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ELECTROLYTE DISTURBANCES AMONG CHILDREN UNDER FIVE YEARS OF AGE WITH PRIMARY MALNUTRITION

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Abstract

Objective: *To determine the frequency of electrolyte disturbances among children under five years of age with primary malnutrition presenting to a tertiary care hospital.*

Methods: *A hospital-based cross-sectional study was conducted in the Department of Pediatrics, Madina Teaching Hospital, Faisalabad, from May to October 2024. A total of 100 children under five years of age fulfilling the eligibility criteria were enrolled through non-probability consecutive sampling. Demographic and clinical information was collected using a structured proforma. Anthropometric assessment was performed according to the World Health Organization Child Growth Standards. Serum sodium, potassium, calcium and magnesium levels were measured, and electrolyte abnormalities were identified using laboratory reference ranges. Data were analyzed using SPSS version 26.0.*

Results: *The reported mean age was 22.63 ± 12.71 months, and 62 (62%) participants were male. Diarrhoea was reported in 69 (69%) children, fever in 67 (67%), anorexia in 65 (65%), vomiting in 35 (35%) and acute respiratory infection in 57 (57%). Severe acute malnutrition was reported in 33 (33%) children, while 22 (22%) had moderate acute malnutrition. Stunting, underweight and wasting were reported in 59 (59%), 42 (42%) and 8 (8%) children, respectively. Overall, 93 (93%) children were reported to have at least one electrolyte disturbance. Hypokalemia was the most frequent abnormality (70%), followed by hypocalcemia (57%), hyponatremia (33%) and hypomagnesemia (28%).*

Conclusion: *Electrolyte disturbances appear to be an important concern in children with malnutrition, with hypokalemia being the most frequently reported abnormality.*

INTRODUCTION

Malnutrition remains a major health problem among children under five years of age, particularly in low- and middle-income countries. Inadequate dietary intake, recurrent infections, poverty, and poor feeding practices contribute to impaired growth and increase the risk of morbidity and mortality in young children.[1,2] Severe forms of malnutrition are associated with profound metabolic and physiological changes that can adversely affect multiple organ systems.[3]

Electrolyte disturbances are common but may remain clinically unrecognized in malnourished children. Depletion of intracellular potassium and magnesium, altered sodium balance, and abnormalities of calcium can occur as a consequence of inadequate intake, gastrointestinal losses, altered renal handling, and metabolic adaptation to prolonged nutritional deficiency.[4,5] Hypokalemia is particularly frequent and may lead to muscle weakness, abdominal distension, cardiac arrhythmias, and increased risk of death.[6]

Sodium abnormalities are also frequently reported, especially among malnourished children with diarrhoea or dehydration. Importantly, serum sodium levels may not accurately reflect total body sodium stores in severe malnutrition, making careful assessment and management essential.[4,7] Hypocalcemia and hypomagnesemia may occur concurrently and can further contribute to neuromuscular and cardiac complications.[8]

Studies from South Asia have reported a high frequency of electrolyte abnormalities among malnourished children, with hypokalemia, hyponatremia, and hypocalcemia among the commonly observed disturbances.[7,9,10] However, the pattern and frequency of these abnormalities may vary according to nutritional severity, associated illnesses, dietary intake, and gastrointestinal losses.

Early recognition of electrolyte disturbances is therefore important for appropriate management and prevention of potentially serious complications. The present study was conducted to determine the **frequency and pattern of electrolyte disturbances among children under five years of age with primary malnutrition** presenting to the pediatric department of Madina Teaching Hospital, Faisalabad.

Methodology:

A hospital-based cross-sectional study was conducted in the Department of Pediatrics, Madina Teaching Hospital, Faisalabad, from May to October 2024. The sample size was calculated using the WHO sample size calculator based on a previously reported prevalence of electrolyte imbalance of 93.5% among children with severe acute malnutrition in Pakistan, with a 95% confidence level and margin of error = 5%. The calculated sample size was then 100 used for participant enrollment.

Children under five years of age who presented to the pediatric department and fulfilled the predefined criteria for primary malnutrition were enrolled through non-probability consecutive sampling. Children with chronic renal, hepatic, cardiac, endocrine or metabolic disorders, congenital abnormalities, malignancy, chronic gastrointestinal disease, or other conditions that could independently affect nutritional status or electrolyte levels were excluded. Written informed consent was obtained from the parents or legal guardians before enrollment.

Demographic and clinical information, including age, sex, feeding history, diarrhoea, vomiting, fever, dehydration and other relevant clinical features, was recorded on a structured proforma. Anthropometric assessment included measurement of weight, length or standing height, and mid-upper arm circumference where appropriate. Nutritional status was assessed according to the WHO Child Growth Standards.

A venous blood sample was obtained from each participant under aseptic conditions and analyzed for serum sodium, potassium, calcium and magnesium levels. Electrolyte abnormalities were defined according to the age-appropriate reference ranges of the hospital laboratory. Serum sodium below 135 mEq/L was considered hyponatremia and potassium below 3.5 mEq/L was considered hypokalemia, while hypocalcemia and hypomagnesemia were defined according to the laboratory reference ranges.

Data were entered and analyzed using SPSS version 26.0. Quantitative variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Ethical approval was obtained from the institutional committee, and confidentiality of participant information was maintained throughout the study.

Results:

A total of 100 children under five years of age were included in the study. The mean age of the participants was 22.63 ± 12.71 months. Of the total participants, 62 (62.0%) were male, while 38 (38.0%) were female, indicating a male predominance in the study population (Table 1).

Regarding clinical characteristics, diarrhoea was reported in 69 (69%) children, vomiting in 35 (35%), and fever in 67 (67%). Anorexia was observed in 65 (65%) children, while acute respiratory infection was present in 57 (57%). Assessment of nutritional status showed that 22 (22%) children had moderate acute malnutrition and 33 (33%) had severe acute malnutrition based on mid-upper arm circumference (MUAC). Stunting was observed in 59 (59%) children, underweight in 42 (42%), and wasting in 8 (8%) children (Table 2).

Electrolyte analysis revealed that 93 (93%) children had at least one electrolyte disturbance. Hypokalemia was the most frequently reported abnormality, affecting 70 (70%) children, followed by hypocalcemia in 57 (57%), hyponatremia in 33 (33%), and hypomagnesemia in 28 (28%) children. These findings indicate that electrolyte disturbances were common among the study population, with hypokalemia being the predominant abnormality (Table 3).

The mean serum sodium level was 135.65 ± 4.27 mEq/L, while the mean serum potassium level was 2.89 ± 0.80 mEq/L. The mean reported serum calcium level was 7.70 ± 1.03, and the mean reported serum magnesium level was 1.93 ± 0.43 (Table 4). The units for calcium and magnesium should be verified against the original laboratory records before manuscript submission.

Important note: These results reproduce the figures in your tables. As the figures were previously derived from published literature rather than verified participant-level data, they should not be presented as findings from your own study until confirmed against your actual dataset.

Table 1. Sociodemographic characteristics (n=100)

Characteristic	n (%)/ (mean ± sd)
Mean age (months)	22.63 ± 12.71
Male	62 (62.0%)
Female	38 (38.0%)

Table 2. Clinical characteristics and nutritional status of children with malnutrition (n=100)

Clinical characteristic	n(%)
Clinical features	
Diarrhoea	69 (69%)
Vomiting	35 (35%)
Fever	67 (67%)
Anorexia	65 (65%)
Acute respiratory infection	57 (57%)
Nutritional status	
Moderate acute malnutrition (MUAC-based)	22 (22%)
Severe acute malnutrition (MUAC-based)	33 (33%)
Stunting	59 (59%)
Underweight	42 (42%)

Wasting	8 (8%)

Table 3. Frequency of electrolyte abnormalities (n=100)

Electrolyte abnormality	n(%)
Any electrolyte disturbance	93 (93%)
Hypokalemia	70 (70%)
Hypocalcemia	57 (57%)
Hyponatremia	33 (33%)
Hypomagnesemia	28 (28%)

Table 4. Mean serum electrolyte levels

Parameter	mean ± SD
Sodium (mEq/L)	135.65 ± 4.27
Potassium (mEq/L)	2.89 ± 0.80
Calcium (as reported, mEq/L)	7.70 ± 1.03
Magnesium (as reported, mEq/L)	1.93 ± 0.43

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DISCUSSION

Malnutrition remains a major cause of childhood morbidity, particularly in low- and middle-income countries. The present study examined the clinical profile and electrolyte abnormalities among 100 children under five years of age with malnutrition. The mean age was 22.63 ± 12.71 months, and males accounted for 62% of participants. This age distribution is comparable to findings from Raza et al., who reported a mean age of 22.63 ± 12.71 months and male predominance among children with severe acute malnutrition in Karachi.[6] The similarity highlights the vulnerability of young children to nutritional deficiencies, although the populations should be considered comparable only after confirming the underlying study data.

Clinically, diarrhoea was reported in 69% of children, fever in 67%, anorexia in 65%, vomiting in 35%, and acute respiratory infection in 57%. The frequent occurrence of gastrointestinal symptoms is clinically important because diarrhoea and vomiting can aggravate fluid and electrolyte losses in already malnourished children. Khan et al. also reported diarrhoea in 66% of children with severe acute malnutrition in Multan.[11] Similarly, Bilal et al. found substantial electrolyte disturbances among malnourished children presenting with acute diarrhoea.[12] These findings support the close relationship between malnutrition, intercurrent infections and disturbances in fluid balance. However, differences in patient selection and clinical severity may explain variations in the reported frequencies.

Regarding nutritional status, 22% of children were classified as having moderate acute malnutrition and 33% as having severe acute malnutrition based on mid-upper arm circumference (MUAC). Stunting was reported in 59%, underweight in 42%, and wasting in 8%. These indicators represent different aspects of undernutrition and should not be interpreted as mutually exclusive categories. The World Health Organization recommends standardized anthropometric assessment, including MUAC and weight-for-height or length, to identify and classify acute malnutrition.[13,14] The relatively high proportion of stunting suggests that chronic nutritional deprivation may coexist with acute illness in this population. Nevertheless, these proportions require confirmation using the original anthropometric measurements and WHO classification criteria.

The principal finding reported in the study tables was that 93% of children had at least one electrolyte disturbance. Hypokalemia was the most frequent abnormality (70%), followed by hypocalcemia (57%), hyponatremia (33%) and hypomagnesemia (28%). These findings are broadly consistent with the study by Azizullah et al. in Nawabshah, which reported electrolyte disturbances in 93.4% of children with severe acute malnutrition. Their reported frequencies of hypokalemia, hypocalcemia, hyponatremia and hypomagnesemia were 70.08%, 56.52%, 32.60% and 28.26%, respectively.[15] The close similarity between the two sets of figures is notable; however, the current study values must be verified against the original dataset before this comparison can be interpreted as independent replication.

Other Pakistani studies have also demonstrated substantial variation in electrolyte abnormalities among malnourished children. Ayaz et al. reported hypokalemia in 68%, hypocalcemia in 35% and hyponatremia in 14% of children with severe acute malnutrition in Peshawar.[16] Khan et al., in contrast, reported hypokalemia in 23% and hyponatremia in 28% of their study population.[11] Differences in nutritional severity, associated illnesses, diagnostic thresholds, laboratory methods and referral patterns may contribute to these variations. Laghari et al. and Memon et al. likewise examined electrolyte disturbances in malnourished children with and without diarrhoea, emphasizing the importance of gastrointestinal illness when interpreting biochemical abnormalities.[17,18]

The mean serum sodium level was 135.65 ± 4.27 mEq/L, potassium was 2.89 ± 0.80 mEq/L, calcium was reported as 7.70 ± 1.03, and magnesium as 1.93 ± 0.43. These values are identical to those reported by Raza et al. in their study of 184 children with severe acute malnutrition.[6] This exact correspondence requires verification before the values can be attributed to the present sample. Raza et al. also documented a high frequency of hypokalemia and hypocalcemia, supporting the clinical importance of biochemical assessment in severe malnutrition.[6] Dakshayani et al. reported hyponatremia in 43.4% of children with severe acute malnutrition, although their observed hypokalemia frequency was substantially lower than that reported here.[19]

Routine assessment of serum electrolytes should be considered in children with severe malnutrition, particularly when diarrhoea, vomiting or other acute illnesses are present. Abnormalities should be managed according to established paediatric and WHO guidance, with careful monitoring during nutritional rehabilitation.[13,14] The strengths of the proposed study include its hospital-based assessment, use of anthropometric measurements and evaluation of four major electrolytes. Its limitations include the cross-sectional design, single-centre setting, consecutive non-probability sampling and inability to establish causal relationships.

Conclusion:

Electrolyte disturbances are an important concern among children under five years of age with malnutrition. Hypokalemia was the most frequently reported abnormality, followed by hypocalcemia, hyponatremia and hypomagnesemia. The coexistence of gastrointestinal symptoms and infections may further increase the risk of electrolyte imbalance. These findings highlight the importance of

appropriate nutritional assessment, timely electrolyte evaluation and prompt management of identified abnormalities, particularly in children with severe malnutrition.

Conflict of Interest: Nil
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