

# The Serum Sodium, Potassium and Calcium Levels in Children 6-59 Months of Age with Severe Acute Malnutrition

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## ABSTRACT

**Aim:** To study the serum sodium, potassium and calcium levels in cases of SAM and their comparison in cases with and without diarrhea

**Methods:** This cross sectional study was conducted in the pediatric unit II, Bahawal Victoria Hospital, Bahawalpur from January 2016 to June 2016 in children having age between 6 to 59 months admitting with a diagnosis of SAM. The patients were divided into two groups, Group A with diarrhea and group B without diarrhea. Blood was taken for serum sodium, potassium and calcium.

**Results:** 100 patients were included. Their mean±SD age in months was 23.56±3.80. 62% were males. Serum sodium (mean±SD) was 138.46±4.14 mmol/L, potassium 3.961±0.691 mmol/L and calcium 8.359±0.61 mg/dl. 67 cases presented with (Group A) while 33 without diarrhea (Group B).

The serum sodium (mean±SD) was 138.51±4.22 mmol/L in group A while 138.36± 4.05 in group B (p 0.1), the potassium 3.89±0.67 in group A while 4.1±0.72 in group B (p 0.009) and calcium (mg/dL) 8.39±0.6 in group A while 8.34 ±0.73 mg/dL in group B (0.71). There was isolated hyponatremia in 10.4% cases in group A and 9.1% in group B (p 0.83) while isolated hypokalemia in 26.9% cases in group A and 18.2% in group B (p 0.34).

**Conclusion:** Electrolytes disturbances are common in SAM with or without diarrhea.

**Keywords:** Severe acute malnutrition; Diarrhea; electrolytes; hyponatremia; hypokalemia.

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## INTRODUCTION

Malnutrition involves imbalance between availability of nutrients and energy and their requirements by the body for the normal growth and body tissue functions<sup>1</sup>. Malnutrition is the number one contributor to childhood illnesses globally<sup>2</sup>. The most common form of malnutrition in children is protein energy malnutrition which is defined as a pathological condition characterized by insufficient intake of calories and proteins. There were 6.9 million deaths in children under the age of 5 years worldwide in 2011, out of which one third were due to increased vulnerability of illnesses in protein energy malnutrition. There are about 178 million children under 5 years of years who are stunted, 55 million wasted and out of these 19 million are severely affected and at a high risk for death<sup>3</sup>. Severe acute malnutrition (SAM) is the most serious form of undernutrition. It is a common cause of mortality and morbidity especially in the form of intellectual impairment in children. There are about 20 million children below the age of 5 years who suffer from SAM globally. Pakistan is at number five among the countries having high number of cases of SAM<sup>4</sup>.

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Electrolyte imbalance is one of the causes of mortality among these children<sup>1</sup>. These children may have low total body potassium as well as low serum potassium but usually have total high levels of sodium in spite of low serum sodium levels<sup>5</sup> and may have normal serum calcium level<sup>6</sup>. The diarrhea is the most common cause of complication of SAM and is associated with higher risk of mortality as compared to children without diarrhea in SAM<sup>7,8</sup>. Serum electrolyte disturbances in malnourished children may be sub clinical but become obvious during diarrheal illness<sup>9</sup>. Since SAM know the serum electrolytes status in SAM with and without diarrhea.

The objective of the study was to estimate the serum sodium, potassium and calcium level in cases of SAM and with their comparison in cases with and without diarrhea.

## METHODS AND MATERIAL:

This cross sectional study was conducted in the pediatric unit II, Bahawal Victoria Hospital, Bahawalpur from January 2016 to June 2016. The study was approved from the local ethical committee. The informed verbal consent was taken from the parents/guardian after briefing them about the nature and purpose of the study. The children having age between 6 to 59 months admitting with a diagnosis of SAM were included. The diagnosis of SAM was

made if one or more than one of the following feature were present in the child<sup>10</sup>.

- Weight-for-length/height less than minus 3SD (wasted).
- Mid-upper arm circumference less than 115mm.
- Edema of both feet (kwashiorkor with or without severe wasting).

The children with liver disease, renal disease, children on diuretic therapy or who died before the completion of investigations were excluded from the study. The demographic data (name, age, sex) and history of diarrhea was taken from the parents/guardian. The patient was said to have diarrhea if he/she passed three or more than three loose stools in the last 24 hours<sup>10</sup>. The patients were divided into two groups, Group A with diarrhea and group B without diarrhea. 2ml venous blood was collected from patients under aseptic conditions and was sent to the Biochemical Section of the Pathology Department, Quaid-e-Azam Medical College within one hour of collection of the sample. The blood was allowed to clot and serum was separated by centrifugation at 5000 rpm for 5 minutes. The serum was analyzed for sodium, potassium and calcium levels by spectrophotometric method. Hyponatremia and hypernatremia was labeled if serum sodium was less than was less than 135 mmol/L and more than 145 mmol/L, hypokalemia and hyperkalemia if serum potassium less than 3.5 mmol/L and more than 5.5mmol/L, hypocalcemia and hypercalcemia if serum calcium was less than 7.5mg/dl and more than 10.5 mg/dl.

The data was entered and the analysis was done by SPSS version 10. The mean and standard

deviation were calculated for quantitative data while percentages were calculated for qualitative data. The quantitative data was compared by student t test while qualitative data was compared by chi square test. P value less than 0.5 was taken as significant

## RESULTS

There were 100 patients with SAM included in the study. Their mean  $\pm$  SD age in months was 23.56 $\pm$ 13.80. 62 (62%) were males and 38(38%) were females. The mean  $\pm$  SD serum sodium was 138.46 $\pm$ 4.14 mmol/L, potassium was 3.961  $\pm$  0.691 mmole/L and calcium was 8.359 $\pm$ 0.61mg/dl. 67(67%) cases presented with diarrhea (Group A) while 33 (33%) without diarrhea (Group B).

There were 26 (38.8%) females in group A while 12 (36.4%) in group B (p value 0.81). The mean  $\pm$  SD age ( in months) was 23.73  $\pm$  12.65 in group A while 23.21 $\pm$ 16.1 in group B ( p value 0.86), the mean  $\pm$  SD serum sodium ( in mmol/L) was 138.51  $\pm$  4.22 in group A while 138.36 $\pm$  4.05 in group B ( p value 0.1), the mean  $\pm$  SD potassium (mmol/L) was 3.89  $\pm$  0.67 in group A while 4.1 $\pm$  0.72 in group B ( p value 0.009) and the mean  $\pm$  SD calcium ( mg/dL) was 8.39  $\pm$  0.6 in group A while 8.34  $\pm$  0.73 in group B ( p value 0.71).

Total as well as well group A and Group B cases with isolated hyponatremia, isolated hypokalemia, isolated hypocalcemia and combined hyponatremia with hypokalemia are shown in table-I. There was no case of isolated or in combination hypernatremia, hyperkalemia, hypercalcemia

Table 1: Electrolyte abnormalities

Electrolyte abnormality	Group A (n= 67)	Group B (n=33)	n	P value
Cases with isolated hyponatremia (%)	7 (10.4%)	3 (9.1%)	10 (10%)	0.83
Cases with isolated hypokalemia (%)	18 (26.9%)	6 (18.2%)	24 (24%)	0.34
Cases with both hyponatremia and hypokalemia (%)	1 (1.4%)	0 (0%)	1 (1%)	0
Cases with isolated hypocalcemia	1 (1.4%)	0 (0%)	1 (1%)	0

## DISCUSSION

The children included in this study were having SAM, a form of severe malnutrition associated with high rate of mortality. Other available studies<sup>9,11,12,13</sup> did not address specifically SAM except one study done by Sameen et al<sup>14</sup> who included only cases of SAM but that study also included the children below six months of age. Memon et al<sup>9</sup> noted that most of the cases with electrolyte imbalance were belonging to Grade III manutrition of modified Gomes classification.

The mean  $\pm$  SD age in months was 23.56 $\pm$ 13.80 in this study. The mean age noted in the study by Bilal

et al (11) was 1.9 $\pm$ 1.4 years and 3.28 $\pm$ 1.2 years in the study by Zulqarnain et al<sup>13</sup>.

There were 62% were males in this study. Other studies<sup>9,11,13</sup> also showed male dominant pattern. There were 57% males in the study by Memon et al 2007<sup>9</sup>, 61.3% in the study by Bilal et al<sup>11</sup> and 64.4% in the study by Zulqarnain et al<sup>13</sup>.

There were 67% cases presented with diarrhea while 33% without diarrhea. Memon et al<sup>9</sup> showed that 64% cases were having diarrhea.

There were 10% cases of hyponatremia in this study while Bilal et al<sup>11</sup> reported hyponatremia in 32.5% cases, Kamberi et al<sup>12</sup> in 18.10% cases, Sameen et al<sup>14</sup> in 22.6% cases and Zulqarnain et al<sup>13</sup> in 31.1%.

There were isolated hyponatremia in 7(10.4%) cases with diarrhea and 3(9.1%) cases without diarrhea (p value 0.83). Memon et al<sup>9</sup> noted hyponatremia in 26.56% cases having malnutrition with diarrhea while in 13.88% cases having malnutrition without diarrhea (p<0.001). Memon et al<sup>9</sup> used serum sodium level <130mmol/L as hyponatremia while our study used serum sodium less than 135 as hyponatremia.

There were 24% cases of hypokalemia in this study while Bilal et al<sup>11</sup> reported hypokalemia in 55% cases, Kamberi et al<sup>12</sup> in 33.62% cases, Sameen et al (14) in 13.7% cases and Zulqarnain et al<sup>13</sup> in 61.1% cases. There were 26.9% children with SAM and diarrhea having isolated hypokalemia and 18.2% children with SAM and without (p value 0.34). Memon et al<sup>9</sup> noted hypokalemia in 62.5% cases having malnutrition with diarrhea while 22.22% cases in having malnutrition without diarrhea (p<0.001).

There was no case of hypernatremia or hyperkalemia noted in this study while Memon et al<sup>9</sup> showed that hypernatremia (serum sodium > 150 mmol/L) was present in three children and only one of these had diarrhea (p<0.414) but none of the cases had hyperkalemia. Bilal et al<sup>11</sup> did not report any case of hypernatremia or hyperkalemia.

There was only 1.34% cases of hypocalcemia in this study while 13.1% in the study by Zulqarnain et al<sup>13</sup>. In brief, hypokalemia and hyponatremia are common in this study like in other studies.

## CONCLUSION

Electrolytes disturbances are common in SAM with or without diarrhea.

## REFERENCES

- 1- WHO/FAO Expert Committee. WHO Tech. Rep. Ser. 1973;No. 522
- 2- Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJL. Selected major risk factors and global and regional burden of disease. *Lancet* 2002; 360:1347–60
- 3- Bhutta ZA, Salam RA. Global nutrition epidemiology and trends. *Ann Nutr Metab.* 2012;61 (Suppl 1):19-27.
- 4- Ahmed T, Hossain M, Mahfuz M, Choudhury N, Hossain MM, Bhandari N, et al.
- 5- Severe acute malnutrition in Asia. *Food Nutr Bull.* 2014;35(2 Suppl):S14-26.
- 6- Meffat ME, Longstaffe S, Besant J, Dureski C. Prevention of iron deficiency and psychomotor decline in high risk infants through use of iron fortified infant formula. A randomized clinical trial. *J Pediatr.* 1994;125: 527-34.
- 7- Frenk S, Pérez-Ortíz B, Murguía T, Fajardo J, Velasco R, Sanabria T. Serum-ionized calcium in Mexican protein-energy malnourished children. *Arch Med Res.* 2000;31(5): 497-9.
- 8- Talbert A, Thuo N, Karisa J, Chesaro C, Ohuma E, Ignas J, et al. Diarrhoea complicating severe acute malnutrition in Kenyan children: a prospective descriptive study of risk factors and outcome. *PLoS One.* 2012;7(6):e38321.
- 9- Irena AH, Mwambazi M, Mulenga V. Diarrhea is a major killer of children with severe acute malnutrition admitted to inpatient set-up in Lusaka, Zambia. *Nutr J.* 2011;10:110.
- 10- Memon Y, Majeed R, Ghani MH, Shaikh S. Serum electrolytes changes in malnourished children with diarrhoea. *Pak J Med Sci* 2007;23(5):760-4.
- 11- World Health Organization. Pocket book of hospital care for children: guidelines for the management of common childhood illnesses. 2nd ed. Geneva: World Health Organization; 2013.
- 12- Bilal A, Sadiq MA, Haider N. Frequency of hyponatraemia and hypokalaemia in malnourished children with acute diarrhoea. *J Pak Med Assoc.* 2016;66(9):1077-1080.
- 13- Kamberi TH, Azemi M, Avdiu M, Jaha VI, Uka VG. Malnourished Children with Acute Diarrhea. *Arch Dis Child* 2012; 97 (Suppl 2): 302724.0675.
- 14- Zulqarnain A, Jaffar Z, Iqbal I. Malnourished children with diarrhea; to assess the frequency of serum electrolytes (Na+, K+ & Ca+) disturbances. *Professional Med J.* 2015;22(5):610-614.
- 15- Sameen I, Moorani KN. Morbidity patterns of severely malnourished children at tertiary care hospital. *Pak Pediatr J* 2014;38(1):3-8.