



CODEN [USA]: IAJPBB

ISSN: 2349-7750

## INDO AMERICAN JOURNAL OF PHARMACEUTICAL SCIENCES

<http://doi.org/10.5281/zenodo.3928700>

Available online at: <http://www.iajps.com>

Research Article

### CHANGES IN SERUM ELECTROLYTES AMONG MALNOURISHED CHILDREN HAVING DIARRHOEA

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**Article Received:** May 2020

**Accepted:** June 2020

**Published:** July 2020

**Abstract:**

**Objective:** To determine the frequency of electrolyte disturbances in malnourished children with and without diarrhea and whether these findings have therapeutic value or not.

**Methodology:** This is a descriptive study conducted in Pediatric department of Ayub Teaching Hospital, Abbottabad for one year duration from March 2019 to March 2020. The study included one hundred caloric malnourished children from 6 months to 5 years old, regardless of sex, admitted for diarrhea, failure to thrive, acute respiratory infection, malaria, anemia, heart failure and feeding problems. Based on the history, physical examination and anthropometric measurement, they were divided into patients from group A (n = 64) who were malnourished but had diarrhea, and patients from group B (n = 36) who were also malnourished and had no diarrhea. Serum electrolytes were taken in patients from both groups and the results were statistically analyzed.

**Results:** Analysis of serum electrolytes in both groups showed that hypokalaemia, hyponatraemia and low serum bicarbonate were more frequently observed in patients in group A than in group B. In group A, hypokalemia was observed in 40 patients (62.5%), while it was observed in 8 patients (22.22%) in group B (p <0.001), hyponatraemia was observed in 17 patients (26.56%) in group A and 5 patients (13.88%) in group B (p <0.001). In group A, 41 patients (64%) had low serum bicarbonate content, while in group B only 15 patients (41.66%) had low serum bicarbonate value (p <0.001)

**Conclusion:** Electrolyte changes were commonly observed especially in patients with grade II and III malnutrition with variable duration of diarrhea attacks. If these changes are diagnosed early and treated appropriately, morbidity and mortality may decrease.

**Keywords:** malnutrition, diarrhea, electrolyte changes.

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Please cite this article in press Zeshan Ahmad *et al*, *Changes In Serum Electrolytes Among Malnourished Children Having Diarrhoea.*, *Indo Am. J. P. Sci*, 2020; 07(07).

**INTRODUCTION:**

Malnutrition is a major problem worldwide. It interacts with diarrhea in a sterile environment that causes high morbidity and mortality in children and is a factor that makes other diseases difficult in developing countries<sup>1-2</sup>. Malnourished children have more severe diarrhea that lasts longer. The prevalence of diarrhea in children with malnutrition is 5-7 times higher than in normal children and 3-4 times more in children with malnutrition than normal children. In malnutrition, various abnormalities appear, which become more pronounced in the body's electrolytes, accompanied by diarrheal diseases<sup>3-4</sup>. Electrolytes are ionized molecules in the body's blood, tissues, and cells. It conducts an electric current and helps balance the pH and acid base level in the body<sup>5</sup>. They also facilitate the passage of fluid between and within cells through the osmosis process and play a role in regulating the function of the neuromuscular, endocrine and excretory systems.

The main serum electrolytes are:

1. Sodium- It helps to balance fluid level in the body and facilitate neuron functioning.
2. Potassium- It is the main component of cellular fluid and helps to regulate neuro- muscular function and osmotic pressure.
3. Bicarbonate- It carries negative charge and assists in regulation of blood pH. Increase or decrease in bicarbonate cause acid base disorder.

In malnutrition, various abnormalities occur in the electrolytes of the body. The most common electrolyte abnormalities are those containing sodium, potassium, bicarbonate and water. In malnutrition in an edematous state, the body's water content increases with sodium retention, which is essentially extracellular, but the serum sodium level decreases in most children with malnutrition that mask sodium overload<sup>5-6</sup>. These levels may be low depending on the associated diarrhea. Total body potassium is reduced by up to 25% in excessive malnutrition due to malnutrition and low muscle mass. Potassium is predominantly an intracellular ion necessary to maintain extensive homeostasis of normal cellular function, but only 2% of the body's content is in extra cell fluid, so plasma potassium is a weak indicator of total amount<sup>7-8</sup>. However, plasma potassium concentration is important in emergency treatment in life-threatening

hypokalemia. In malnutrition, subclinical potassium deficiency may exist without any clinical features, but these children are at risk of hypokalemia during diarrheal disease, which makes the clinical deficit clear and the patient's muscle weakness, hypotonia and paralysis<sup>9-10</sup>. Both malnutrition and electrolyte disorders are considered risk factors for death among children with diarrhea. The aim of this study was to determine the status of serum electrolytes in malnourished and non-diarrhea children so that changes in serum electrolytes could be managed to reduce the risk of death or disability<sup>11</sup>.

**METHODOLOGY:**

This is a descriptive study conducted in Pediatric department of Ayub Teaching Hospital, Abbottabad for one year duration from March 2019 to March 2020. This study of 100 cases of protein calorie malnutrition was conducted in a pediatric ward. Each child was assessed on the basis of a detailed mother / guardian history, physical examination, anthropometric measurements such as weight, height, accipitofrontal circumference and investigations in particular serum electrolytes. The nutritional status of these children was assessed on the basis of a modified Gomez classification using body weight for age as a reference and they were classified as stage I malnutrition (weight 70% -80% of the expected weight depending on age), stage II malnutrition (weight 60% - 70% of the expected weight depending on age) and stage III malnutrition (weight <60% of the expected weight for age). All information was saved on a specific form, and the data was statistically analyzed using SPSS version 18.0.

**Inclusion criteria:** Malnourished children from 6 months to 5 years old, with or without diarrhea of varying duration.

**Exclusion criteria:** Malnourished children under 6 months or older than 5 years. Malnourished children who had expired before the end of the full investigation were not included in this study.

**RESULTS:**

Out of 100 children 57 are men and 43 women. Regarding nutritional status, 12 children were in class I, 27 were in class II, and 61 were in malnutrition group III (Table I).

**Table-I: Protein calorie malnutrition status**

SEX	PCM I	PCM II	PCM III	Total
Male	9 (15.78%)	14(24.56%)	34(59.64%)	57
Female	3 (6.97%)	13(30.23%)	27(62.79%)	43
Total	12 (12%)	27 (27%)	61(61%)	100

Patients were divided into two groups (Table II). Group A includes sixty-four children with variable duration diarrhea and group B, which includes thirty-six malnourished children who did not have diarrhea. Serum electrolyte analysis showed that 22 children had hyponatraemia, i.e. serum sodium <130 milli-equivalents / L, of which 17 had diarrhea ( $p < 0.001$ ), which indicates that diarrhea has a serum sodium lowering effect whereas hypernatremia, i.e. sodium serum > 150 milli-equivalents / L present in 3 children and only one of them had diarrhea ( $p < 0.414$ ). Isonatremia was found in 75 children, 47 of whom had diarrhea. In group A, 40 children had hypokalemia, i.e. serum potassium <3.5 milli equivalents / L, and in group B, only 8 children had low K. ( $p < 0.001$ ), which indicates that diarrheal disease lowers K more often than Na. Serum bicarbonate was found in 56 children. Of these, 41 children were in group A and 15 in group B ( $p < 0.001$ ) (Table II).

**Table-II: Electrolyte Disturbances in two Groups**

<i>Electrolyte Disturbances</i>	<i>Group A (n=64)</i>	<i>Group B (n=36)</i>	<i>P. Value</i>	<i>Total (n=100)</i>
Hypokalemia	40 (62.5%)	8(22.22%)	0.000*	48(48%)
Hyponatremia	17(26.56%)	5(13.88%)	0.000*	22(22%)
Hypernatremia	1(1.56%)	2 (5.55%)	0.414	3 ( 3%)
Acidosis	41 (64%)	15(41.66%)	0.000*	56(56%)

Most electrolyte disturbances were observed in grade III (Table III) compared to grade I and II and in those who had diarrhea of varying duration. Hypernatremia was observed in 3 children with stage II malnutrition, one of whom had diarrhea.

**Table-III: Electrolyte disturbances according to PCM grades.**

<i>Serum electrolyte</i>	<i>Nutritional Status</i>							
	<i>PCM I</i>		<i>PCM II</i>		<i>PCM III</i>		<i>Total</i>	
	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>
<b><i>S. Sodium</i></b>								
Isonatremia	9	3	11	8	21	23	41	34
Hponatremia	0	0	3	2	13	4	16	6
Hypernatremia	0	0	0	3	0	0	0	3
<b><i>S. Potassium</i></b>								
Normokalemia	6	2	7	9	13	15	26	26
Hypokalemia	3	1	7	4	21	12	31	17
<b><i>S. Bicarbonate</i></b>								
Normal S.Hco <sub>3</sub>	5	1	5	5	15	13	25	19
Mild Acidosis S.HCO <sub>3</sub> 16-20 meq/l	2	0	5	4	13	7	20	11
Moderate AcidosisS.HCO <sub>3</sub> 0-15 meq/l	2	1	3	4	5	5	10	10
Sever AcidosisS.HCO <10 meq/l	0	1	0	1	2	1	2	3

**DISCUSSION:**

Diarrhea remains a serious problem in our children and can be fatal when it coincides with malnutrition. It causes loss of water and electrolytes, especially sodium, potassium and bicarbonate to a large extent. Sodium chloride and bicarbonate are the main ions that contribute to the osmolality of the extracellular fluid when potassium is in low concentration, but it is still required for normal cellular function<sup>12</sup>. Bicarbonate is the main ion that regulates the pH of the extracellular fluid. Individual ion concentrations affect the properties and behavior of the excitable membrane, such as nerve cells, and the performance of many intracellular enzymes<sup>13</sup>. In malnutrition, serum electrolytes do not reflect the body content,

only reflect circulating concentration, so an intracellular potassium deficiency with a high serum potassium mask, sodium overload with a low sodium serum mask, but it is important in emergency treatment in life-threatening situations<sup>14</sup>. Studies show that malnutrition is associated with a higher incidence and duration of acute diarrhea and is a risk factor for diarrhea and respiratory mortality. An important risk factor for fatal diarrhea in severe malnutrition includes hyponatremia, hypokalemia and metabolic acidosis. In a study from Bangladesh, the incidence of hyponatremia was reported to be directly related to the degree of malnutrition and a serious complication of diarrhea, with a 10.1% case death rate compared to isonatremia or

hypernatremia. Malnourished children have a weaker sodium balance during acute diarrhea and lose more sodium in the stool and urine during diarrhea, thereby reducing sodium balances in the body. In our study, 3 children had hypernatremia. Hypernatremia associated with malnutrition and diarrhea is associated with neurological damage and high mortality risk. Hypokalaemia impairs the function of various organs and significantly affects the cardiovascular system, neurological system, muscles and kidneys. In deep potassium deficiency, muscle paralysis may occur. Ortuno et al reported a hypokalemic-induced stroke secondary to acute diarrhea in the case series<sup>15</sup>. Hypokalaemia may be subclinical in malnourished children, but it becomes clinically evident during diarrheal disease and manifests as hypotonia, bloating, paralytic ileus, cardiac arrhythmia and respiratory distress. Our study also confirms that hypokalemia is more pronounced when diarrhea occurs. A study by Rehana found that 37% of children with acute diarrhea were hypokalemic.

### CONCLUSION:

It has been found that electrolyte disturbances in malnourished children may be subclinical, but they become obvious during diarrheal disease, and serum electrolyte measurement is helpful in immediate therapy to avoid a serious life-threatening situation.

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