

Research Article**Serum analyte levels in children: relationship with malnutrition****Noreen Samad*, Sadia Jabeen, Amna Liaqat, Iqra Zulfiqar, Rahat Bano***Department of Biochemistry, Bahauddin Zakariya University, Multan, Pakistan***History**

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Keywords

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***Correspondence**noreen.samad@bzu.edu.pk**Abstract**

Malnutrition is the cellular unbalancing among the supply of energy and nutrients which are essential for maintenance, growth and particular functions. It becomes a major cause of mortality of children less than five years of age. The aim of present study to evaluate the serum analytes such as electrolytes (sodium (Na⁺), potassium (K⁺) and calcium (Ca⁺⁺), creatinine and blood components in malnourished than healthy children. We had collected the data of 300 malnourished children (100 marasmus, 100 kwashiorkor and, 100 healthy children) with age 6-36 months from Children Complex Hospital Multan, Pakistan. Data was analyzed by paired sample t-test by SPSS software. Socio-demographic data of these children's mothers was also collected. Results showed that level of Na⁺ and creatinine was high whereas, the levels of K⁺ and Ca⁺⁺ were lower in both marasmus and kwashiorkor than control subjects. The levels of leukocytes, platelets and hemoglobin (Hb) were also decreased in both diseases. Erythrocytes (RBCs) levels were decreased in marasmus while increased in kwashiorkor. It is concluded that inadequate feeding practices, birth order, poverty, illiterate mothers, low nutritional quality of meals responsible for malnutrition. Feasible strategies are needed to address the dietary inadequacies and chronic malnutrition of rural infants..

1. Introduction.

Malnutrition is the impairment of supply of energy and nutrients that is necessary for the performance of daily activities (Deepika, Akanksha, & Agarwal, 2014); Malnutrition has become an enduring concern of the World Health Organization for some decades (Ullah et al., 2014). In Pakistan, two out of five children are malnourished under five years of age (Olaf & Michael, 2005). In developing countries, malnutrition is important factor for the burden of disease. An approximate estimation about 200 million children of playgroup age are malnourished worldwide. It has been estimated that about 800 million people are malnourished worldwide and an about 852 million people were malnourished in 2000-2002 in USA (Terrence et al., 2012). It is the directly cause of about 300,000 deaths per year and is indirectly responsible for causing about half of all deaths in young children. In each year nine million children are dying under age five and malnutrition contributes to one third of these deaths (Baitun_et al., 2010). It is also

indicated in recent studies that malnutrition is a cause of an increased hospital length of stay, mortality and morbidity (Phadke et al., 1995).

The main causes of malnutrition across all over the world are poverty, poor water sanitation illiterate mothers, child birth order, exposure to unhygienic condition (Hanifa et al., 2006). Physiological factors just as isolation, tension, confusion, nervousness. Political state, season, food production, climate condition, breast feeding habit of mothers and availability and quality of health service is also major causes of malnutrition (Mishra, Bastola, & Jha, 2009).

Malnutrition includes some disorders such as marasmus, kwashiorkor and intermediate condition marasmic-kwashiorkor. There are number of biochemical parameters that are altered in these disorders. In marasmus and kwashiorkor, significant risk factors are serum electrolytes alterations that are hypokalemia, hypernatremia (John & Golden, 1977) and metabolic acidosis as intracellular Na⁺ retention (Shirin

et al., 2014). Basically, level of serum Na^+ is increased in malnourished child but contents are low due to water resorption that mask Na^+ contents whereas K^+ level is reduced in marasmus and kwashiorkor. Creatinine level is also reduced because muscle mass is decreased due to wasting. Hematological parameters like total RBC's, WBC's are also altered in marasmus and kwashiorkor. Hematological parameters are depleted during marasmus and which are directly associated with intake of less nutritious diet (Haider & Mirghani, 2015). Growth is also impaired because they experience hypocalcaemia and for linear growth Ca^{++} is very important.

The present study is aimed to compare the serum anlyates in malnourished than healthy children.

2. Materials and Methods

The present study was conceded in on children in Children Medical Complex Hospital Multan, Punjab, Pakistan. The permission was taken from the MS of Children Medical Complex Hospital. These children belonged to Multan as well as other regions of Pakistan and classified as nourished and malnourished patient. The ages of all children were 6-36 months, and reported to the Children Complex Hospital, Multan during September 15 to December 15, 2015. They were screened for severe malnutrition by using weight, height and presence of edema as described before (Lisa, Marie, & Aida, 2005); as Z score using method adopted by Zogget al. (2013).

About 300 subjects (100 marasmus, 100 kwashiorkor, and 100 controls) were selected in this study. Case histories of all patients were collected. Complete biochemical tests were performed at the department of chemical pathology of Children Medical Complex, Multan by using standard laboratory methods. Complete blood cell count is performed. Serum creatinine and electrolytes (Na^+ , K^+ and Ca^{++}) were analyzed.

2.1. Z score

Z score, is one of initial step of marasmus and kwashiorkor diagnosis, is a scheme used for examination the exactness ranking of marasmus and kwashiorkor in children. Range of Z score for nourished child was -2, while in marasmic and kwashiorkor child <-3 and <-2 (Cheryl et al., 2013).

2.2. Biochemical analysis

Platelets and RBC's count in blood were determined by the method as described by Andrew et al. (2015).

Monocytes count in blood were checked by the method as described by Jeremy et al. (2004).

Hb levels in blood were determined by the method as described by Ricardo et al. (2011).

Serum creatinine levels in blood were checked by the method as described earlier (Hankins et al., 2002).

Na^+ , K^+ and Ca^{++} levels in blood were analyzed by the method of Quamar et al. (2014).

3. Statistical Analysis

Data were analyzed by applying SPSS statistical software (Version 20). Difference in group mean was analyzed according to distribution by paired sample t-test. $P < 0.05$ was taken as significant.

Table 1: Data of Z score of control and test (marasmus and kwashiorkor)

Z score for	Score range obtained
Control (n=100)	-2 and -3
Marasmas (n=100)	< -3
Kwashiorkor (n=100)	< -2

Z score measures the severity of malnutrition on the basis of weight and height.

Table 2: Baseline characteristics of the patients (n=300)

Age group	Healthy Individuals (Frequency)	Marasmus (Frequency)	Kwashiorkor (Frequency)
6-12	15 (15%)	18 (18%)	12 (12%)
13-18	30 (30%)	20 (20%)	30 (30%)
19-25	35 (35%)	32 (32%)	28 (28%)
25-36	20 (20%)	30 (30%)	30 (30%)
n=300	n=100	n=100	n=100

Table 3: Baseline characteristics of the patients (n=300)

Individuals	Male (Frequency)	Percentage (%)	Female (Frequency)	Percentage (%)
Healthy	50	16%	50	16%
Marasmus	70	23%	45	15%
Kwashiorkor	45	15%	40	13%

4. Results

4.1. Z score of control and test (marasmus and kwashiorkor)

Results of table 1 show that the range of Z score in nourished child was -2, while in marasmic and kwashiorkor child it is < -3 and < -2 respectively.

4.2. Baseline characteristics of the patients

The table 2 and 3 describes the age and sex of healthy individuals as well as of the marasmic and kwashiorkor children. It also reveals about the frequency as well as the percentages of healthy individuals and malnourished children.

4.3. The socio demographic data of malnourished mothers

The data of table 4 is mainly a socio-demograph that provides information about the major factors. Majority of mothers had 5 children and almost 6% mothers had children less than 5 year in which 4% were under nourished. By collecting information about parental education we concluded that 30% mother and 16% fathers were qualified. 160% people were poor and having income less than ten thousand. They can't afford highly nutritious diet in limited source of income. Some mothers having different diseases and they were weak. According to survey, 38% mothers were anemic. A noteworthy risk factor for malnutrition is that 60% mothers were anemic. Most of the mothers were between 18-35 years of age. 10% were older than 35years, whereas 14% were of 18 years and younger. 70% mothers are weak and their weight is less than 45 Kg. Breast feeding is not common while bottle feeding is more common and this is also a major factor of malnutrition.

4.4. Biochemical parameters of Control and marasmic children

The serum level of platelets, RBC's, monocyte, hemoglobin, creatinine, Na⁺, K⁺ and Ca⁺⁺ in nourished and marasmic child were analyzed by Paired sample t-test which showed that level of Na⁺ (t=39.6 , df=99) and creatinine (t=11.9, df=99) were significantly (P<0.05) increased in marasmic patient than control. On the other hand, platelets (t=16.81, df=99), Hb (t=20.31, df=99), Monocyte (t=21.65, df=99), K⁺ (t=19.77, df=99), Ca⁺⁺ (t=70.480, df=99) and RBCs (t=39.62,

df=99) were significantly (P<0.05) decreased in marasmic patient than control. (Table 5)

4.5. Biochemical parameters of control and kwashiorkor children

The serum level of platelets, RBC's, monocyte, hemoglobin, creatinine, Na⁺, K⁺ and Ca⁺⁺ in nourished and kwashiorkor child were analyzed by Paired sample t-test which showed that levels of Na⁺ (t=39.4 , df=99) creatinine (t=10.9, df=99), RBCs (t=-12.9, df=99), monocyte (t=-6.8, df=99) and platelets (t=-9.1, df=99) were significantly (P<0.05) increased in kwashiorkor child than control while serum levels of K⁺ (t=20.5, df=99), Ca⁺⁺ (t=20.3, df=99) and Hb (t=30.6, df=99) were significantly (P<0.05) decreased in kwashiorkor patient than control (Table 6).

5. Discussion

Malnutrition is a most important worldwide problem leading to high morbidity and mortality in individuals and also become a complicated factor for other diseases in developing countries. Marasmus and kwashiorkor are critical and devastating form of malnutrition. The risk of death is associated with the degree of malnutrition. The present study showed that major cause of malnutrition is a common factor that is parental education (Rahman & Chowdhury, 2007), the parents of malnourished child are not aware about the composition of balanced diet that is necessary for the better growth of their child. So, improper diet that is

Table 4: Socio-demographic data of malnourished mothers (n=200)

Factors	Numbers (mean)	Percentage (%)
Number of children	5	10
Number of children under 5 years	3	6
Number of child are malnourished	2	4
Education of Mother	15	30
Education of father	8	16
Income less than 10 thousand	80	160
Anemic mothers	19	38
Age greater than 35	10	10
Age less than 18	7	14
Age between 18-35	8	16
Weight of mother less than 45Kg	35	70
Breast feeding	28	56
Bottle feeding	88	176

Table 5: Biochemical parameters of Control and marasmic children

Biochemical parameters	control (n=100), (Mean ± S.D)	Test (n=100) (Mean ± S.D)
Platelets Count	243.5±29.9	187.6±8.1
Monocyte count	4.21±.71	2.0±.63
Hemoglobin level	12.7±1.6	9.2±.54
RBCs count	3.06±.020	4.4±.34
Creatinine level	0.92±0.17	0.63±0.10
Na ⁺ levels	137.9±1.52	145.2±1.89
K ⁺ levels	4.32±.49	3.02±.42
Ca ⁺ levels	8.7±.36	5.70±4.59

Values are ± S.D. All the values are significant (less than 0.05).

Table 6: Biochemical parameters of Control and kwashiorkor children

Biochemical parameters	control (n=100), (Mean ± S.D)	Test (n=100) (Mean ± S.D)
Platelets Count	238.3±51.20	349.6±87.55
Monocyte count	4.0±0.8	4.82±0.88
Hemoglobin level	12.61±1.137	8.57±0.40
RBCs count	4.59±0.231	5.14±0.35
Serum Creatinine level	0.92±0.17	0.63±0.10
Sodium level	137.2±1.52	145.2±1.89
Potassium level	4.19±0.34	2.98±0.38
Calcium level	8.94±0.68	6.04±1.125

Values are ± S.D. All the values are significant (less than 0.05).

deficient in micro and macronutrients causes serum electrolytes and blood analytes imbalancing. Parental education directly linked with the nutritional status of their child (Leslie & Hara, 1982). Our study reveals that due to improper intake of electrolytes the mean serum values of K⁺ and Ca⁺⁺ were significantly decreased and Na⁺ is increased as compared to control groups in both marasmic and kwashiorkor patients. Previous study (Shaheen et al., 2013) also showed that the mean serum values of Na⁺, K⁺ were notably decreased in malnourished cases when compared to control group that is similar to our study. Another study also reflects that K⁺, and Ca⁺⁺ level decrease in malnourished child while Na⁺ level is increased due to retention of fluid in the body (Hallgeir, Van den & Torleif, 2014);

Protein based diet is very necessary for the growing child because protein is structural component of our body.

Impairment of protein based diet can effect on the growth and decrease muscle mass (Ciliberto et al., 2005). Our study exhibited that creatinine levels were decreased in both marasmic and a kwashiorkor individual as carnitine is a muscle protein and its end product is creatinine. Urinary creatinine is decreased when muscle mass is decreased. The muscle mass is increased by taking nutritious diet (Tahmeed, Sabuktagin, & Cravioto, 2009) suggesting that muscle mass is decreased in malnourished children.

Poverty is also a major factor to cause malnutrition. Highly nutritious diet is not affordable for poor people. So, they prefer low cost diet that is mostly carbohydrate based and it is deficient to enough nutrients that are essential. Previous work showed that most of people who are labor having malnourished child that is due to poverty (Saito et al., 1997). Another Study conducted in Uganda find out that both socio-economic status and education of parents linked with health of child (Kikafunda & Tumwine, 2006);

Diet is deficient in vitamins and minerals impair the biosynthesis of different essential components present in blood and crucial for different important functions. Present study reveals that due to iron deficiency, formation of Hb as well as RBCs not taken place. So, RBCs and monocytes were significantly decreased in marasmic patient and significantly increased in kwashiorkor patient while Hb level was decreased in both diseases. Platelets also decreased in marasmic patients and significantly increased in kwashiorkor patient. Previous study also showed that Hb and RBC indices significantly decreased in malnourished patient. Another study also shows that Hb level was low in marasmus and kwashiorkor children (Abid et al., 2011).

The major risk factor for severe underweight children is parental education (Srikantia, Pargaonkar, & Vinodini, 1965); low income, child birth-order, teen age mothers, environmental and other underlying socioeconomic factors and early child-feeding practices (Bhagavan et al., 1962). Many factors have need to be modifiable by development of intervention that are much reliable and recommended family planning and Breast feeding practice to young and illiterate mothers (Younas et al., 2012).

It is concluded that different steps should be taken to treat the condition of malnutrition in children of

Pakistan. Seminars and workshop would be organized for medical practitioners for their up to date knowledge. Similarly, various developing strategies should be lounded from the government to aware the peoples regarding malnutrition, and to improve their dietetic conditions.

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