Full Length Research Paper

Intestinal infections in malnourished children in south of Tehran, Iran

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Intestinal and urinary tract infections are the most common infections in malnourished children. In the present study, intestinal infections were surveyed in malnourished children. The present research was a cross sectional study in 12 months. During the study period, all the malnourished children admitted to health center in south of Tehran, were included in the study. Malnutrition was found in children with clinical examinations. Malnourished children and control group were referred to the laboratory for stool screening of ova of worms and protozoa cysts or trophozoite and also stool culture. In a total of 84 cases, 4 children were infected with cysts of *Giardia intestinalis*, 2 children were infected with *Blastosistis hominis*, 5 children were infected with *Enteropathogenic Escherichia coli* and 3 children were infected with *Shigella* spp. In the control group, one child was infected with *G. intestinalis*, 2 children were infected with *B. hominis* cysts and one child was infected with *Enteropathogenic E. coli*. Statistical analysis showed significantly higher rates of parasitic infection in malnourished children with *G. intestinalis* as compared to the control group (P<0.05) but there was significantly higher rates of *B. hominis* infection in the control group as compared to malnourished children (P<0.05). With regards to bacterial infections, statistical analysis showed significantly higher rate of bacterial infection of malnourished children with EPEC and *Shigella* spp. as compared to control group (p<0.05). The causes of malnutrition are multiple and complex and infections are common precipitating factor. Acute intestinal and respiratory infections are the most important causes of high morbidity and mortality in malnourished children and malnutrition is an important associated factor in these deaths. The present study showed that, parasite and bacterial intestinal infection in malnourished children were significantly higher than healthy children, thereby malnourished children should be tested periodically for detecting bacterial and parasitic intestinal infections and should be treated in first stages of illness.

Key words: Intestinal infection, malnutrition, children.

INTRODUCTION

Malnutrition is one of the most important underlying causes of child mortality and morbidity in developing countries, particularly during the first 5 years of life. It is estimated that more than 10 million children under 5 years of age die each year worldwide (Rodriguez et al., 2011).

In 2009, the WHO estimated 32% of children under the age of 5 years were malnourished in developing countries (Ahmed et al., 2009). Approximately 178 million children (32% of children in the developing world) suffer from chronic malnutrition. Although, the prevalence of childhood malnutrition has been decreasing in Asia, countries in South Asia still have highest rates of malnutrition in children. Indeed, the prevalence of malnutrition

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in India, Bangladesh, Afghanistan, and Pakistan (38 to 51%) is higher than in sub-Saharan Africa (26%) (Leonor et al., 2011) Nutritional status affects every aspect of a child's health, including normal growth and development, physical activity and response to serious illness. Malnutrition may be the origin of the deficiency or absence of any nutrient. The establishment and severity of malnutrition depend on the cause, intensity and duration of the nutritional deficiency (Leonor et al., 2011; Canani et al., 2011)

Malnutrition is one of the consequences of disease or inadequate nutrition and has a multifaceted nature, so how to deal with children's nutrition is different. Diagnosis of malnurished children based on initial history and physical examination findings and laboratory tests, would be helpful in less than 2% of cases.

More than two million children die each year in developing countries from diarrheal diseases. Infection adversely affects nutritional status through reductions in dietary intake, increased catabolism and sequestration of nutrients that are required for tissue synthesis and growth (Mondal et al., 2009; Martorell and Zongrone, 2012). Synergistic effects between infection and nutrition for the first time were introduced by Carl Taylor and John Gordon in 1959 (Ahmed et al., 2009).

Deficiency in macronutrients such as protein, carbohydrates and fat provoke protein-calorie malnutrition (PCM), and when combined with micronutrient deficiencies, they are among the most important nutritional problems with hundreds of millions of pregnant women, elderly and young children particularly affected. Iran is a developing country and in some parts of south of Tehran there are more malnourished children than other parts of Tehran. There are few researches on causes of malnutrition in children living in these parts, so in this study, we surveyed bacterial and parasite intestinal infections in malnourished children living in south of Tehran.

MATERIALS AND METHODS

The present research was a cross sectional study in 12 months. During the study period, all the malnourished children admitted to health center in south of Tehran, were included in the study. In this area, people are living with weak or moderate economy and malnutrition is common in other areas. Malnutrition was found in children with clinical examinations. The clinical examinations included measurement of body weights, heights and weight-for-age children Z scores and compared with the standard growth curve. The severity malnutrition was calculated using the child's weight-for-age ratio, according to World Health Organization Guidelines (Weisz et al., 2012; WHO, 2008). Growth curve is upward in normal children, but in malnourished, the growth curve is horizontal or even downward. Based on growth curve and clinical examinations malnourished children were divided into three groups: severe malnutrition, moderate malnutrition and mild malnutrition (Leonor et al., 2011).

The present study is a cross sectional study and included children with downward growth curve. The severity malnutrition was calculated using the child's weight-for-age ratio, according to World Health Organization Guidelines. In addition, the control group included children matched for age and sex to malnourished children laboratory for stool screening of ova of worms and protozoa cysts or

trophozoite and also stool culture. To obtain the highest accuracy, stool examination was performed on three consecutive sampling and was performed with three methods: smear stained with Lugol's iodine, smear prepared by formol-ether concentration and wet smear in physiological normal saline and surveyed by light microscope. Stool examination was done to check the ova of parasitic worms and trophozoites or cysts of protozoa. Stool samples were cultured on selective and differential media cultures for detecting of pathogenic bacteria in samples. Bacteria and parasites common cause of diarrhea in children are *Enteropathogenic Escherichia coli, Shigella* spp. and *Giardia intestinalis.* Media cultures included blood agar, E.M.B agar, Mac Conkey agar and Selenite F broth. Pathogenic bacteria isolated from stool samples were identified by differential biochemical and serological tests. Differential biochemical media cultures included TSI, SIM, Simon Citrate, MR-VP, Lysin, KIA. Serological tests by agglutination were applied for detection of serotypes of *E. coli* (Bailly and Scotts, 2010).

All the children's parents were thoroughly informed on the purpose and procedures of the study, and the study was reviewed and approved by the National Ethics Committee, Tehran University of Medical Sciences.

All experiments were conducted at least three times. Statistical calculations were done using SPSS 13.0 software with one way variance analysis (ANOVA). Results were expressed as means ± S.D. $p < 0.05$ was considered as significant difference.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Ethics Committee of Tehran University of Medical sciences.

RESULTS

In the present study, 84 malnourished children less than five years old were examined. Malnourished children (patient group) include 32 (38.1%) male and 52 (61.9%) female. Age range in patients group was 6 to 59 months (mean: 28 months). We evaluated 58 "healthy" children (control group) matched for sex and age of malnourished children. Control group include 20 (34.5%) male and 38 (65.5%) female. Age range in control group was 8 to 55 months (mean: 30 months). Weight-for-age and growth curve in control children group was normal. This information is summarized in Table 1.

In malnourished children, 3 had severe malnutrition (3.57%), 32 had moderate (38.1%) and 49 children had mild (58.3%) malnourishment (Table 2). Results for specific parasites and bacterial infections in malnourished children are summarized in Table 3.

In a total of 84 cases, 4 (4.76%) children were infected with cysts of *G. intestinalis*. In *Giardia* infected children, one child (1.19%) had severe malnutrition, one child (1.19%) had moderate malnutrition and 2 children (2.38%) had mild malnutrition. Also, one child (1.19%) with moderate malnutrition and one child (1.19%) with mild malnutrition were infected with cysts of *B. hominis*.

With regards to incidence of bacterial infections in malnourished children, *Enteropathogenic E. coli* (EPEC) were isolated from stool samples of 5 cases (5.95%) and *Shigella* spp., were isolated from stool samples of 3 malnourished children (3.57%). Results for specific parasites and bacterial gastrointestinal infections in the control group are summarized in Table 4.

Table 1. Age and sex of malnourished and healthy children.

	Age (month)	Male	Female	Total
Malnourished children	6-59 (mean 28)	32 (38.1%)	52 (61.9%)	84
Healthy children	8-55 (mean 30)	20 (34.5%)	38 (65.5%)	58

Table 2. Severity of malnutrition in children.

Malnutrition	Male	Female	Total
Severe	1	2	3 (3.57%)
Moderate	12	20	32 (38.1%)
Mild	19	30	49 (58.3%)
Total	32(38.1%)	52 (61.9%)	84 (100%)

In a total of 58 healthy children under the parasitic study, one child (1.72%) was infected with cysts of *G. intestinalis*, two children (3.45%) were infected with cysts of *B. hominis* and with incidence of bacterial infections in the control group, EPEC was isolated from stool sample of one child (1.72%).

Statistical analysis showed significantly higher rates of parasitic infection in malnourished children with *G. intestinalis* as compared to the control group (P<0.05) but there was significantly higher rates of *B. hominis* infection in the control group as compared to the malnourished children (P<0.05). With regards to bacterial infections, statistical analysis showed significantly higher rate of bacterial infection in malnourished children with EPEC and *Shigella* spp as compared to the control group (p<0.05).

DISCUSSION

Malnutrition is one of the most important underlying causes of child mortality in developing countries, particularly during the first 5 years of life (Leonor et al., 2011). Infection and nutrition have a synergistic effect when put together, thus the risk of infections caused by inadequate nutrition and on the other hand, infection due to inadequate intake or absorption of nutrition. One of the most infections associated with malnutrition is gastrointestinal infection. Gastrointestinal infections, including bacterial and parasitic infections, directly affect the integrity, morphology and function of the absorptive mucosa of the intestine, possibly resulting in malabsorption. It has been proposed that an important proportion of childhood malnutrition is due to impaired intestinal absorptive function resulting from multiple and repeated gastrointestinal infections. Gastrointestinal pathogenic bacteria can either be ingested or ascend from the distal bowel; however, their survival is usually limited by gastric acidity. Therefore, hypochlorhydria can result in bacterial overgrowth in the stomach; further, the expanded bacterial populations may also contribute to increase of the intragastric pH.

Helicobacter pylori is associated with childhood malnutrition in developing countries either for the occurrence of malabsorption or for an increased susceptibility to enteric infections caused by hypochlorhydria (Rahimkhani and Ghofrani, 2008; Vitale et al., 2011).

In 2001, the World Health Organization (WHO) established the external Child Health Epidemiology Reference Group (CHERG) to develop estimates of the proportion of deaths in children younger than 5 years which is attributable to pneumonia, diarrhea, malaria and measles (Black et al., 2010). In 2009, the WHO estimated that 27% of children in developing countries under the age of 5 years are malnourished. Approximately, 178 million children (32%) of children in the developing world) suffer from chronic malnutrition. Although, the prevalence of childhood malnutrition is decreasing in Asia, countries in South Asia still have both the highest rates of malnutrition and the highest number of malnourished children. Indeed, the prevalence of malnutrition in India, Bangladesh, Afghanistan, and Pakistan (38 to 51%) is much higher than in sub-Saharan Africa (26%) (Ahmed et al., 2009). The causes of malnutrition are multiple and complex and infections are common precipitating factor. Acute gastrointestinal and respiratory infections are the most important causes of high morbidity and mortality among malnourished children and malnutrition is an important associated factor in these deaths (Leonor et al., 2011).

The aim of this study was to determines the incidence of bacterial and parasitic gastrointestinal infections in malnourished children. The study included 84 mal-nourished children less than five years old, admitted to health centers in Tehran University of Medical Sciences. Also, 58 children as control group were matched with sex and age of malnourished children. Stool samples were collected three times from all the malnourished and health children undergoing bacteriological and parasitological examinations. In parasite investigation, results showed that giardiosis in malnourished children was significantly higher than in health children. In general, parasitic infections are an important health problem which affects children more than adults. In growth-age children, this leads to problems such as malnutrition, malabsorption, growth retardation and learning disabilities (Hamamcı et al., 2011). Especially, giardia can lead to malnutrition and cognitive deficits in children from developing countries (Ignatius et al., 2012). *G. intestinalis* caused fatty diarrhea in children and may lead to failure to absorb fat-soluble vitamins and this situation led to severe malnutrition in children and the cycle continued without the

Table 3. Intestinal infections in malnourished children.

Malnourished children	*Giardia intestinalis*	*Blastosistis hominis*	EPEC	*Shigella* spp.
Severe	1 (1.19%)	0	1 (1.19%)	1 (1.19%)
Moderate	1 (1.19%)	1 (1.19%)	1 (1.19%)	0
Mild	2 (2.38%)	1 (1.19%)	3 (3.57%)	2 (2.38%)
Total	4 (4.76%)	2 (2.38%)	5 (5.95%)	3 (3.57%)

Table 4. Intestinal infections in the control group.

Control group	*Giardia intestinalis*	*Blastosistis hominis*	EPEC	*Shigella* spp.
58	1 (1.72%)	2 (3.45%)	1 (1.72%)	0

treatment of giardiosis (Ignatius et al., 2012; Prendergast and Kelly, 2012).

With regards to prevalence of *B. hominis* in malnourished children (counterpart to control group), *B. hominis* in malnourished children was not significantly more than in healthy children. *B. hominis* lives in gastrointestinal tract in many cases, without any problem or causing diseases. In malnourished and healthy children groups, we observed the same results in surveying *B. hominis* cysts in feces but the number of cysts was low in both groups. Staat et al. (2011) reported that the prevalence of *B. hominis* was 10% in children surveyed without disease.

Enteropathogenic *E. coli* and *Shigella* spp. are the two most common cause of diarrhea in children. Based on our results, EPEC and *Shigella* spp. was isolated from stool samples in malnourished children, which significantly more than healthy children. Nitiema et al. (2011) investigated the prevalence and epidemiology of enteric pathogens causing gastroenteritis and the level of malnutrition in young children in Burkina Faso. He surveyed 309 children less than 5 years of age. Based on his results, Enteropathogenic *E. coli* was isolated from 9.7% and *Shigella* spp. was isolated from 5.8% of fecal samples from malnourished children. These percents were less than our results but ratios of the two isolated genuses of bacteria (EPEC and *Shigella* spp.) are similar in both studies (Nitiema et al., 2011). The present study showed that bacterial and parasitic intestinal infections in malnourished children are significantly higher than healthy children. These chronic or some cases of acute infections due to worse situations of malnutrition in children and this vicious cycle are repeated. Malnourished children should be tested periodically to detect bacterial and parasitic intestinal infections and should be treated in first stages of illness.

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