ORIGINAL RESEARCH

Risk Factors, Clinical Profile and Outcome of Severe Acute Malnutrition In Infants Below 6 Months of Age

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Received date: 23 January, 2024 Acceptance date: 27 February, 2024

ABSTRACT

Objective:This study aims to ascertain the clinical range, predictors, socio-demographic variables, and outcomes linked to severe acute malnutrition (SAM). Additionally, the findings of this study will contribute to the enhancement of the management protocol for children with similar conditions in this specific geographical region. **Methodology**: This study was conducted as a prospective observational investigation from 2021 to July 2023. The study focused on children between the ages of one month and five years who were admitted to the pediatric ward. The study included children diagnosed with severe acute malnutrition (SAM) according to the criteria established by the World Health Organisation (WHO). A classification of wasting was used for distinguishing the mild, moderate and severe wasting. A z score less than -1 was attributed to mild wasting while -2 and -3 was attributed to moderate and severe wasting. **Results**: A total of 123(62.1%) cases were not immunized. Only 27 (13.7%) children had successfully undergone the immunization process. The major symptoms were fever in 140 (70.6%) cases, 112 (56.8%) were suffering from diarrhea, and 100 (50.8%) cases of lethargy were reported. Weight loss and cough were reported in 98 (49.7%) and 94 (47.6%) cases. The mean duration of hospitalization for children with severe acute malnutrition (SAM) was found to be 19.53 ± 9.54 days, with a range of 3 to 35 days. The duration of hospitalization was significantly longer in patients who presented with shock ($P<0.05$), hypoglycemia ($P<0.05$), lethargy ($P<0.05$), and sepsis ($P<0.05$) upon admission. **Conclusion**: The prevalence of SAM is observed in children aged 6 to 24 months. The implementation of the revised World Health Organisation (WHO) guidelines for the management of hospitalized patients has demonstrated a significant reduction in mortality rates, hence achieving a satisfactory level of patient outcomes.

Keywords: Severe Acute Malnutrition, Clinical profile, risk factors

INTRODUCTION

Childhood malnutrition is a prominent public health issue in India and is a substantial factor in the mortality of children under five. These children have a greatly elevated risk of both mortality and morbidity [1]. In the context of India, it is observed that a significant proportion of approximately 57 million children experience moderate to severe malnutrition, which contributes to over 50% of mortality cases within the age range of 0-4 years. Furthermore, it is worth noting that a significant proportion of children under five, specifically 48%, experience stunted growth due to acute malnutrition [2]. A large percentage of children under the age of five in the nation show indicators of undernutrition, according to the results of the National Family Health Survey-4 performed in India. According to the report, around 21% of these kids have moderate to severe wasting, 38.4% of them are stunted, and 35.7% of them are underweight [3]. The results of the National Family Health Survey-5, which was carried out in Jammu and Kashmir, show that roughly 21% of children under the age of five in this area are considered to be underweight. Additionally, 9.7% of these kids are classified as severely wasting, and 26.9% are stunted [4].

The issue of malnutrition in children is a pressing concern, with multiple reasons identified as contributing to this catastrophe. These variables include insufficient and unsuitable food consumption, childhood illnesses, detrimental childcare practices,

low literacy levels, poverty, and high population density. There is limited evidence to suggest that the sex of the child, religion, or living conditions significantly influence the prevalence of undernutrition [1]. The prevalence of undernutrition tends to decrease as the level of maternal education increases,indicating a positive correlation between the educational attainment of mothers and their nutritional well-being. The prevalence of stunting and undernutrition is greater in rural regions compared to metropolitan areas [1].

The management of severe acute malnutrition (SAM) follows a standardized inpatient treatment protocol consisting of ten phases, as outlined in the revised guidelines 2016 [5]. Using ready-to-use therapeutic foods, specifically F-75 and F-100, has enhanced the practicality of community-based management strategies. Notwithstanding the implementation of this standardized care routine, the death rate among hospitalized patients remains substantial, ranging from 10% to 40% [5], and the underlying causes for this phenomenon have yet to be fully understood. The potential reasons for the observed outcomes in children with severe acute malnutrition (SAM) may include the presence of many co-morbidities, inadequate adherence to the treatment protocol, suboptimal management practices, and other socio-demographic factors. In India, it has been observed that malnutrition is linked to about one-third of mortality cases among children under the age of five [3]. The observed phenomenon could potentially be attributed to alterations in both innate and adaptive immunity, which may arise from shortages in essential nutrients and micronutrients [6]. In addition to these factors, comorbidities such as anemia, diarrhea, dehydration, hypoglycemia, hypothermia, electrolyte imbalance, and sepsis significantly contribute to elevated death rates [7].

Despite the significant incidence of malnutrition and its status as a primary contributor to death among children under the age of five, there exists a dearth of comprehensive data about the clinical manifestations and factors influencing Severe Acute Malnutrition (SAM) in the state of Odisha, as well as the broader eastern region of India [8]. This study aims to ascertain the clinical range, predictors, socio-demographic variables, and outcomes linked to severe acute malnutrition (SAM). Additionally, the findings of this study will contribute to the enhancement of the management protocol for children with similar conditions in this specific geographical region.

METHODOLOGY

This study was conducted as a prospective observational investigation from 2021 to July 2023 in tertiary care hospital, Gadag Institute of Medical Sciences, Gadag, Karnataka, India. The study focused on children between the ages of one month and five years who were admitted to the pediatric ward. The study included children diagnosed with severe acute malnutrition (SAM) according to the criteria established by the World Health Organisation (WHO) [9]. All children diagnosed with severe acute malnutrition (SAM) were subsequently admitted to the pediatrics ward or the nutritional rehabilitation center.The exclusion criteria consisted of childrenwho were discharged from the hospital before the completion of their treatment and were affected by secondary malnutrition, which includes conditions such as malabsorption syndromes. Additionally, children with congenital heart disease, metabolic disease, kidney and lung disease were also excluded.

Weight and length measurements were obtained for children under two using a Salter hanging scale and length board.Weight and length measurements for kids between the ages of two and five were taken using a stadiometer and a weighing scale. A classification of wasting was used for distinguishing the mild, moderate and severe wasting. A z score less than -1 was attributed to mild wasting while -2 and -3 was attributed to moderate and severe wasting. On the left arm, the midpoint between the olecranon process and acromion was used to measure the mid-upper arm circumference (MUAC).

Anaemia is characterized by a hemoglobin (Hb) level below 12 g/dL in individuals under 6 months and below 11g/dL in individuals aged 6 months to 5 years. Hypoglycemia is characterized by a blood glucose concentration below 54 mg/dL. Laboratory analyses were conducted to facilitate the diagnostic process and to rule out prevalent illnesses and their related co-morbidities. All the children in the SAM cohort were administered treatment following the latest guidelines provided by the World Health Organisation (WHO) [10].

Predictors of severe acute malnutrition (SAM) were assessed considering age, sex, socio-economic status, immunization status, feeding practices, perinatal history, socio-demographic factors, household characteristics, and environmental history. Additionally, the presence of various symptoms and conditions, including fever, diarrhea, vomiting, weight loss, edema, dehydration, visible severe wasting, cough, cold, anemia, shock, hypoglycemia, hypothermia, sepsis, and electrolyte imbalance, were considered as predictors of the outcome of SAM, specifically the likelihood of recovery or death.

The criteria for discharge encompassed several factors, including a minimum weight gain of 15%, resolution of pedal edema (if present), and attainment of weight-for-height measurements at either -1 standard deviation or -2 standard deviations, as determined by age and gender.

The calculation of descriptive statistics was performed using SPSS software version 21, developed by IBM Corp, located in Armonk, NY. The data were condensed and presented in the form of frequency tables. The comparison of variables was conducted through the utilization of logistic regression analysis. A P-value below the threshold of

0.05 was deemed to be statistically significant.

RESULTS

According to the data presented in Table 1, a significant proportion of children diagnosed with severe acute malnutrition (SAM) were found to fall between the age range of 6 to 24 months, specifically accounting for 129 (65.5%) cases of the total sample size. Most of the study population comprised the male gender (108, 54.6%). Most children in the SAM sample, specifically 191 (96.5%), are from a lower socio-economic background. A total of 123(62.1%) cases were not immunized. Only 27 (13.7%) children had successfully undergone the immunization process. The major symptoms were fever in 140 (70.6%) cases, 112 (56.8%) were suffering from diarrhea, and 100 (50.8%) cases of lethargy were reported. Weight loss and cough were reported in 98 (49.7%) and 94 (47.6%) cases. Table 2 displays the social risk factors commonly connected with children suffering from Severe Acute Malnutrition (SAM). 157 (79.1%)children in the study were not exclusively breastfed, while 157 (88.2%) children started complementary feeding before 6 months. Additionally, 138 (77.55%) infants were bottle-fed. Meanwhile, low birth weight was reported in 157 (79.1%). Furthermore, 115 (58.2%) infants lived in kutcha houses, and 131 (66.4%) did not have access to safe drinking water. These factors were significant risk factors for developing severe acute malnutrition (SAM) in children, with a statistical significance of $P<0.05$. In the context of univariate analysis, it was shown that all the components mentioned above exhibited a statistically significant odds ratio. We observed 69 (34.8%) young mothers, defined as those under 20. However, the analysis found no statistically significant association between young maternal age and unfavorable outcomes, as indicated by a p-value greater than 0.05. The prevailing comorbidities linked to malnutrition are presented in Table 3. Table 4 presents a comprehensive overview of the factors linked to the outcome of children affected by Severe Acute Malnutrition (SAM). Various factors were shown to be related to bad outcomes, including nutritional risk factors in 107 (58.1%) cases, edematous malnutrition in 38 cases (20.5%), as well as symptoms such as lethargy, pneumonia, hypothermia, and shock observed at the time of admission. The mean duration of hospitalization for children with severe acute malnutrition (SAM) was found to be 19.53 ± 9.54 days, with a range of 3 to 35 days. The duration of hospitalization was significantly longer in patients who presented with shock ($P<0.05$), hypoglycemia ($P<0.05$), lethargy ($P<0.05$), and sepsis ($P<0.05$) upon admission. Out of the overall sample size of 198 children diagnosed with severe acute malnutrition (SAM), a significant proportion of 183 (92.4%) children successfully underwent treatment. They were subsequently released, whereas a smaller number of 15 (7.6%) cases unfortunately resulted in mortality. Septicemia is responsible for almost 25% of mortality cases.

Table 1: Demographic parameters and vital symptoms

Parameters	Total Number (N; %)
Age	
> 24 to 59 months	56 (28.4-%)
6 to 24 months	129 (65.5%)
< 6 months	13 (6.5%)
Gender	
Male	108 (54.6%)
Female	90 (45.5%)
Socio-economic Status	
Upper	2 (1%)
Upper Middle	5 (2.5%)
Lower middle	28 (14%)
Upper lower	123 (61.8%)
Lower	40 (20.2%)
Status of Immunization	
Non immunized	123 (62.1%)
Incomplete	48 (24.2%)
Complete	27 (13.2%)
Symptoms	
Signs of Vitamin deficiency	55 (27.7%)
Fever	140 (70.6%)
Hair changes	49 (24.6%)
Diarrhea	112 (56.8%)
Skin Changes	70 (35.6%)
Vomiting	101 (51%)

Visible severe wasting	66 (33.4%)
Cough and Cold	94 (47.6%)
Dehydration	30 (15.4%)
Weight Loss	98 (49.7%)
Lethargy	100 (50.8%)
Edema	57 (28.7%)

Table 2: Associated Social Risk factors

	Total (N;%)	**Odd ratio**	**p-value**
Maternal age at the time of childbirth			
> 30 years	13 (6.7%)	0.068	0.98
21 to 30 years	116 (58.5)	refrence	
< 20 years	69 (34.8%)	1.233	0.076
Feeding Method			
Katoori spoon	34 (19.1%)		
Bottle feeding	138 (77.5%)	4.235	0.0012
Both	6 (3.4%)		
Duration of exclusive birth feeding			
≥ 6 months	41 (20.9%)	reference	
< 6 months	157 (79.1%)	4.765	0.004
Colustrum			
Not given	112 (56.6%)	reference	
Given	86 (43.4%)	0.236	0.78
Prelacteal feed			
Not given	81 (40.9%)	reference	
Given	117 (59.1%)	1.356	0.456
Age of starting complementary feeding			
> 12 months	4 (2.3%)	3.654	0.654
6 to 12 months	17 (9.5%)	reference	
< 6 months	157 (88.2%)	6.785	0.0032
Birth weight of Child			
≥ 2.5 kg	41 (20.9%)	reference	
< 2.5 kg	157 (79.1%)	3.783	0.012
Safe drinking water status			
Absent	131 (66.4%)	3.546	0.0043
Present	67 (33.6%)	reference	
Type of house			
Pakka house	83 (41.8%)	1.376	0.023
Kutcha house	115 (58.2%)	reference	

Table 3: Prevalence of Co-morbidities

Co-morbidities	**Total (N; %)**
Acute gastroenterotis	89 (44.9%)
Acute respiratory tract	88 (44.4%)
Sepsis	54 (26.7%)
Urinary tract infection	51 (25.7%)
Malaria	9 (4.5%)
Measles	6 (3%)
Tuberculosis	6 (3%)
Otitis Media	5 (2.5%)

Table 4: Association of Socio-demographic, clinical symptoms of SAM

Parameters	Outcomes		p-value
	Cured (N=183)	Death (N= 15)	
Socioeconomic Status			0.08
Lower	3 (1.7%)	0 (0%)	
Upper lower	50 (27.4%)	6 (38.5%)	
Lower Middle	73 (40.2%)	8 (53.8%)	
Upper middle	52 (28.2%)	1 (7.7%)	
Upper	5 (2.6%)	0 (0%)	
Housing and Environmental risk factors			0.988
Absent	120 (65.8%)	2 (15.4%)	
Present	63 (34.2%)	13 (84.6%)	
Complete immunization			0.98
No	36 (19.7%)	3 (23.1%)	
Yes	147 (80.3%)	12 (76.9%)	
Socio-demographic risk factors			0.086
Absent	180 (98.3%)	6 (38.5%)	
Present	3 (1.7%)	9 (61.5%)	
Dietary risk factors			0.003
Absent	76 (41.9%)	3 (23.1%)	
Present	107 (58.1%)	12 (76.9%)	
Perinatal risk factors			0.56
Absent	153 (83.8%)	7 (46.2%)	
Present	30 (16.2%)	8 (53.8%)	
Shock			0.0055
Absent	178 (97.4%)	2 (15.4%)	
Present	5 (2.6%)	13 (84.6%)	
Diarrhea			0.012
Absent	122 (66.7%)	8 (53.8%)	
Present	61 (33.3%)	7 (46.2%)	
Electrolyte imbalance			0.467
Absent	5 (2.6%)	1 (7.7%)	
Present	178 (97.4%)	14 (92.3%)	
Cough and Cold			0.0034
Absent	133 (72.6%)	6 (38.5%)	
Present	50 (27.4%)	9 (61.5%)	
Hypoglycemia			0.76
Absent	166 (90.6%)	5 (30.8%)	
Present	7 (9.4%)	10 (69.2%)	
Edema			0.0013
Absent	145 (79.5%)	8 (53.8%)	
Present	38 (20.5%)	7 (46.2%)	
Hypothermia			0.0055
Absent	133 (72.6%)	6 (38.5%)	
Present	50 (27.4%)	9 (61.5%)	
Lethargy			0.023
Absent	100 (54.7%)	0 (0%)	
Present	83 (45.3%)	15 (100%)	
Anemia			0.47
Absent	94 (51.3%)	8 (53.8%)	
Present	89 (48.7%)	7 (46.2%)	
Dehydration			0.0046
Absent	163 (88.9%)	7 (46.2%)	
Present	20 (11.1%)	8 (53.8%)	
Sepsis			0.98
Absent	180 (98.3%)	6 (38.5%)	
Present	3 (1.7%)	9 (61.5%)	

Visible severe wasting			0.887
Absent	131 (71.8%)	8 (53.8%)	
Present	52 (28.2%)	7 (46.2%)	

DISCUSSION

This study aimed to ascertain the coexisting medical conditions, treatment results, and diverse factors linked to the outcome of children with severe acute malnutrition (SAM). Severe acute malnutrition (SAM) is notably higher inchildren aged 6 to 24 months. The potential cause of the observed phenomenon could be attributed to the introduction of inadequately prepared supplemental food, resulting in a heightened susceptibility to gastrointestinal tract infections. Previous investigations have revealed similar findings [11,12]. It is noteworthy that infants below the age of six months accounted for 6.5% of the total cases. The investigation conducted by Chiabi et al. (2017) in Cameroon examined the occurrence of malnutrition in infants under six months, which aligns with our results [11]. Our study identified the presence of pre-lacteals, suboptimal feeding practices, premature cessation of breastfeeding, and the utilization of bottle feeding as contributing factors. Despite the significance of colostrum as an essential first food source, our study revealed that a considerable proportion of newborns, specifically 112 out of the total sample, accounting for 56.6%, did not obtain this vital substance. However, there is no significant association between this characteristic and the chance of developing SAM in later life ($p > 0.05$). However, previous research has indicated that the absence of colostrum and the administration of pre-lacteals immediately after birth are associated with a heightened likelihood of malnutrition, as demonstrated in other investigations [13,14].

The presence of co-morbidities such as acute gastroenteritis, acute respiratory infection (ARI), sepsis, urinary tract infection (UTI), and anemia is associated with suboptimal nutritional recovery. Seven risk variables determined to be statistically significant are connected with an elevated death rate. These include dietary risk factors, pneumonia, diarrhea, dehydration, nutritional edema, hypothermia, and circulatory shock. A comparable study was documented by Derseh et al. in Ethiopia [15]. These factors mentioned above, in conjunction with comorbidities, play a role in the decompensation of physiological pathways and the impairment of the immune system, ultimately resulting in the severity of severe acute malnutrition (SAM). Potential interventions for achieving improved outcomes include adequate immunization, sanitation practices, access to safe drinking water, and the implementation of universal health coverage [16].

Persistent or long-lasting diarrhea might result in malnutrition [17]. The observed phenomenon can be attributed to reduced appetite, impaired nutrient absorption, compromised immune function, and a perpetuating cycle of diarrhea. These crises financially strain households residing in a developing nation [18]. This study identified a substantial relationship between the introduction of pre-lacteals, deviation from exclusive breastfeeding for six months, and the introduction of supplemental meals before six months with severe acute malnutrition (SAM). Previous research has documented comparable findings [12,19]. Our results revealed that the presence of infections such as acute respiratory infections (pneumonia), sepsis, and urinary tract infections (UTIs) diminishes the physiological capacity of children with severe acute malnutrition (SAM) and amplifies the metabolic requirements needed to manage fever, respiratory effort, and heart function. These children experience hypoxia, resulting in a subsequent decrease in appetite. These factors contribute to reduced food and calorie consumption, often necessitating nasogastric tube feeding, which can lead to malnutrition.

In our study, approximately 48.7% (n=89) of children with severe acute malnutrition (SAM) are found to have anemia, which can be attributed to the heightened iron requirements during this critical period of growth. Iron deficiency arises due to insufficient iron intake, shortages in micronutrients, and illnesses such as malaria, measles, tuberculosis, and hookworm infestation. Iron deficiency has negatively affected innate and adaptive immunity, making individuals more susceptible to infections [20,21].

Children with severe acute malnutrition (SAM) who exhibit symptoms of shock, indicating a compromised physiological condition and functioning of vital organs, are at a higher risk of mortality than other admitted cases. These cohorts of children exhibit limited physiological capacity, and throughout the process of resuscitation, there is an increased likelihood of fluid overload, which can result in unfavorable outcomes.

The present investigation observed that maternal age below 20 years did not significantly impact the prevalence of severe acute malnutrition (SAM). However, previous research has indicated that maternal age below 25 is associated with an increased risk of severe malnutrition [22,23]. This study found that infants with a birth weightof less than 2.5 kg were identified as an autonomous risk factor for severe acute malnutrition (SAM). The investigation conducted by Mukuku et al. (2019) [22] reached a comparable conclusion. The occurrence of low birth weight in infants can be attributed to maternal malnutrition, which indicates unfavorable socio-economic circumstances, inadequate feeding practices, and suboptimal environmental hygiene within the household. A child who experiences malnutrition throughout the prenatal period and is persistently

malnourished will endure ongoing or exacerbated malnutrition.

As per the World Health Organisation (WHO), a mortality rate of severe acute malnutrition (SAM) in children below 10% is deemed normal, whereas a rate beyond 15% is considered worrying [24]. The study observed a mortality rate of 7.6%, a figure that falls within the global range. This finding suggests that an updated guideline for inpatients offers significant advantages. Septicemia, being a significant factor, necessitates the implementation of intensive therapy in all suspected cases with appropriate antibiotics to mitigate the risks of death and morbidity in children suffering from severe acute malnutrition (SAM).

CONCLUSION

The prevalence of SAM is observed in children aged 6 to 24 months. The implementation of the revised WorldHealth Organisation (WHO) guidelines for the management of hospitalized patients has demonstrated a significant reduction in mortality rates, hence achieving a satisfactory level of patient outcomes. The study found substantial associations between dietary risk factors, including the length of exclusive breastfeeding, bottle feeding, and delayed introduction of supplemental feeding, and adverse outcomes. It is recommended that systematic screening for the early diagnosis of children with severe acute malnutrition (SAM) be conducted in all healthcare centers within the community. The implementation of immunization programs and the provision of universal health coverage have the potential to mitigate malnutrition and decrease mortality rates among children suffering from severe acute malnutrition (SAM).

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