International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 1, January 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.1.2025.59

ORIGINAL RESEARCH

Assessing the Prevalence and Risk Factors of Severe Acute Malnutrition in Children Aged 6 Months to 5 Years in Rural Bhopal

Kaushlendra[1], Anju Kapoor[2], Dr. Mital Prajapati[3], Veerendra Singh[4], Vinay Kumar[5]

[1]Post Graduate,[2]Professor,Department of Paediatrics, Peoples College of Medical Sciences and Research Centre, Bhopal, India
[3]Assistant Professor, Department of Community Medicine, Peoples College of Medical Sciences and Research Centre, Bhopal, India
[4]AssistantProfessor,[5]Associate Professor, Department of Paediatrics, Peoples College of Medical Sciences and Research Centre, Bhopal, India

Corresponding Author
Vinay Kumar
Associate Professor, Department of Paediatrics, Peoples College of Medical Sciences and Research Centre, Bhopal, India

Received: 21 November, 2024 Accepted: 20 January, 2025 Published: 21 January, 2025

ABSTRACT

Background: Undernutrition is a significant public health concern in India because of poverty and hunger. Nearly half of under five children deaths are linked to undernutrition especially Severe Acute Malnutrition (SAM). **Objectives:** To assess prevalence of SAM and its associated risk factors in children aged 6 months to 5 years in selected villages of Bhopal.**Methods:** A cross-sectional study was conducted among 356 children, using a structured proforma to collect data on maternal factors, dietary factors, socio-environmental and economic factors.**Results:** The prevalence of SAM was 4.8%, with significant associations found between SAM and low birth weight (p=0.001), calorie deficit (p=0.018), and protein deficit (p=0.012). **Conclusion:** A study in Bhopal found prevalence of Severe Acute Malnutrition (SAM) (4.8%) and Moderate Acute Malnutrition (MAM) (5.1%) among children aged 6 months to 5 years. Low birth weight, calorie deficit, and protein deficit were significant risk factors for SAM. Improving maternal health services during antenatal period can lead to reduce low birth weight and consequently SAM prevalence. Enhancing food security and promoting breast feeding, complementary feeding and balanced diet practices for children of underprivileged sector will lead to reduce protein and energy deficiency in diet. This will improve nutrition status of children since birth.

Keywords: Severe Acute Malnutrition, Low Birth Weight, risk factors, Under five Children, India

INTRODUCTION

Growth and development of the Children is important for demographic and socio- economic yield of any nation. Malnutrition in children is a global issue that may have short- and long-term irreversible negative health consequences. [1] Undernutrition is one of the leading causes of morbidity and mortality in children under the age of 5 years in low and middle income countries.[2] Acute malnutrition is responsible for about 875,000 (13%) deaths in children under five years of age globally. Severe acute malnutrition (SAM) contributes to almost three-fifths of these deaths.[3]In India, where the prevalence of undernutrition is nearly twice that of Sub-Saharan Africa, the situation is dire.[4] The National Family Health Survey (NFHS)-3 documented that nearly 57 million children are undernourished in India, accounting for one-third of the world's share.[3] Improved socioeconomic conditions, a reduced burden of infectious diseases, and changes in treatment modalities and approaches have been key factors in progress made thus far. Despite continuing economic progress, the country is still burdened with 8.1 million children suffering from Severe Acute Malnutrition.[5]According to the National Family Health Survey-5 (2019-21), 7.7% of children below 5 years of age were estimated to have Severe Acute Malnutrition in rural areas. The survey reflects poor nutrition among children.[6]For decades, organizations such as UNICEF and the WHO have implemented nutrition-sensitive and nutrition-specific interventions in afflicted low- and middle-income countries. These interventions target both the immediate and underlying determinants of child

DOI: 10.69605/ijlbpr_14.1.2025.59

malnutrition, such as food and nutrient intake, feeding and caregiving practices, poverty and food insecurity, to improve child growth and development. However, the outcomes from both types of interventions are mixed and the evidence generated is limited and not robust.[7]With the current estimated total population of India at 1,100 million, it is expected that about 8.1 million individuals are likely to be suffering from Severe Acute Malnutrition (SAM). This condition is more prevalent in socioeconomically deprived communities. The risk factors for malnutrition include lack of exclusive breastfeeding, late introduction of complementary feeds, feeding diluted feeds containing insufficient nutrients, repeated enteric and respiratory tract infections, ignorance, poverty, parental illiteracy and large family size.[8] Additional factors identified in scientific literature investigating the relationships among specific individual, household, and environmental factors and the development of acute malnutrition in children include fetal growth restriction, inadequate sanitation, incomplete vaccination, and economic, political, and environmental instability, as well as emergency situations.[9]Identification of modifiable risk factors helps to plan interventions to reduce its exposure and occurrence of Undernutrition and its consequences in children. In this study, we evaluate the risk factors for SAM in children aged 6 months to 5 years in selected villages of Bhopal. These factors include maternal factors, dietary factors, and socioenvironmental and economic factors.

MATERIALS AND METHOD

This cross-sectional study was conducted among 356 children aged 6 months to 5 years in villages attached to Ratua Primary Health Center (PHC) in Bhopal, after obtaining ethical clearance and informed consent from parents. Ten households were selected using simple random sampling. The sample was collected from households having children fulfilling eligibility criteria.

Study Setting and Population

The study was conducted in villages affiliated with Rural Health Training Centre of People's College of Medical Sciences and Research Centre in Bhopal. The study population included children aged 6 months to 5 years residing in these villages.

Inclusion Criteria: All children aged 6moth- 5 years living in the selected villages.

Exclusion criteria: Children with visible congenital defects, syndromic children, those with chronic medical conditions and children or parents unwilling to participate in the study.

Data Collection

Data was collected using a structured, pre-validated proforma through one-on-one interviews conducted by the principal investigator. The proforma included:

1. Demographic information
2. Anthropometric measurements (weight, height/length)
3. Dietary assessment using a 24-hour recall method

Anthropometric measurements were performed using a digital weighing machine, measuring tape, and infantometer.

Statistical Analysis

Statistical analysis was performed using SPSS version 28. Independent t-tests and chi-square tests were employed to ensure group similarities and determine statistical significance. A p-value less than 0.05 was considered statistically significant.

RESULTS

Of the 356 children, 90.2% (n=321) had normal nutritional status, 5.1% (n=18) had Moderate Acute Malnutrition (MAM) and 4.8% (n=17) had Severe Acute Malnutrition (SAM). Among children with birth weight <2.5 kg, 89.7% had normal nutritional status, 9.5% had SAM and 0.9% had MAM. Amongst children with birth weight >2.5 kg, 90.4% had normal nutritional status, 3.8% had MAM and 5.8% had SAM. This association was statistically significant (p=0.001).

About 89.3% children (n=318) received nutritional supplementation in the form of porridge, khichdi, halwa, etc., while 10.7% (n=38) did not receive any supplementation. 18.5% (n=66) of the children had calorie and protein deficits, while 81.5% (n=290) had not. Among children without calorie deficit, 95.81% had normal nutritional status, 3.84% had MAM and 0.69% had SAM. Amongst children with calorie deficit, 71.95% had normal nutritional status, 11.59% had MAM and 21.73% had SAM. This association was statistically significant (p=0.018). Children without protein deficit showed 95.17% normal nutritional status, 3.44% MAM and 1.37% SAM. Among those with protein deficit, 68.18% had normal nutritional status, 12.12% had MAM and 19.69% had SAM. A significant association was observed between protein deficit and nutritional status (p=0.012). 97.5% (n=347) children were completely immunized, while 2.5% (n=9) had incomplete immunization. Study of correlation between parent’s education and children’s Undernutrition revealed varying distributions across different educational levels; however, no statistically significant association was found (p=0.209).The predominant occupations of fathers were clerk/shop/farm (28.4%, n=101) and semi-professional (23.9%, n=85). A small proportion of fathers were unemployed (2.0%, n=9).

In-house toilet facilities were available for 95.8% (n=341) of the subjects, while 4.2% (n=15) lacked this amenity. The primary water source was tap water (63.2%, n=225), followed by well water (36.5%, n=130), with a small percentage using ground water (0.3%, n=1). The majority of caregivers (98.0%, n=349) reported washing their hands, while 2.0% (n=7) did not. Similarly, 95.2% (n=339) of children

DOI: 10.69605/ijlbpr_14.1.2025.59

washed their hands before meals, whereas 4.8% (n=17) did not. The key findings are highlighted in table 1.

Table: 1 Distribution of participants based on various variables

Variable	Category	Frequency	Percentage	Association with
Nutritional Status	Normal	**321**	**90.2%**	-
	MAM	**18**	**5.1%**	-
	SAM	**17**	**4.8%**	-
Immunization	Complete	**347**	**97.5%**	Not provided
	InComplete	**9**	**2.5%**	Not provided
In House				
Toilet	Yes	**341**	**95.8%**	Not provided
	No	**25**	**4.2%**	Not provided
Water Source	Tap Water	**225**	**63.3%**	Not provided
	Well Water	**130**	**36.5%**	Not provided
	Ground Water	**1**	**0.3%**	Not provided
Birth Weight	<2.5kg	**116**	**32.6%**	Significant (P=0.001)
	>2,5 kg	**240**	**67.4%**	
Mothers Education	Various level			Not significant (P=0.209)
Fathers education	Professional	**64**	**18.0%**	Not provided
	Semi Professional	**85**	**23.9%**	Not provided
	Clerk/Shop/Farm	**101**	**28.4%**	Not provided
	Skilled Worker	**37**	**10.4%**	Not provided
	Semi Skilled Worker	**56**	**15.7%**	Not provided
	Unskilled	**4**	**1.1%**	Not provided
	Unemployed	**9**	**2.0%**	Not provided
Hand washing				
Care giver	yes	**349**	**98.00%**	Not provided
	No	**7**	**2.00%**	Not provided
Child	Yes	**339**	**95.2%**	Not provided
	No	**17**	**4.8%**	Not provided
Nutritional Supplementation	Yes	**318**	**89.3%**	Not provided
	No	**38**	**10.7%**	Not provided
Calorie Deficit	No	**287**	**81.5%**	Significant (p=0.018)
	Yes	**60**	**18.5%**	
Protein Deficit	No	**290**	**81.5%**	Significant (p=0.012)
	Yes	**66**	**18.5%**	

DISCUSSION

Early detection of children with severe acute malnutrition (SAM) facilitates their categorization for appropriate intervention, either in community or institutional settings. Among 356 enrolled study subjects, 90.2% (n=321) exhibited normal nutritional status, 5.1% (n=18) had moderate acute malnutrition (MAM) and 4.8% (n=17) had SAM. The prevalence of SAM (4.8%) reported in the present study is lower than the national average of 7.6% according to NFHS-5[10]. A comparable study by Illalu S et al.[8] among children in rural Hubli, Karnataka, reported a SAM prevalence of 5.79%.

A significant association between birth weight and nutritional status was observed (p=0.001). Among subjects with birth weight <2.5 kg, 89.7% had normal nutritional status, 9.5% had SAM, and 0.9% had MAM. For subjects with birth weight >2.5 kg, 90.4% had normal nutritional status, 3.8% had MAM, and 5.8% had SAM. This aligns with National Family Health Survey (NFHS) III data on chronic childhood malnutrition, which identified low birth weight (LBW) as a major determinant of SAM. Birth weight is influenced by various socioeconomic factors, including geographic location, wealth, caste, religion, education, occupation and maternal tobacco or alcohol use[64]. Similar studies conducted by Bomela NJ et al.[11], Enweronu-Laryea CC et al.[12], and Mukuku O et al.[13] in different countries also demonstrated a strong association between malnutrition and LBW. Enweronu-Laryea CC et al.[12] in Ghana showed that preterm babies were prone to develop malnutrition in later life. Ambadekar NN[14] reported that low birth weight is a risk factor for SAM. However, David SM et al.[15] did not find a significant association between prematurity and child nutritional status, possibly due to high early neonatal death among preterm babies or improved nursery care following the introduction of the National Rural Health Mission (NRHM) Programme in India. Ambadekar NN reported that SAM is associated with factors including maternal height <145 cm, maternal weight <45 kg,

DOI: 10.69605/ijlbpr_14.1.2025.59

and lower maternal age at marriage. The strength of positive association between LBW and SAM indicates need for interventions during antenatal period to achieve normal birth weight of the bay.

In the present study, 97.5% (n=347) of subjects had complete immunization, while 2.5% (n=9) had incomplete immunization. A comparable study by Kikafunda JK et al.[16] reported an immunization rate of 93.1%, while Illalu S et al.[8] reported 100% complete immunization. The high vaccination coverage observed in this study underscores the crucial role of immunization in preventing childhood illnesses and resultant malnutrition.

Access to uncontaminated, safe drinking water and proper sanitation facilities are fundamental to overall human health and welfare. In this study, 95.8% (n=341) of subjects had toilet availability, while 4.2% (n=15) did not. The majority used tap water (63.2%, n=225), followed by well water (36.5%, n=130), and a small percentage used ground water (0.3%, n=1). All families had access to water supply. Hand washing was practiced by 98.0% (n=349) of caregivers and 95.2% (n=339) of children. Soap was used by 79.2% (n=282) of study subjects, while 20.5% (n=73) did not use soap. These findings contrast with an Indian study by Sabud P et al.[17], which reported that only 35% of households used safe drinking water, 97.2% of mothers had poor handwashing habits and 67.1% had average water, sanitation, and hygiene (WaSH) scores. The satisfactory access to water and toilet facilities and good hygiene practices observed in the present study may have contributed to the low rate of SAM. Ambadekar NN et al.[14] found that SAM prevalence increased significantly with poor hand hygiene practices and lack of water purification measures. Rao VG[18] documented that inadequate environmental sanitation and unhygienic personal behaviors significantly impact the frequency of diseases in children, which are closely linked to malnutrition.

Socio-economic factors such as gender inequality, poverty, lack of education, limited access to clean water, and poor sanitation significantly impact health outcomes in developing countries. Research has consistently shown that undernutrition is closely linked to poverty and low maternal education levels. Parents' literacy status profoundly impacts their children's nutritional status, with non-formally educated parents being more likely to have malnourished children under three years old, particularly in terms of weight. Additionally, poverty and poor living conditions are significant risk factors for malnutrition, highlighting the need to address these underlying socio-economic factors to improve health outcomes[19].

The present study found no significant correlation between mother's education (p=0.209) or mother's occupation (p=0.076) and nutritional status. However, some interesting trends emerged. Mothers with post-high school or high school education were more likely to have children with normal nutritional status, while those with high school education were more likely to have children with MAM. Interestingly, mothers with graduate or post-high school education were more likely to have children with SAM. There is a need to explore studies to understand dynamics between education and occupation of mother and SAM.

A significant association (p=0.012) between protein deficit and nutritional status was observed. Subjects without protein deficit had 95.17% normal nutritional status, 3.44% MAM, and 1.37% SAM. For subjects with a protein deficit, 68.18% had normal nutritional status, 12.12% MAM, and 19.69% SAM. In contrast, David SM et al. did not find a statistically significant correlation between protein consumption and child malnutrition.

The protein and amino acid needs of infants throughout the first three years of life, particularly during the critical first 1000 days, are not well understood[20]. The impact of viral diseases and disorders like environmental gastrointestinal dysfunction on protein and amino acid needs of children in impoverished countries, as well as specific requirements during catch-up growth, remains unknown[20-21]. A recent study by Pillai RR et al. using the indicator amino acid oxidation (IAAO) approach demonstrated that infants with intestinal parasite infections had an approximately 20% increase in their lysine demand[22].

The inflationary situation has hiked food prices, potentially leading to reduced calorie and protein consumption. As per ICMR, trends in dietary habits in India show that only a small percentage of the population meets recommended intake levels for essential food groups. Specifically, just 8.7% of rural and 14.3% of urban residents consumed milk and milk products as recommended, while 8.8% of rural and 17% of urban residents met the recommended vegetable intake. Nuts and oil seeds were consumed at recommended levels by 22% of rural and 27% of urban residents. Urban areas showed a higher intake of unhealthy foods, accounting for 11% of daily energy, compared to 4% in rural areas[23].

There is growing recognition of the significance of protein in complementary dietary supplements for young infants, as indicated by studies by Huo J et al.[24], de Pee S et al.[25], Ghosh S et al.[26], and Christian P et al.[27]. A significant correlation between the consumption of milk and animal source foods and the linear growth of children in poor nations has been reported by Krebs NF et al.[28], Dror DK et al. (2011)[29], Dror DK et al. (2014)[30], and Hoppe C et al.[31]. Golden MH[32] highlights the absence of universally recognised recommened nutrient intake for children with mild malnutrition, wasting, and stunting, particularly those residing in impoverished conditions. It is suggested that the diet should include 24 grams of protein per 1,000 calories, with a quality of at least 70% of the reference protein. For supplementary foods, protein intake should be increased to 26 grams per 1,000 calories. For children

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with stunting, it is recommended to focus on proteins containing sulfur amino acids[32].

The study was limited by the absence of controls within the community. Additionally, mothers experienced challenges in accurately recalling breastfeeding duration and the timing of complementary food introduction, potentially resulting in recall bias. Furthermore, calorie consumption was determined solely through a single 24-hour dietary recall, which could have led to either an overestimation or underestimation of the children's actual calorie intake.

Further research is needed to explore other potential risk factors and to develop effective interventions to reduce the prevalence of SAM in this age group. The association of individual risk factors with SAM can be studied through higher analytical studies like cohort or case-control designs to analyze the strength of association.

CONCLUSION

The study revealed a low prevalence of Severe Acute Malnutrition (SAM) (4.8%) and Moderate Acute Malnutrition (MAM) (5.1%) among children aged 6 months to 5 years in selected villages of Bhopal. This low prevalence was associated with availability of water and sanitation facilities and good hygiene practices. Identified risk factors for SAM included low birth weight, calorie deficit and protein deficit. Addressing these factors, particularly optimizing maternal nutrition during pregnancy, is critical for SAM prevention, the promotion of healthy birth weights and developmental outcomes. Further research is warranted to elucidate additional potential risk factors and develop efficacious interventions.

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