ORIGINAL RESEARCH PAPER
Volume-9 | Issue-1 | January-2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

PREDICTORS OF MORTALITY IN CHILDREN WITH SEVERE ACUTE MALNUTRITION (SAM): A PROSPECTIVE OBSERVATIONAL STUDY IN NORTHERN INDIA

Paediatrics

Rana Chanchal — Consultant, Paediatrician, U. K.

Siddhartha Koonwar* — Department Of Paediatrics, King George's Medical University, Lucknow, India *Corresponding Author

Chandrakanta — Department Of Paediatrics, King George's Medical University, Lucknow, India

Sarvesh kumar — Department Of Community Medicine, Govt. Medical College, Datia, Madhya Pradesh, India

Sarika Gupta — Department Of Paediatrics, King George's Medical University, Lucknow, India

ABSTRACT

OBJECTIVE: The aim of the study was to find out the impact of different clinical and biochemical features on the final outcome in a child with SAM.

MATERIALS AND METHODS: Study was conducted in Department of Pediatrics, King George Medical University, Lucknow, a tertiary care teaching hospital in Northern India. It was a prospective observational study done over one year. Patients with World Health Organization (WHO) defined SAM from 6 months to 5 years were included in the study. A data collection form was designed and all the details were recorded in it. Standard statistical methods of analysis were used.

RESULTS: A total of 65 patients were enrolled during the study period of 1 year, out of which 69.2% of patients were discharged, 15.4% expired whereas in 15.4% the final outcome was not recorded as the patients went LAMA or absconded. The hospital stay of patients ranged from 6-21 days with mean and SD (10.22±4.20) days and median 10 days. We found direct association of final outcome with hypothermia (OR = 4.67, CI (1.05-20.67), p=0.042). Whereas skin manifestation (OR = 4.00, CI (0.95-16.87), p=0.059) increases the risk of bad outcome but not significantly. Apart from this the CNS status of the patient has a significant effect (OR=4.67, CI (1.05-20.67), p=0.042) on the outcome. We also found significant and direct association of poor final outcome with hypoglycemia (OR = 5.25, CI (1.24-22.32), p=0.025) and HIV reactivity (OR = 14.37, CI (1.54-380.38), p=0.032). However, it did not (p>0.05) correlate well with other parameters.

CONCLUSION: Sensorium (GCS ≤ 8) of the patients is the only independent predictor of mortality in patients with severe acute malnutrition.

KEYWORDS

Sam, Gcs.

INTRODUCTION:

Severe acute malnutrition (SAM) is defined as a weight for height ratio below -3 z-scores of the median as per the World Health Organization (WHO) growth standards, by visible severe wasting, or by presence of nutritional bilateral/generalized oedema [1]. Severe acute malnutrition remains a major cause of child mortality worldwide. While pneumonia and diarrhoea are often the final steps in the pathway, severe wasting is estimated to account for around 4 Lac child deaths each year [2]. For this reason accurate management of severe acute malnutrition is an integral part of the World Health Organization resolution on young-infant and child Nutrition to improve child survival and to reduce the global burden of disease. While there have been studies which have reported increasing mortality among children with severe acute malnutrition in several African countries, the burden of disease based on the revised growth standards has not been estimated, especially in India and other settings in South Asia. The key for initiation of this small scale observational prospective study is to bridge the gap of knowledge about burden of SAM as a disease and overcome the paucity of Indian data on the impact of different clinical and biochemical features on severe acute malnutrition and its outcome in Indian set up.

MATERIAL AND METHODS:

This was a prospective observational study for duration of 1 year between August 2014 and July 2015 conducted in the department of Pediatrics, King George's Medical University (KGMU), Lucknow, India. All children between six months to sixty months of age, who were admitted during the study period to the hospital with severe acute malnutrition as per WHO definition, were included in the study with parents/guardians consent. Patients were excluded if they had clinical rickets, renal and endocrine disorders, malabsorption and chronic diarrhoea or non nutritional causes of bipedal oedema. Subjects were classified according to the WHO criteria for SAM. Ethical clearance for this study was obtained from Ethics Committee of Research Cell of King George's Medical University, Lucknow. (Letter No. 6620 /R. Cell-15)

Clinical and laboratory procedures: The initial evaluation included data collection on a predesigned data collection form including a complete history, socioeconomic status, anthropometry, clinical history/examination. Laboratory variables including (Haemoglobin levels, Total Leukocyte Count (TLC), Differential Leukocyte Count (DLC), Platelet count, Serum electrolyte, Serum phosphate level (before feeding and on day 3 after feeding), magnesium levels (before and after feeding), Random Blood Sugar (RBS), Renal Function Test (RFT), Liver Function Test (LFT), test for HIV and X-Ray Chest.) along with type of feeding, final associated diagnoses, outcome and duration of hospital stay were also documented and reviewed timely.

Specimen collection: Consent taking and detailed explanation of the method of collection were mandatory before actual taking of the samples. After hospitalization 7 ml venous blood (2, 2, 1 ml each in EDTA, two plain vials and a fluoride vial respectively) was collected from enrolled patients using safe and aseptic technique and sent for in appropriated labs for automated counts, LFT, RFT and Random blood sugar levels respectively and rest in appropriate vials for other lab studies.

Patients' follow-up: While hospitalized, the patients were managed for malnutrition by the treating clinicians as per the hospital policies and their judgements who reviewed every child regularly for their clinical improvements and the final outcome along with complete diagnosis was recorded. The feeding details and methods were recorded in the data collection form. Clinical complications of SAM managed prophylactically and routinely as per standard protocols.

Sample size: All the patients during the study period of one year with clinically diagnosed SAM, who fulfilled the inclusion and exclusion criteria, were included in the study.

Statistical analysis: The data were entered on a Microsoft excel sheet and analysed using Epi Info 7. Continuous data were summarized as Mean ± SD while discrete (categorical) in No. and Percentage (%). Comparison of the categorical groups was done by chi-square (χ^2) test while pairing by McNemar test. Univariate and multivariate binary logistic regression analysis was carried out to assess independent predictor (s) of mortality using standard cut off values of Serum blood parameters. A p value less than 0.05 were considered statistically significant.

OBSERVATIONS AND RESULTS:

Total 65 children with SAM were recruited and evaluated. The median age of the study population was 22 month. The hospital stay was 6-21 days (mean ± SD 10.22 ± 4.20 days and median 10 days). To summarize the outcome, 45 (69.2%) patients were discharged whereas 10 (15.4%) patients expired and 10 patients absconded or took leave against medical advice (LAMA).

To find out the factors which can influence the mortality of patients in SAM, various epidemiological, clinical and laboratory parameters where analysed for their association with poor outcome of the patients. The patients whose outcomes could not be recorded (absconded /LAMA) were not include in the analysis. The association of epidemiological factors with outcome in SAM patients is summated in Table 1. However the analysis showed that none of the epidemiological factors correlated well with mortality in these patients.

The association of clinical features with the final outcome of SAM patients is summarized in Table 1. The statistics showed significant and direct association of final outcome with hypothermia (OR= 4.67, 95% CI (1.05-20.67), p=0.042). Whereas skin manifestation (OR= 4.00, 95% CI (0.95-16.87), p=0.059) increases the risk of bad outcome but not significantly. Apart from this the CNS status of the patient has a significant effect (OR=4.67, 95% CI (1.05-20.67), p=0.042) on the outcome.

Table 1: Correlation of clinical features with outcome of patients with SAM (N=55)

Clinical Features (Present/Positive)	Outcome (n, %)		Odds Ratio	CI (95%)	p-value
	Expired (10)	Discharged (45)			
Fever	08 (80.0)	23 (51.1)	3.826	(0.73-20.04)	0.112
Loose stools	4 (40.0)	14 (31.1)	1.476	(0.36- 6.06)	0.589
Vomiting	3 (30.0)	13 (28.9)	1.055	(0.24- 4.72)	0.944
Cough	3 (30.0)	12 (26.7)	1.178	(0.26-5.31)	0.831
Dyspnea	7 (70.0)	21 (46.7)	2.667	(0.61-11.64)	0.192
TB Contact	3 (30.0)	10 (22.2)	1.500	(0.33-6.89)	0.602
Past h/o Measles	1 (10.0)	11 (24.4)	0.343	(0.04-3.02)	0.336
Exclusive Breast feeding*	2 (20.0)	8 (17.8)	1.156	(0.21-6.51)	0.869
Complementary feeding#	8 (80.0)	36 (80.0)	1.000	(0.18-5.54)	1.000
Hypothermia	7 (70.0)	15 (33.3)	4.667	(1.05-20.66)	**0.042**
Dehydration	6 (60.0)	16 (35.6)	2.718	(0.67-11.08)	0.163
Oedema	2 (20.0)	5 (11.1)	2.000	(0.33-12.18)	0.452
Skin Manifestations	5 (50.0)	9 (20.0)	4.000	(0.95-16.87)	**0.059**
Vitamin A Deficiency	3 (30.0)	20 (44.4)	0.535	(0.12-2.34)	0.407
Tone (Abnormal)	6 (60.0)	23 (51.1)	1.434	(0.36-5.782	0.612
GCS ≤ 7	7 (70.0)	15 (33.3)	4.67	(1.05-20.67)	**0.042**
* For 6 months # Inadequate					

The association of blood and biochemical parameters with final outcome in patients with SAM are summarised in Table 2. The χ^2 test showed significant and direct association of final outcome with hypoglycemia (OR = 5.25, 95% CI (1.24 – 22.32), p=0.025) and HIV reactivity (OR = 14.37, 95% CI (1.54 – 380.38), p=0.032) which if present increases the risk of bad outcome significantly. However, mortality did not (p>0.05) correlate well with other parameters.

Table 2: Association of laboratory parameters with outcome of patients with SAM

Lab findings (Present)	Outcome (N = 65) (%)		Odds Ratio	Confidence Interval (95%)	p value
	Expired (10)	Dicharged (45)			
HIV (Reactive)	1 (10.0)	0 (0.0)	14.36	(1.54 – 380.38)	**0.032**
Hypoglycemia	6 (60.0)	10 (22.2)	5.25	(1.24 – 22.32)	**0.025**
Hypoalbuminemia	9 (90.0)	28 (62.2)	5.46	(0.64 – 47.01)	0.122
Hypocalcemia	7 (70.0)	19 (42.2)	3.19	(0.73 – 13.97)	0.123
Hemoglobin <10gm%	8 (80.0)	39 (86.7)	0.61	(0.10 – 3.61)	0.450
Hypokalemia	8 (80.0)	35 (77.8)	1.14	(0.21 – 6.26)	0.624

To identify, independent predictor(s) of final outcome of SAM patients univariate (crude or unadjusted) and multivariate (adjusted) logistic regression was done between outcome of SAM patients (excluding LAMA group) and other clinical and laboratory parameters and were adjusted for age, sex, residence and socioeconomic status. The results are summarised in Table 3. Among these parameters, univariate binary logistic regression analysis found sensorium, HIV status, hypothermia and random blood sugar as the significant (p<0.01) risk predictor of poor outcome in a patient of SAM. Further, in multivariate analysis, binary logistic regression analysis further revealed that only sensorium of the patient at the time of admission was a significant (p<0.05) factor, suggesting that is it an independent and significant predictor of poor outcome in these patients.

Table 3: Univariate and multivariate association of final outcome in a patient of SAM with different baseline clinical and lab parameters using binary logistic regression analysis

Predictors	Univariate (crude or unadjusted)		Multivariate (Adjusted)	
	OR (95% CI)	p value	OR (95% CI)	p-value
Age				
> 25 months	Ref	0.234	Ref	0.254
≤ 25 months	2.67 (0.51 – 14.02)		6.41 (0.26 – 156.7)	
Sex				
Female	Ref	0.892	Ref	0.737
Male	1.09 (0.27 – 4.43)		0.66 (0.06 – 7.50)	
Residence				
Urban	Ref	**0.027**	Ref	0.700
Rural	0.21 (0.05 – 0.91)		0.06 (0.01 – 1.26)	
Socioeconomic status				
Upper/Middle	Ref	0.149	Ref	0.998
Lower	Undefined		3.79 (0.00 – 0.00)	

Hemoglobin ≥ 8 gm/dl < 8 gm/dl	 Ref 0.68 (0.17 – 2.80)	0.610	 Ref 0.64 (0.06 – 6.47)	0.701
Skin manifestation No Yes	 Ref 4.00 (0.95 – 16.87)	**0.059**	 Ref 2.79 (0.12 – 63.11)	0.519
Sensorium GCS > 7 GCS ≤ 7	 Ref 4.67 (1.05 – 20.6)	**0.042**	 Ref 28.42 (1.05 – 768.0)	**0.047**
Hypothermia No Yes	 Ref 4.67 (1.05 – 20.66)	**0.042**	 Ref 0.00 (0.00 – 0.00)	0.998
RBS > 54 mg/dl ≤ 54 mg/dl	 Ref 5.25 (1.24 – 22.32)	**0.025**	 Ref 1.20 (0.07 – 21.72)	0.902
HIV Status Non reactive Reactive	 Ref 14.4 (1.54 – 380.4)	**0.032**	 Ref 6.60 (0.00 – 0.00)	0.998

DISCUSSION:

Malnutrition in children typically develops during the period from 6 to 18 months of age, when brain development and growth velocity are especially high. Infants and children are particularly susceptible to malnutrition if complementary foods have low bioavailability of micronutrients and are of low nutrient density. In addition, the nutritional status of the child will be further compromised if introduction of complementary foods are too late or too early or contaminated. The nutritional status of children can also be affected by chronic infections such as HIV and tuberculosis. It is estimated that over 2 million children worldwide are living with HIV, 90% of them in sub-Saharan Africa [3]. In a report describing children admitted to hospital in southern Africa, the prevalence of HIV in children with severe acute malnutrition was 29% and these children were more likely to die than malnourished children who were not infected with HIV [4]. Higher HIV prevalence, i.e. up to 50%, has been reported among children with severe acute malnutrition [5].

The strengths of this study is that inclusion and exclusion criteria were well defined and strictly followed during the recruitment of cases and WHO classification was used in classification of SAM patients. Whereas the limitations of the study are that, the sample size was small because of the limited study time and strict exclusion criteria. The usual tertiary care hospital scenario and the type and severity of patients reaching there may reflect a bit deviation from the actual conditions prevailing in the society. The majority of the patients had other coexisting illnesses also which also would have affected the final outcome but this weakness has to be incorporated for an otherwise good study with not much of alternative options.

In our study we tried to find out the association of various epidemiological, clinical and laboratory variable with outcome of SAM patient of all the epidemiological and clinical features only hypothermia and GCS < 8 were found to have a significant association with mortality. This observation is supported by the study done by Roy S K *et al* (2011) [6], who also concluded that hypothermia is a major risk factor for mortality among the severely-malnourished children with diarrhoea and bronchopneumonia led to the increased risk of death in children by 3.9. This is also supported by the studies done by Karim AS *et al* (2001) and Van Der Broek J M *et al* (2005) [7] [8].

We found that to some extent skin manifestations also increased mortality in these patients (OR = 4.0, 95% CI (0.95 – 16.87), p=0.059) but this association was not statistically significant and this is similar to what Kimutai *et al* (2005) concluded [9]. In their study they reported that children with dermatoses and hypomagnesaemia showed a trend for association with mortality (p=0.082 and 0.099 respectively).

Limaye CS *et al* (2010) concluded that hypomagnesaemia directly contributes to cellular alterations leading to increased mortality, morbidity and poor patient outcome in critically ill patients or it is just a marker of critical illness is not clear [10]. Our study did not show any significant association between hypomagnesaemia and mortality although it was present in 25% of patients on admission and in 45% of patients on day 3 after feeding.

Poor sensorium (GCS < 8) was also found to increase mortality significantly (p=0.021), as the GCS depressed, contributing to the percentage of expired patients from 9.4% in those having GCS > 8 to 60% in those with GCS > 8. This can be explained by the fact that depressed sensorium of magnitude of GCS < 8 is a sign of severe disease effecting neuronal involvement and can be caused by multiple underlying disease processes. So increased mortality in comatose patients can not only be contributed to SAM but also as a result of SAM being associated with other underlying pathology.

In biochemical investigations, Hypoglycaemia (OR = 5.25, 95% CI (1.24 – 22.32), p=0.025) was found to contribute to poor outcome. Hypoglycaemia may result in different clinical ways resulting in neuronal death as it is commonly known to cause brain fuel deprivation, resulting in functional brain failure (Philip E Cryer, 2007) [11]. Poor nutrition in patients of SAM results in poor immunity leading to increased infection rate resulting in turn in hypoglycemia in these patients. In our study out of total, 31% children presented with hypoglycemia. Maimuna M. Ahmed (2013) found that hypoglycemia was significantly associated with death in multivariate logistic regression (p= 0.018) [12].HIV positivity (OR= 14.37, 95% CI (0.54 – 380.4), p=0.032) was also found to be associated with poor outcome. Desta KS (2015) [13],in their study concluded that although being HIV positive was not an independent predictor of mortality in children with SAM, it was among the co-morbidities which are independent predictors of mortality. Similarly, a cohort study conducted in South-West Ethiopia by Efrem T, Meskele L, Sahle S (2010) showed mortality rate was 4(16%) among HIV infected children which was higher than the mortality rate in HIV uninfected children 14 (7.4%) [14].

Our study revealed that hypoalbuminemia, and hypokalemia did not have a significant association with the outcome. But since hypokalemia was present in 78% and 65% had hypoalbuminemia in our study their effect on mortality is needed to be studied in detail.

In a similar study by Maimuna M. Ahmed (2013) concluded that in univariate logistic regression analysis, age 6 to 12 month (OR=3.8; 95% CI=1.7 – 8.5; p= 0.001) hypothermia (OR= 2.7; 95% CI=1.3 – 5.8; p= 0.009) and dehydration (OR=3.6; 95% CI= 2.0 – 6.5; p= <0.001) were all significantly associated with death. When these factors were subjected to multivariate logistic regression analysis, they all remained to be statistically significant associated with death in malnutrition [12].

So to identify, independent predictor(s) of final outcome of SAM patients, univariate (crude or unadjusted) and multivariate (adjusted) logistic regression was done between outcome of SAM patients (excluding LAMA group) and other clinical and lab parameters, and was adjusted for age, sex, residential area (rural or urban) and socioeconomic status. Among these parameters, univariate binary logistic regression analysis found sensorium, HIV status, hypothermia and random blood sugar as the significant (p<0.01) risk predictor of poor outcome in a patient of SAM. Further, in multivariate analysis, binary logistic regression analysis further revealed only sensorium of the patient at the time of admission as significant (p<0.05). Suggesting that is it an independent and significant predictor of poor outcome in these patients.

CONCLUSIONS:

From the study we conclude that hypoglycemia, hypothermia,

depressed sensorium and HIV infection increase the risk of mortality significantly in patients of SAM and so should be monitored cautiously in these patients. We also conclude that GCS of less than 8 is independent risk factors for poor outcome in a patient of SAM.

ACKNOWLEDGEMENT:
We thank all the consultants of the department and the residents for their interest and involvement in this research. We did not receive any funds from any agency. R.C. and C. K did the study design, data collection and manuscript writing. S. K. carried out statistical analysis and performed all laboratory work. S. K. and S. G. also were involved in collecting the data and critically reviewing the manuscript. There were no conflicts of interest

REFERENCES

1. Myatt M, Khars T, Collin S. A review of methods to detect cases of severely malnourished children in the community for their admission into the community based therapeutic care programmes.Food NutriBull 2006, 27:37-23.
2. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al, Maternal and child undernutrition and overweight in low income and middle income countries, Lancet ,2013; 382, 427-51
3. Joint united Nations Programme on HIV/AIDS, AIDS epidemic update, Geneva, UNAIDS;2007
4. Fergusson P, Tomkins A. HIV prevalence and mortality among children undergoing treatment for severe acute malnutrition in Sub-Saharan Africa: a systematic review and meta-analysis.Trans. R. Soc. Trop. Med. Hyg. 2009;103:541–8.
5. B Amadi, P Kelly, M Mwiya, E Mulwazi, S Sianongo, F Changwe et al. Intestinal and systemic infection, HIV and mortality in Zambian children with persistent diarrhoea and malnutrition, J. Pediatr. Gastroenterol. Nutr 2001;325:550-4
6. Roy SK, Buis M, Weersma R, Khatun K, Chowdhury S. Risk Factors of Mortality in Severely-malnourished Children Hospitalized with Diarrhoea; J Health Popul Nutr. 2011 Jun; 29(3): 229–235
7. Karim AS, Akhter S, Rahman MA, Nazir MF. Risk factors of persistent diarrhea in children below five years of age. Indian J Gastroenterol. 2001;20:59–61.
8. van den Broek JM, Roy SK, Khan WA, Ara G, Cha-kraborty B, Islam S, et al. Risk factors for mortality due to shigellosis: a case-control study among severely-malnourished children in Bangladesh. J Health Popul Nutr. 2005;23:259–65.
9. Kimutai D, Maleche-Obimbo E, Kamenwa R, Murila F. Hypo-phosphataemia in children under five years with kwashiorkor and marasmic kwashiorkor. East African Medical Journal, 2009, July, 86(7):330–336
10. Limaye CS, Londhey VA, Nadkart MY, Borges NE. Hypomagnesemia in critically ill medical patients. J Assoc Physicians India. 2011;59:19–22.
11. Philip E. Cryer. Hypoglycemia, functional brain failure, and brain death; J Clin Invest. 2007 Apr 2; 117(4): 868–870.
12. Maimuna M. Ahmed, Adolfine Hokororo, Benson R. Kidenya, Rogatus Kabyemera, Erasmus Kamugisha. BMC Nutr (2016) 2: 49. doi:10.1186/s40795-016-0090-6
13. Desta KS. A Survival Status and Predictors of Mortality among Children Aged 0-59 Months with Severe Acute Malnutrition Admitted to Stabilization Center at Sekota Hospital Waghemra Zone. J Nutr Disorders Ther 2015,5:160. doi: 10.4172/2161-0509.1000160
14. Efrem T, Meskele L, Sahle S (2010) Treatment outcome of children with severe acute malnutrition admitted to therapeutic feeding centers in Southern Region of Ethiopia. Ethiop.J Health Dev 24:234-238