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ESTIMATION OF SERUM ZINC AND MAGNESIUM LEVELS IN SUDANESE CHILDREN UNDER FIVE YEARS WITH PROTEIN ENERGY MALNUTRITION (PEM)

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ABSTRACT

Objective: To estimate serum levels of zinc and magnesium among Sudanese children under 5 years with protein energy malnutrition (PEM), in comparison with apparently healthy volunteers. **Materials and methods:** A cross- sectional hospital based study conducted during the period from May to September 2013. Children with PEM were chosen from Omdurman Teaching Hospital for Pediatric. The studied populations consist of 90 subjects: Fifty children patients less than five years with PEM. Forty apparently healthy subjects matching age and sex were also included as control. **Results:** We found significantly low serum zinc and magnesium levels in PEM types [kwashiorkor: zinc = (0.31mg/dl), magnesium = (1.09 mg/dl), marasmus: zinc = (0.31mg/dl), magnesium = (0.99 mg/dl), marasmic-kwashiorkor: zinc = (0.33 mg/dl), magnesium = (0.98mg/dl)] patients as compared to control [zinc = (0.76 mg/dl), magnesium = (1.92 mg/dl)], P <0.05 **Conclusion:** This findings can be concluded to that PEM is associated with zinc and magnesium deficiency.

KEY WORDS: PEM, zinc, magnesium, Sudan.

INTRODUCTION

Protein-energy malnutrition (PEM) is a syndrome resulting from interaction between poor diets and diseases, leading to anthropometric deficits, and generally with deficits in

micronutrients. Protein-energy malnutrition in children can be of three types by clinical classification: marasmus (wasting from malnutrition), kwashiorkor, and marasmic kwashiorkor; the latter two are oedematous malnutrition. Three anthropometric indices are commonly-used indicators of malnutrition, decreased weight compared with age (underweight),decreased height compared with age (stunting), and decreased weight compared with height (wasting) (length is used if the age is less than two years or the length is less than 85 cm). A deficit (z-score below -2) in any one of these indices reflects malnutrition, and a z-score below -3 reflects a severe form of that condition.[1]

Kwashiorkor Is an acute form of childhood protein-energy malnutrition characterized by edema, irritability, anorexia, ulcerating dermatoses, and an enlarged liver with fatty infiltrates. The presence of edema caused by poor nutrition defines kwashiorkor.[2] Kwashiorkor was thought to be caused by insufficient protein consumption but with sufficient calorie intake, distinguishing it from marasmus. More recently, micronutrient and antioxidant deficiencies have come to be recognized as contributory. [3]

Marasmus is characterized by a chronic and severe restriction of both energy and protein to the body. Marasmus is more frequently found at a younger age than kwashiorkor, usually in children under one year of age. Body weight may be reduced to less than 80% of the average weight that corresponds to the height. A marasmic child presents severe wasting, with a very low weight-for-age and reduced length-for-age, it can be distinguished from kwashiorkor in that kwashiorkor is protein wasting with the presence of edema. The prognosis is better than it is for kwashiorkor. [4]

Marasmic kwashiorkor is The most severe form PEM in children, with weight for height less than 60% of that expected, and with edema and other symptoms of kwashiorkor. [5]

Underweight: Is characterized by failure to thrive as judged by retarded growth and development. In addition, signs of infection and anemia may be present. The body weight is 80% of the standard for age. [5]

Recent clinical and experimental findings have reinforced the link reported from developed and developing countries. Zinc has been known to be an essential element since its discovery among zinc deficiency, malnutrition and diarrheal disease. Because there is a strong association between protein and zinc content in virtually all types of foods, insufficient

protein intake may often be the cause of zinc deficiency. Marginal and moderate zinc deficiencies in children with impairment in their growth has been by Raulin in 1869. [6]

To date more than 300 zinc dependent enzymes have been identified in biochemical pathways. Because of zinc's central role in cellular growth and differentiation, the effects of its deficiency are especially pronounced in tissues and organs with rapid turnover (e.g., the immune system), and during periods of rapid growth. Meats and many plant sources like lentils and grains such as wholemeal meat, maize and polished rice provide a high zinc concentration but the release and absorption of zinc is limited by the abundant phosphorus compound, phytate, which binds zinc. [7]

The zinc availability from human milk is far greater than from cow's milk, soy milk and combined formulas [8]. The normal serum zinc levels of healthy children is 0.6-1.0 mg/dl.

Magnesium is the second most abundant intracellular cation and the fourth most abundant cation in the body. Magnesium is a cofactor of various enzymes in carbohydrate oxidation and plays an important role in glucose transporting mechanism of the cell membrane. It is also involved in insulin secretion, binding, and activity (Chaudhary D et al. 2010). [9]

Magnesium deficiency is common in people who eat processed food diet; in people who cook or boil all foods, especially vegetables; in those who drink soft water; in alcoholics (Romani A et al. 2008). [10]

MATERIALS & METHODS

This is a cross-section al case control study conducted in Khartoum state during the period from May to September 2013. The case group was composed of (50) patients with PEM the control group was composed of (40) apparently healthy children. None of the case or control subjects was in a supplement that included magnesium, zinc.

A coded enrollment number was given for each enrolled subject. The data were collected by using a direct interviewing questionnaire. Medical information was collected from the patient with help of the physician. The questionnaire was used to collect data regarding name, age, gender and medication.

Three ml venous blood were collected from each enrolled subject and poured into plain containers, left at R.T for one hour and centrifuged at 3200 rpm for three minutes to obtain

sera. Sera obtained were analyzed for magnesium using advanced clinical chemistry analytical system (Mindray BS200- China).

Zinc was determined by flame atomic absorption spectroscopy (Buck Scientific, model 210 VGP) at Academy of Science and technology-Khartoum-Sudan.

Statistical evaluation was performed using the Microsoft Office Excel (Microsoft Office Excel for windows; 2007) and SPSS (SPSS for windows version 19). Normal distribution of the studied variables was examined using Kolmogorov-Smirnova and Shapiro-Wilk tests. Student Ttest and Mann-Whitney U test were used to assess significant difference in the means of the zinc and magnesium measurements in males and females. Correlations between serum zinc,magneisum and the age were assessed using bivariate correlations. $P < 0.05$ was considered statistically significant.

RESULTS

The weight, height and serum zinc and magnesium level were measured for 90 Sudanese children, 50 with PEM (aged 4-36 month) served as patients group, and 40 normal apparently healthy subjects (aged less than 59 month) served as control group Sudanese children with PEM is more common in boys (54%) than girls (46%), and also percentage of PEM types among patients group, marasmus more common which represent 60%,then kwashiorkor26% and marasmic kwashiorkor14%.

Table1 below shows there are significant differences in the mean±SD of weight, height in PEM types: (kwashiorkor, marasmus , marasmic kwashiorkor) which are [7.6±0.47 kg, 77±1.61 cm],[5.7±.77 kg, 69±1.02cm] and [7.2±.44 kg ,76±1.94cm] respectively) compare with weight, height in control group which are[9.5±0.45 kg, 81±1.19 cm]. Also show there is significant difference in the mean±SD of serum zinc and magnesium concentration in PEM types (kwashiorkor, marasmus, marasmic kwashiorkor) which are [0.31±0.06mg/dl, 1.09±0.27mg/dl],[0.31±0.05mg/dl,0.99±0.25mg/dl], [0.31±0.06mg/dl, 0.98±0.16mg/dl] respectively) compare with zinc, magnesium in control group which are [0.76±0.14 mg/dl, 1.9±0.19 mg/dl].

Table 1. The means of measured variables in Kowash , Marasmus, and Marasmusic kwashiorkor

Parameter	Study population (n=90)				*P*.values		
	Kowash (n = 13) M ± SD	Marasmus (n = 30) M ± SD	Marasmic-kwashiorkor (n = 7) M ± SD	Control (n =40) M ± SD	Kowa. vs Control	Mar. vs Control	Mar - Kowa. vs Control
Zinc (mg/dl)	0.31±0.06	0.31±0.05	0.33±0.06	0.76±0.14	0.000	0.000	0.000
Mg (mg/dl)	1.09±0.27	0.99±0.25	0.98±0.16	1.92±0.19	0.000	0.000	0.000
Weight in Kg	7.84±0.48	5.79±0.77	7.21±0.45	9.57±0.46	0.0000	0.000	0.000
Height in cm	77.15±1.61	69.37±1.02	76.43±1.94	81.03±1.2	0.000	0.000	0.000

DISCUSSION

Zinc is required for normal growth and development [11] and deficiency can result from inadequate dietary intake, impaired absorption, excessive excretion, or inherited defects in zinc metabolism .[12] Requirements depend on the weight, age, and growth rate of children, and the bioavailability of zinc from different sources.[13] Indeed, nutritional insufficiency was one of the main reasons of zinc deficiency. [14]

This study showed that PEM were more common in boys compared to girls this agree with study done in Southwestern Saudi Arabia by Al-Hashem FH (2008) who found that PEM was more common in boys than girls, and study done in Kenya by Sunguya Bruno (2006) who found that 55% of all malnourished children were boys.[15] The study showed that the most common types of PEM among children under five years was marasmus and this agree with study done by Gernaat et al (1998),[16] who found that most common type of PEM was marasmus.

Also this study showed that there was significant decrease in weight of children suffered from PEM types compare to healthy children and this agree with study done in Turkey by Atalay (1989)[17] who found that weight was decreased in children with PEM compared to control. Also there was significant decrease in height in children with PEM types compare with control group and this agree with established for healthy study done in Mexico (2001) by Jere R. et al [18] that reported Within rural Mexico stunting — short height relative to standards populations — was the major form of PEM was decreased in children with PEM.

Regarding zinc, the present study showed that there was significant decrease in serum zinc level in patient with PEM types compared with control group and showed the children with

PEM had low serum zinc levels, and this agree with study done in India by Farhan J (2009)-[19] who found that the mean of serum zinc level of 75 of malnourished children significantly low compared with 75 of healthy children.

children with PEM are vulnerable to zinc deficiency due to lower dietary intake and the cycle of diarrhea with fecal nutrient losses may substantially reduce zinc store which could result in growth faltering and increased morbidity especially among malnourished children. This study indicated that, serum zinc level was decreased in children with PEM compared to healthy children, also there were significant differences of weight, height between healthy children and children with PEM. Also this study showed that there was significant decrease in magnesium level in patient group with PEM types. This result is similar to study done in India by (PN singla 1998). [20]

CONCLUSION

PEM is more common in boy than girls. The predominant type of PEM is marasmus. There is significant decrease in serum zinc and magnesium concentration in PEM types, Also there are significant decreases in weight, height in PEM types compare to control group.

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