y. Belyhun, G .Medhin, A .Amberbir, *et al*. ***Prevalence and risk factors for soil transmitted helminth infection in mothers and their infants in Butajira, Ethiopia: A population-based study. BMC Pub. Heal. 2010,*** 10:21–27.

[19] M.J Raghad, K.M Nadham, KH. Mea'ad ***Intestinal Parasitic Infections Including Cryptosporidiosis And Immunological Aspects Among Malnourished Children. J. Bahrain Med. Soc. 2005***, 17(1).

[20] W.A Petri, D .Mondal, K.M Peterson, P. Duggal, R .Haque. ***Association of malnutrition with amebiasis. Nutr Rev. 2009***, 67 (l) 2:207–215.

[21] D. Mondal, R .Haque, R.B Sack, B.D Kirkpatrick, W.A Petri. ***Attribution of malnutrition to cause-specific diarrheal illness: evidence from a prospective study of preschool children in Mirpur, Dhaka, Bangladesh. Am J Trop Med Hyg. 2009***, 80(5):824–826.

[22] Helen II, Y. Binta and Y.E Sabo, ***Asymptomatic Giardiasis and Nutritional Status of Children in Two Local Government Areas in Kaduna State***, Nigeria. Sierra Leone J. Biomed. Res. 2011, 3(3) :157-162.

[23] C .Durán, G.A Hidalgo, W. Rodriguez-Morales, A.J Albano, C. Cortez, J .Jiménez, S. Díaz, M .Renzo and R.N. ***Incani Giardia lamblia infection is Associated with Lower Body Mass Index Values.*** J Infect Dev Ctries. 2010, 4(6):417-418.

[24] E.I Ikeh, M.O Obadofin, B .Brindeiro, C. Baugherb, F .Frost, D .Vanderjagt and R.H Glew . ***Intestinal Parasitism in Magama Gumau Rural Village and Jos Township in Northcentral Nigeria***. Niger Postgrad Med J. 2007, 14: 290-295.

[25] A.M.O Assis, M.S Prado, M.L Barreto, M.G Reis, S.M.C Pinheiro, I.M Parraga, R.E. Blanton Childhood stunting in northeast Brazil: ***the role of Schistosoma mansoni infection and inadequate dietary intake***. Euro. Clin. Nutr. J. 2004, 58:1022-1029.

[26] J .Nematian, A .Gholamrezanezhad, E .Nematian. ***Giardiasis and other intestinal parasitic infections in relation to anthropometric indicators of malnutrition: a large-population-based survey of school children in Tehran***. Ann. Trop. Med. Parasitol. 2008, 102:209-214.

[27] D.W. Crompton, M.C Nesheim. ***Nutritional impact of intestinal helminthiasis during the human life cycle***. Ann. Rev. Nutr. 2002, 22:35-59.

[28] TGAN. Chandrasena, ACD. De Alvis, LDR. De Silva., R.P Morel, N.R De Silva. ***Intestinal parasitosis and the nutritional status of Veddah children in Sri Lanka***. South-East Asian J. Trop.l Med. Pub. Heal. 2004, 35(2):255-259.

[29] M .Hurtado, C.A Lambourne, P .James, K. Hill, K .Cheman, K. Baca. Human rights, ***biomedical science and infectious disease among South American indigenous groups***. Ann. Rev. Anthro. 2005, 34:639-665.

[30] M.O Obiukwu, P.U Umeanaeto, C.I Eneanya, G.O Nworgu. ***Prevalence of gastro-intestinal helminth in school children in Mbaukwu, Anambra State, Nigeria***. Ann. Trop. Med. Parasitol. 2008, 101 (8):705-713.

[31] O.A Egwunyenga, D.P Ataikiru. ***Soil-transmitted helminthiasis among school age children in Ethiope East Local Government Area, Delta State, Nigeria***. Afr. J. Biotech. 2005, 4:938-941.

[32] R .Haque, *et al*. ***Entamoeba histolytica infection in children and protection from subsequent amebiasis***. Infect. Immun. 2006, 74(2):904–909.

[33] P .Duggal, *et al*. ***Influence of human leukocyte antigen class II alleles on susceptibility to Entamoeba histolytica infection in Bangladeshi children***. J. Infect. Dis. 2004, 189(3):520–526.

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