



## MALNOURISHED CHILDREN WITH DIARRHEA; TO ASSESS THE FREQUENCY OF SERUM ELECTROLYTES (Na<sup>+</sup>, K<sup>+</sup> & Ca<sup>+</sup>) DISTURBANCES

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### Article received on:

04/02/15

### Accepted for publication:

21/02/15

### Received after proof reading:

06/05/2015

**ABSTRACT...Objectives:** "To assess the frequency of serum electrolytes (Na<sup>+</sup>, K<sup>+</sup> & Ca<sup>+</sup>) disturbances in malnourished children with diarrhea". **Study Design:** Cross-sectional. **Setting:** Pediatrics Department Nishtar Hospital Multan. **Period:** 01-07-2013 to 31-12-2013. **Methodology:** Approval from the institutional ethical committee was taken. Malnourished children with diarrhea admitted to Pediatrics Department Nishtar Hospital Multan were registered. Children meeting the inclusion and exclusion criteria enrolled in the study. **Results:** In this study there were 90 patients which were found to be malnourished and having diarrhea. The average age of patients was 3.28±1.2 years and the average duration of diarrhea was 4.67±0.821 days. There were 58(64.4%) males and 32(35.5%) female patients. Hyponatremia was present in 28(31.1%) patients, Hypokalemia was present in 55(61.1%) while Hypocalcemia was present in 12(13.3%). **Conclusion:** Serum electrolyte disturbances in malnourished children are obvious during diarrheal illness particularly in those patients with Grade III malnutrition and measurement of these Serum electrolytes is helpful for immediate therapy to avoid serious life threatening situations.

**Key words:** Malnutrition, Diarrhea, Serum electrolyte disturbances.

**Article Citation:** Zulqarnain A, Jaffar Z, Iqbal I. Malnourished children with diarrhea; to assess the frequency of serum electrolytes (Na<sup>+</sup>, K<sup>+</sup> & Ca<sup>+</sup>) disturbances. Professional Med J 2015;22(5):610-614.

## INTRODUCTION

Malnutrition is the leading contributor to global burden of disease in children.<sup>1</sup> Deaths attributable to malnutrition encompass 53% of all childhood deaths.<sup>2,3</sup> In Pakistan 38% of children below five years of age are malnourished.<sup>4</sup>

Malnutrition is a major problem globally.<sup>5</sup> It interacts with diarrhea in a vicious circle leading to high morbidity and mortality in children, and is a complicating factor for other illnesses in developing countries. Malnourished children have more severe diarrhea, which lasts longer. Malnutrition interacts with diarrhea in a vicious circle leading to high morbidity and mortality in children in developing countries. In a study by Syed M. Shah et al, the prevalence of diarrhea reported in Pakistan is 51%.<sup>6</sup>

The prevalence of diarrhea is 5-7 times more in malnourished as compared to normal children and its severity is 3 to 4 times greater in malnourished children as compared to normal children.<sup>7</sup> So

diarrhea continues to be a serious problem in our children and may be fatal when superimposed upon malnutrition.

In malnutrition various abnormalities occur in body electrolytes, which become more marked if accompanied by diarrhea. Diarrhea results in large losses of water and electrolyte especially sodium, potassium and bicarbonate.<sup>8</sup> However plasma potassium concentration has importance in immediate therapy in case of life threatening hypokalemia. In malnutrition sub clinical deficiency of potassium may be present without any clinical feature but these children are at risk of hypokalemia during diarrheal disease, which makes the clinical picture of deficiency obvious and patient presents with muscle weakness, hypotonia, apathy, abdominal distention, paralytic illness and serious cardiac arrhythmias.<sup>9</sup> Both malnutrition and electrolyte disturbances are considered to be risk factors for death among children with diarrhea.<sup>10</sup>

In a study by Yasmeen Memon et al, at Liaquat university hospital Hyderabad hypokalemia was seen in 62.5% while hyponatremia was seen in 26.56% patients who were having diarrhea with malnutrition.<sup>11</sup> These losses of electrolyte have importance in immediate therapy in cases of life threatening situation.<sup>12</sup> it was observed that serum electrolyte disturbances in malnourished children may be sub clinical but become obvious during diarrheal illness and measurement of Serum electrolyte is helpful for immediate therapy to avoid serious life threatening situation.

Both malnutrition and electrolyte disturbances are considered to be risk factors for death among children with diarrhea. In severe malnutrition significant risk factor for fatal diarrhea includes hyponatremia, hypokalemia and metabolic acidosis.<sup>13</sup>

The present study plans to determine the serum electrolyte status in malnourished children with diarrhea, so that serum electrolyte disturbances could be managed immediately to reduce the risk of mortality and morbidity. As it is very important to determine and then immediately correct these serum electrolytes changes to prevent the serious life threatening conditions and decrease the mortality due to diarrhea and malnutrition.

## MATERIAL AND METHOD

**Study Design** Cross-sectional.

### Place and Duration of Study

Pediatrics Department Nishtar Hospital Multan. Before starting the study permission from the ethical committee of hospital was taken. Non-probability Purposive Sampling

Children from 6 months to 5 years of age, both male and female with diarrhea that are passing of more than 3 watery stools per day for more than 3 days.

Malnourished children in which weight of child less than 80% of expected weight for age.

## DATA COLLECTION PROCEDURE

Malnourished children with diarrhea admitted to Pediatrics Department Nishtar Hospital Multan registered. Informed consent from the parents, the basic demographic information including name, age, sex, address noted. Each child assessed by researcher himself, by taking detailed history from mother/caregiver regarding the frequency and duration of diarrhea and measure the weight of patient. Blood sample for serum electrolytes (Na, K, Ca) drawn by researcher himself under aseptic measures and sent to Nishtar hospital laboratory.

The nutritional status of these children assessed by Modified Gomez classification using weight for age as reference and they categorized into grade I malnutrition (weight 70%-80% of expected weight for age), grade II malnutrition (weight 60%-70% of expected weight for age) and grade III malnutrition (weight <60% of expected weight for age). All the information recorded on a specified Performa.

All the computations carried out by using the statistical package of social sciences SPSS 20. Descriptive measures like mean and standard deviation computed for the quantitative variables like age of the children under study and duration of diarrhea. While frequency and percentage computed for the gender (male/female), serum electrolytes changes (low/normal/high) and grade of malnutrition (grade I,II,III) in the patients under study.

Control of confounding done by making cross matched stratified tables for age & duration of diarrhea & Grade of Malnutrition.

## RESULTS

In this study there were 90 patients which were found to malnourished and having diarrhea. The average age of patients was  $3.28 \pm 1.200$  years and the average duration of diarrhea was  $4.67 \pm 0.821$ .; there were 58(64.4%) males and 32(35.5%) female patients. Regarding malnutrition 11(12.2%), 22(24.4%) and 57(63.3%) patients were of Grade-I, Grade-II and Grade-III degree respectively. Electrolyte disturbances in serum found that low sodium level (Hyponatremia) was

present in 28(31.1%) patients while high serum sodium levels were present only in 3(3.3%) patients. Regarding serum potassium levels low potassium level (Hypokalemia) was present in 55(61.1%) patients while high serum potassium level was present only in 1(1.1%) patients.

Regarding serum calcium levels low potassium level (Hypocalcemia) was present in 12(13.3%) patients while high serum calcium level was present only in 1(1.1%) patients. Stratification for degree of Malnutrition shown that hyponatremia was present in 28(31.1%), hypokalemia in 55(61.1%) patients while hypocalcemia in 12(13.3%) with Grade III malnutrition

<b>Mean</b>	<b>4.67</b>
Std. Deviation	0.821
Minimum	4
Maximum	6

**Table-I. Descriptive Statistics for duration of Diarrhoea (in days) in study group (n=90)**

Mal Nutrition	Sodium			Potassium			Calcium		
	Low	Normal	High	Low	Normal	High	Low	Normal	High
<b>Grade I</b>	0 (0.00%)	11 (12.2%)	0 (0.00%)	0 (0.00%)	10 (11.1%)	1 (1.1%)	0 (0.00%)	10 (11.1%)	1 (1.1%)
<b>Grade II</b>	0 (0.00%)	20 (22.2%)	2 (2.2%)	0 (0.00%)	22 (24.4%)	0 (0.00%)	0 (0.00%)	22 (24.4%)	0 (0.00%)
<b>Grade III</b>	28 (31.1%)	28 (31.1%)	1 (1.1%)	55 (61.1%)	2 (2.2%)	0 (0.00%)	12 (13.3%)	45 (50.0%)	0 (0.00%)

**Table-IV. Stratification of Serum Electrolytes according to Grade of Malnutrition**

than 15% of their days with diarrhoea. About 80% of deaths due to diarrhoea occur in the first two years of life. The main cause of death from acute diarrhoea is dehydration, which results from the loss of fluid and electrolytes in diarrhoeal stools.

It results in large losses of water and electrolyte especially sodium, potassium and bicarbonate. Sodium chloride and bicarbonate are the major ions contributing to osmolality of extracellular fluid while potassium is in low concentration but nevertheless is essential for normal cell function. Bicarbonate is the major ion that regulates the pH of extracellular fluid. The concentrations of individual ion influence the properties and behavior of excitable membrane such as nerve

Malnutrition	Frequency	Percentages
Grade I	11	12.2%
Grade II	22	24.4%
Grade III	57	63.3%

**Table-II. Frequency table of Malnutrition in Study group (n=90)**

Serum Electrolytes	Low	Normal	High
Sodium	28(31.1%)	59(65.6%)	3(3.3%)
Potassium	55(61.1%)	34(37.8%)	1(1.1%)
Calcium	12(13.3%)	77(85.5%)	1(1.1%)

**Table-III. Frequency table of Serum Electrolyte Disturbances in Study group(n=90)**

## DISCUSSIONS

Diarrhoea is a leading cause of illness and death among children in developing countries, where an estimated 1.3 thousand million episodes and 4 million deaths occur each year in under-five children. An average of 3.3 episodes each year per child occur worldwide, but in certain areas this average exceeds nine episodes each year. In these areas, young children may spend more

cell and performance of many intracellular enzymes.

In malnutrition serum electrolytes do not reflect the body content but only the circulating concentration, thus high serum potassium mask intracellular potassium deficiency while low serum sodium mask sodium overload but they have importance in immediate therapy in cases of life threatening situation.<sup>14</sup> Studies show that malnutrition is associated with increased incidence and duration of acute diarrhoea and is a risk factor for diarrhoea and respiratory mortality.

In this study patients were in the age of  $3.28 \pm 1.20$  years and the average duration of diarrhea was

4.67±0.82. It is noted that electrolyte disturbance mostly affect the serum potassium particularly hypokalemia seen in 55(61.1%), sodium imbalance hyponatremia is seen in 28(31.1%) while calcium imbalance hypocalcemia is seen in 12(13.3%) cases. The most important finding is that these electrolyte abnormalities were mostly found in Grade III malnourished patients.

In the study by Rehana 37% children with acute diarrhea were found to be hypokalemic.<sup>15</sup> Sarfraz M in 1989 from Rawalpindi, Pakistan has reported hypokalemia in 25% of cases.<sup>16</sup> Majeed R from Hyderabad, Pakistan in 2001 had found 30% of children having hypokalemia with acute watery diarrhoea.<sup>17</sup> However in a study by Yasmeen Memon et al, at Liaquat university hospital Hyderabad hypokalemia was seen in 62.5% patients who were having diarrhea with malnutrition. Our study also confirms that hypokalemia is more marked when there is diarrhea associated with malnutrition. Hypokalemia alters function of several organs and prominently affects the cardiovascular system, neurological system, muscle and kidney. In profound potassium deficiency muscle paralysis can occur.<sup>18</sup> Ortuno et al reported hypokalemic induced paralysis secondary to acute diarrhoea in their case series.<sup>19</sup> Hypokalemia may be sub clinical in malnourished children but during diarrhoeal illness it becomes obvious clinically and manifests as hypotonia, abdominal distension, paralytic ileus, cardiac arrhythmia and respiratory distress.

As in our study sodium imbalance hyponatremia is seen in 28(31.1%) cases and it is directly related with degree of malnutrition, the same results were found in a study at Bangladesh. In a study by Yasmeen Memon et al, at Liaquat university hospital Hyderabad hyponatremia was seen in 26.56% patients who were having diarrhea with malnutrition. Malnourished children have poor sodium balance during acute diarrhea and they lose more sodium in their stool and urine during diarrhea so that their total body sodium balance is diminished. In our study hypernatremia was present in 3 cases. Hypernatremia in children as

with diarrhea is associated with risk of neurological damage and high mortality.<sup>20</sup>

## CONCLUSION

This Cross sectional study concludes that serum electrolyte disturbances in malnourished children are obvious during diarrheal illness particularly in those patients with Grade III Malnutrition irrespective of Age and duration of Diarrhea. Measurement of these Serum electrolytes is helpful for immediate therapy to avoid serious life threatening situations.



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