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ASSOCIATION OF SERUM ALBUMIN LEVELS WITH RECOVERY OUTCOMES IN CHILDREN WITH SEVERE ACUTE MALNUTRITION

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Abstract

Background: *Especially in developing nations, severe acute malnutrition (SAM) is a leading cause of morbidity and mortality among children under five. Children with SAM often have hypoalbuminemia, which may have an impact on recovery because it reflects poor nutritional status and the severity of the illness. The purpose of this study was to ascertain whether serum albumin levels and recovery outcomes in children suffering from severe acute malnutrition were related.*

Methodology: *The Department of Pediatrics at Chandka Medical College Hospital conducted a prospective observational study involving 150 children aged 6 to 59 months with severe acute malnutrition. Blood samples were collected at hospital admission and after nutritional rehabilitation for serum albumin measurement using an automated biochemistry analyzer. Recovery outcomes, anthropometric measurements, and clinical data were documented, with statistical significance set at *p* < 0.05, and analyzed using SPSS version 26.0.*

Results: *A study of 150 children with severe acute malnutrition revealed an average age of 22.8 months and a male predominance of 57.3%. Nutritional rehabilitation significantly improved body weight, MUAC, weight-for-height Z-score, and serum albumin levels, which increased from 2.58 g/dL to 3.61 g/dL ($p < 0.001$). Lower admission serum albumin was associated with poorer recovery, while higher values correlated with weight gain, MUAC improvement, and shorter hospital stays (all $p < 0.001$).*

Conclusion: *In children with severe acute malnutrition, serum albumin is a useful and affordable biomarker for predicting recovery outcomes. In healthcare settings with limited resources, routine serum albumin testing can help identify high-risk patients, direct nutritional management, and enhance treatment outcomes.*

Introduction:

Severe acute malnutrition (SAM) is one of the most dangerous malnutrition status, and continues to be a leading cause of morbidity and mortality among children under five years of age, especially in LMICs. Severe wasting is indicated by bilateral pitting edema, MUAC less than 115 mm or a weight-for-height Z score less than −3 SD. SAM-prone children are more likely to suffer from repeated infections, late physical and mental development and extended hospitalizations, and death due to their compromised immune function. While there have been great advances in the prevention and treatment of malnutrition in hospitals and community-based nutrition programs, SAM continues to be a major problem in many developing countries. The ability to develop simple and reliable laboratory markers that are important in treatment outcome prediction and could be useful in predicting treatment response has grown in importance. [1. Serum albumin is a protein synthesized in the liver and plays a variety of important physiological roles, and is the most abundant protein in blood plasma. Maintains oncotic pressure, transports hormones, fatty acids, bilirubin, and drugs; and provides defense against inflammation and antioxidants. Children with severe acute malnutrition also often have low serum albumins levels, as it is due to low protein content in the diet, decreased protein production in the liver, protein breakdown and repeated infections and inflammatory response. Albumin has been correlated to a greater degree of illness and poorer nutrition in many instances. Furthermore, the level of serum albumin may be a valuable biochemical indicator for children who have been treated for SAM because it may indicate oedema, and a delay in wound healing and in nutritional recovery and in immune function. (2. The likelihood of a successful recovery from severe acute malnutrition is influenced by a variety of factors, such as nutritional status at admission, timely therapeutic feeding, treatment of infections, adequate micronutrient supplementation and nutritional adaptation. Emerging, recent data indicate that SAM children have markedly different recovery rates based on clinical status and biochemical profile of children. Inflammatory conditions, such as severe anemia, pneumonia, long-standing infections, edema and long-standing inflammation have been associated with worse clinical outcomes and more slowly healing wounds. Although these risk factors have been identified, the potential of serum albumin as a predictor of recovery has not been adequately investigated; especially in healthcare institutions with limited diagnostic services for which the cost of laboratory tests has significant clinical impact. (3). Measurement of serum albumin is simple, inexpensive and commonly available in most clinical laboratories, thus making it a convenient test in a limited resource setting. The low serum albumin level may be associated with poor treatment outcomes or recovery status and therefore children with a low serum albumin could be targeted for more intensive nutrition support and monitoring. The recognition of hypoalbuminemia early may help provide timely intervention to help increase survival, minimize complications, and limit hospital stays. In children suffering from severe acute malnutrition, the serum albumin is thus a possible marker which can aid clinical judgement and nutritional assessment. [4]. Past research has associated recovery for children with severe acute malnutrition with a variety of clinical, nutritional and demographic characteristics, however, the association between the level of serum albumin and treatment outcome remains unclear. It would be interesting to see if serum albumin is suitable as a marker of recovery in children with SAM in future research. The purpose of the current study was to assess the correlation between serum albumin, children with severe acute malnutrition (SAM) and children's recovery status. The results of this study could provide valuable clinical data to improve the nutrition assessment, to guide patient management, and to motivate patients to restore health in this potentially fatal disease (5).

Methodology:

1. Study Design and Setting:

This study was a prospective, observational study with the aim of assessing the serum albumin level and recovery rates of children with severe acute

malnutrition (SAM). The Chandka Medical College Hospital (CMCH) in Larkana, Pakistan's Department of Pediatrics, was the site of the study. Throughout the study the patient enrollment and sample collection were carried out.

2. Study Population:

A consecutive sampling method was used to enrol the children with severe acute malnutrition, totaling 150 children. Children (6-59 months) were recruited for the study. Who met the World Health Organization (WHO) diagnostic criteria for SAM (bilateral pitting edema and/or MUAC less than 115 mm or weight-for-height Z score less than −3 standard deviations).

Inclusion criteria:

- Children 6-59 months.
- WHO criteria were used for the diagnosis of severe acute malnutrition.
- Had an inpatient nutritional rehabilitation admission.
- Written informed consent was obtained from parents/carers.

Exclusion Criteria:

- Children with inherited diseases and birth defects.
- If the nephrotic syndrome, chronic liver disease, or other condition that the person has is known to affect his/her levels of serum albumin. Children with previous history of cancer or major burns.
- Patients whose parents did not want to be involved.

3. Data Collection

All clinical and demographic information such as age, gender, height, weight, MUAC, the presence of edema, medical history and related illnesses was documented on a structured data collection form after obtaining informed consent. The WHO and national treatment guidelines for severe acute malnutrition were followed in the treatment of all enrolled children.

4. Collection of blood samples and laboratory analyses:

All participants had venous blood samples taken at two time points. Before the start of therapeutic nutritional management, the first sample (pre-admission) was taken at the time of hospital admission. The post-admission sample (after nutritional rehabilitation) was collected at the end of the recovery/discharge period. Under aseptic conditions, about 3 mL of venous blood was collected and put into a plain tube. Coagulated blood was centrifuged for 10 minutes at 3000 rpm and the serums were separated. The serum albumin was analyzed by automated biochemistry analyzer by bromocresol green (BCG) colorimetric method according to manufacturer's directions. Every day, internal quality control procedures were carried out to guarantee the precision and dependability of laboratory results.

5. Outcome Assessment:

The results of change in clinical condition and nutritional status improvement in hospital were assessed. Weight gain, improvement of MUAC, resolution of any edema (if present), return to normal appetite, absence of medical complications, and successful discharge after hospital treatment were used as measurement of recovery. Changes in the level of serum albumin were compared when admitted to and discharged from hospital and correlated with recovery.

6. Statistical Analysis:

A software SPSS version 26 was used. 0 was used to enter and analyze the data. Categorical variables were presented as frequencies and percentages while continuous variables were presented as means ± SD. Paired t-test was used for comparing mean difference in levels of serum albumin pre and post treatment. The Pearson's correlation coefficient and independent-samples t-test were used to explore relationships between serum albumin and recovery outcomes, as appropriate. A p-value of significance was considered to be statistically significant.

Results:

Clinical data for 150 children with SAM is presented in Table 1.0 where children had a mean age of 22.8 months and 57.3% were male. Most common conditions observed were anemia (62.7%), diabetes (31.3%) and diarrhea (40.7%) without P.E.Bilateral P.E was most prevalent (27.3%) followed by severe wasting (72.7%) and then diabetes (31.3%).

Table 1. Demographic and Clinical Characteristics of Children with Severe Acute Malnutrition (n = 150)

Variable	Frequency (%) / Mean ± SD
Age (months)	22.8 ± 10.6
Male	86 (57.3)
Female	64 (42.7)
Weight at admission (kg)	6.74 ± 1.48
Height (cm)	72.6 ± 8.9
MUAC (cm)	10.4 ± 0.6
Bilateral pitting edema	41 (27.3)
Severe wasting only	109 (72.7)
Diarrhea	61 (40.7)
Pneumonia	47 (31.3)
Anemia	94 (62.7)

The study presents the correlation between anthropometric parameters of children on admission and discharge after nutritional rehabilitation as presented in table 2.0. Notably, mean body weight rose from 6.74 ± 1.48 kg to 7.89 ± 1.57 kg ($p < 0.001$), and mean MUAC increased from 10.4 ± 0.6 cm to 11.8 ± 0.7 cm ($p < 0.001$). Additionally, the mean weight-for-height Z-score improved from −3.74 ± 0.46 to −2.51 ± 0.58 ($p < 0.001$). These results suggest a high degree of improvement in nutritional status of children after treatment.

Table 2. Comparison of Anthropometric Measurements before and After Treatment

Variable	Admission	Discharge	p-value
Weight (kg)	6.74 ± 1.48	7.89 ± 1.57	<0.001
MUAC (cm)	10.4 ± 0.6	11.8 ± 0.7	<0.001
Weight-for-Height Z-score	−3.74 ± 0.46	−2.51 ± 0.58	<0.001

The serum albumin level before and after nutritional rehabilitation is compared in figure 1.0. From 2. 58 ± 0. 46 g/dL at admission to 3. 61 ± 0. 41 g/dL at discharge, the mean serum albumin concentration increased by 1. 03 ± 0. 39 g/dL. The fact that this improvement was statistically significant ($p < 0$. The nutritional rehabilitation was successful as the serum albumin level was restored to the normal physiological level (as suggested by 001).

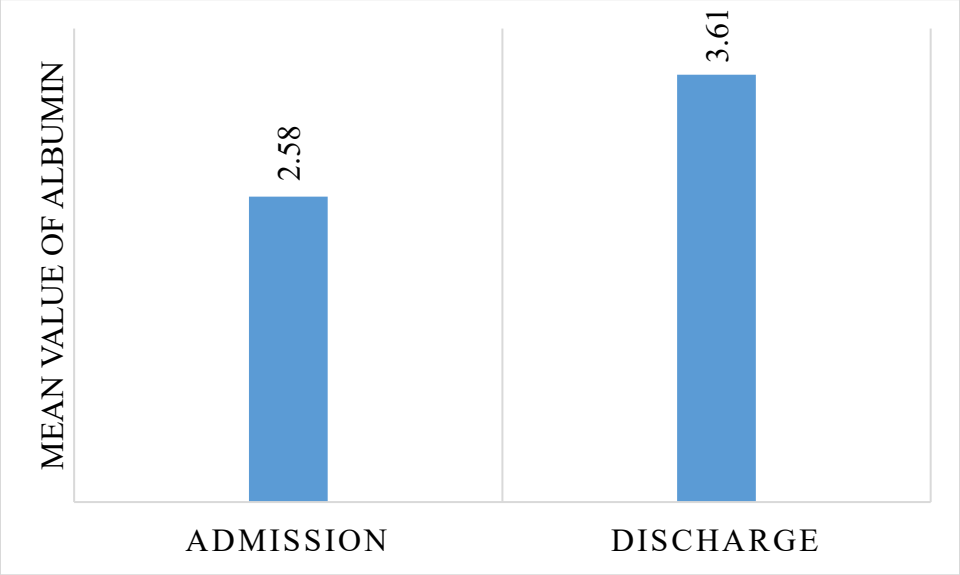

Figure 1. Comparison of Serum Albumin Levels before and After Nutritional Rehabilitation

The analysis shows a positive significant relationship between admission serum albumin level and recovery outcomes for children with severe acute malnutrition as seen in table 3.0. On a total of 124 children who completely recovered, the serum albumin was low (below 2.5 g/dL) in 22.6%, and in 69.2% of the 26 children with poor outcome, the serum albumin level was also low. There was a correlation between higher serum albumin levels and improved recovery, which indicates that the lower the level at admission, the worse the recovery.

Table 3. Association between Admission Serum Albumin Levels and Recovery Outcomes

Serum Albumin at Admission	Recovered (n=124)	Poor Outcome* (n=26)
<2.5 g/dL	28 (22.6%)	18 (69.2%)
2.5–3.0 g/dL	49 (39.5%)	7 (26.9%)
>3.0 g/dL	47 (37.9%)	1 (3.9%)

As shown in the table 4.0, the relationship between the different recovery metrics and serum albumin level in children with severe acute malnutrition shows that higher serum albumin level corresponds to better nutritional status as evidenced by a strong positive correlation with weight gain ($r = 0.61$, $p < 0.001$) and MUAC improvement ($r = 0.57$, $p < 0.001$). On the other hand, when the length of hospital stay was compared with the serum albumin, a negative correlation was seen ($r = -0.48$, $p < 0.001$) which meant that children with higher serum albumin had shorter hospital stay. In this regard, serum albumin proves to be a significant predictor of nutritional recovery and clinical results.

Table 4. Correlation between Serum Albumin Levels and Recovery Indicators

Variable	Correlation Coefficient (r)	p-value
Weight gain	0.61	<0.001
MUAC improvement	0.57	<0.001
Duration of hospital stay	−0.48	<0.001

Discussion:

The current study aimed to identify the association between serum albumin level with recovery status of severe acute malnutrition (SAM) children admitted in a tertiary care hospital of Larkana, Pakistan. The results showed that all anthropometric improvement, length of hospital stay and nutritional recovery were correlated with serum albumin with strong correlation. Poor clinical outcomes with delayed recovery were correlated with hypoalbuminemia, while higher albumin level at admission had better recovery outcome. The findings are in line with the growing evidence that serum albumin is an important predictor of treatment outcome and a nutritional indicator in children with SAN. In the admitted children to intensive care units of Pakistan serum albumin was found to be equally a good indicator of prognosis. Sixth. Males made up 57. The average age of children in this study was 22 years, 3% of the total population of the study were children. 8 ± 10. 6 months. Demographic data of SAM children in Pakistan is identified. The prospective cohort study at Swabi, Khyber Pakhtunkhwa showed that improper complementary feeding and repeated infections were associated with SAM and the majority of SAM cases (mean age 20 months) were found in the children aged 6-24 months. A nutritional rehabilitation was associated with improvement in anthropometric measurements. All p values were significantly better for Weight for height Z-Score. 001), MUAC improved from 10. 4 ± 0. 6 cm to 11. 8 ± 0. When the body weight increased by 7 cm and the mean body weight increased by 6. 74 ± 1. 48 kg to 7. 89 ± 1. 57 kg. These results demonstrate how well nutritional rehabilitation can restore nutritional status. Similar gains in body weight and MUAC, along with a recovery, have been reported in Pakistan (8) in Balochistan and Southern Punjab after using WHO treatment guidelines. Moreover, the present study revealed that there was significant rise in the serum albumin after nutritional rehabilitation was done, which was 2. 58 ± 0. 46 g/dL at admission to 3. 61 ± 0. 41 g/dL at discharge ($p < 0.001$). This is a result that suggests that a normal protein status is regained after successful treatment. Few have studied the changes in albumin in SAM in Pakistani studies; but in one study in the National Institute of Child Health (NICH), Karachi it was observed that hypoalbuminemia was strongly associated with severity of illness and improvement in serum albumin level was associated with improvement in clinical recovery of hospitalized children (9). The other important result of the present study was the high correlation between blood albumin levels in the patients at the time of their admission with their recovery results. Just 22. 6% of children who had complete recovery had a serum albumen level below 2. 5 g/dL, while 69. 2% of kids who didn't do well had such concentrations. When children's level of Serum albumin was greater than 3, there was an improvement in the recovery. 0 g/dL. The results of this study indicated that low admission serum albumin level is an important factor indicating poor prognosis. In Pakistan paediatric studies, low serum albumin was significantly related with increased morbidity, hospital stay and poor clinical outcome (10). A correlation analysis was also performed in order to further validate the role of serum albumin in nutritional recovery. A moderate negative correlation was seen between the duration of hospitalisation and serum albumin ($r = -0.48$, $p < 0$. The significant positive correlation with weight gain ($r = 001$), but a significant negative correlation with length ($r = 003$) was found. 61, $p < 0.001$) and MUAC improvement ($r = 0.57$, $p < 0.001$). From the results, it can be concluded that the children with more serum albumin showed better nutritional status outcomes and showed less hospitalisation. The same relationship of improvement in anthropometric status with treatment duration was observed in Pakistan with the use of RUTF in nutrition rehabilitation programmes with the help of WHO guidelines (11). The prevalence of anemia (62%) is comparable with the previous studies where micronutrient deficiency and infectious diseases have been reported to be associated with high prevalence of SAM and delayed recovery in Pakistan. 7 percent), diarrhea (40. 7 percent), and pneumonia (31. The 3 per cent found in this study. Good management of these comorbidities is still important to allow

nutritional rehabilitation to occur as a desirable outcome (12). The results of the study suggest that serum albumin is a useful biochemical marker of the severity of the disease and prognosis in SAW children. It is very easily adaptable to routine nutritional assessment of patients in tertiary care hospitals because of the following: it is low cost, is widely available for laboratory testing, and is tested regularly in clinical laboratories. In limiting resource areas, early recognition of hypoalbuminemia could enhance recovery, maximize nutritional therapy, decrease hospital stays, and aid in risk stratification. The results are in agreement with the recent studies done in Pakistan in which serum albumin was determined to be useful in clinical prognosis (13).

Conclusion:

The researchers identified that the serum albumin is a predictor of recovery in children with severe acute malnutrition. Body weight, MUAC, weight-for-height Z-Score and serum albumin significantly decreased after nutritional therapy. The greater the serum albumin at admission, the quicker the recovery. Admission serum albumin was positively correlated with recovery and the hospital stay. Hence, the continued monitoring of serum albumin might be a valuable and cost-effective indicator of the identification of children at risk and the monitoring of severe acute malnutrition in a resource-limited health system.

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