International Journal of Contemporary Pediatrics
Singh A et al. Int J Contemp Pediatr. 2025 Feb;12(2):266-272
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291
DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20250095

Original Research Article

Clinical profile and co-morbidities in children with moderate and severe acute malnutrition

Amrita Singh[1], Ekansh Rathoria[1]*, Faraz Ahmad Khan[1], Aatif Sattar[1], Richa Rathoria[2], Utkarsh Bansal[3], Gudiya Kumari[1], Adity Singh[1]

[1]Department of Pediatrics, Hind Institute of Medical Sciences Sitapur, UP, India
[2]Department of Obstetrics and Gynaecology, Hind Institute of Medical Sciences Sitapur, UP, India
[3]Department of Pediatrics, Hind Institute of Medical Sciences, Barabanki, UP, India

Received: 03 December 2024
Accepted: 07 January 2025

***Correspondence:**
Dr. Ekansh Rathoria,
E-mail: rathoriaekansh@yahoo.com,

ABSTRACT

Background: Malnutrition as a problem is multidimensional and multifactorial with varied clinical profiles and comorbidities. The objectives of this study were to evaluate the clinical profile and comorbidities in children suffering from malnutrition and to estimate the association of moderate acute malnutrition (MAM) and severe acute malnutrition (SAM) with demographic parameters, feeding, and immunization.
Methods: This cross-sectional study was conducted on 132 children with malnutrition, aged between 6 to 59 months, at Hind Institute of Medical Sciences, Sitapur over 18 months. Demographic details, clinical history, clinical evaluation, anthropometric measurements, and investigations, were noted on predesigned performa. All the data were analyzed by SPSS software. A p-value<0.05 was considered significant.
Result: The mean age of children with malnutrition was 25.79(15.68) months. Wasting and severe wasting among children with malnutrition were 51.5 % and 48.5% respectively. Major comorbidities were diarrhoea (70.5%), severe anemia (67.4%), pneumonia (62.9%), vitamin A deficiency (59.8%), sepsis (54.6%), urinary tract infection (54.5%), vitamin D deficiency (35.6%), worm infestation (30.3%), and tuberculosis (28.8%). A significant association of malnutrition was found with children of younger age (p<0.0001), Hindu religion (p<0.0001), not exclusively breastfed (p=0.004), delayed initiation of complementary feeding (p=0.029), and incomplete immunization (p=0.006).
Conclusion: Malnutrition is closely linked to poor infant and young child feeding practices. Malnourished children suffer from various infections and micronutrient deficiencies. Adequate and timely nutritional support plays a vital role in breaking the vicious cycle of undernutrition-disease-undernutrition resulting in recovery.

Keywords: Comorbidity, Complementary feeding, Exclusive breastfeeding, Immunization, Moderate acute malnutrition, nutrition, Severe acute malnutrition

INTRODUCTION

World Health Organization (WHO) defines malnutrition as a lack or excess of nutrients, an imbalance of vital nutrients, or poor nutrient utilization.[1] In 2022, 149 million children under the age of five were stunted, 45 million were wasted, and 37 million were overweight or obese worldwide.[2] Undernutrition is a contributing factor in over half of mortality in children under five.[2] WHO defines severe acute malnutrition (SAM) or severe wasting in infants and children aged 6–59 months having weight-for-height/length <–3 Z-scores of the WHO Child Growth Standards median, or a mid-upper arm circumference (MUAC) <115 mm, or the presence of bilateral pitting oedema.[3] Approximately 19 million children under the age of five suffer from SAM globally, and it is estimated to cause about 400,000 child fatalities

annually.[3] WHO defines moderate acute malnutrition (MAM) or moderate wasting in infants and children 6–59 months of age as weight-for-height/length between ≥ -3 SD and < -2 SD (or MUAC ≥ 115 mm to < 125 mm as an alternative measure).[4]

As per National Family Health Survey (NFHS-5) data, children under 5 years who are stunted, wasted, severely wasted, and underweight are 35.5%, 19.3%, 7.7%, and 32.1% respectively.[5] The prevalence of SAM has increased from 7.5% in NFHS-4 to 7.7% in NFHS-5 data.5 However, the under-5 morality (per 1,000 live births) has dropped from 49.7 in NFHS-4 data to 41.9% in NFHS-5 data.[5]

Malnutrition throughout childhood not only raises death rates but also appears to be linked to worse academic achievement, shorter adult height, lower economic output, and the birth of further growth-restricted offspring.[6] Many children in developing countries experience delayed physical and mental development due to poverty, deprivation, and malnutrition.[7] The nutritional status of children is influenced by environmental variables such as socioeconomic status, hygiene, attitudes of parents, and the child-raising process.[7]

Malnutrition is associated with various demographic factors, inadequate feeding practices, and incomplete immunization practices.[8,9] Nutritional rehabilitation is the cornerstone of the management of malnourished children, however, their prognosis and outcome depend on comorbidities, various demographic factors, feeding, and immunization practices.[8-10] This study aimed to evaluate the clinical profile and co-morbidities of children suffering from malnutrition and estimate the association of MAM and SAM with demographic parameters, feeding practices, and immunization practices.

METHODS

Study design

This cross-sectional study was done in the Department of Pediatrics, Hind Institute of Medical Sciences, Sitapur over 18 months after obtaining ethical approval from the Institute's ethical committee and informed consent from parents.

Inclusion criteria

We included all the children between 6 and 59 months of age with clinically diagnosed severe and moderate acute malnutrition.

Exclusion criteria

Children born preterm or low-birth-weight, or born with congenital malformations (cleft palate, tracheoesophageal fistula, congenital diaphragmatic hernia, and congenital hypertrophic pyloric stenosis, congenital heart diseases, malabsorption syndromes) were excluded.

Sampling

A convenient sampling method was used. The sample size was calculated using Cochrane's formula by taking the prevalence (p) of SAM from NFHS-5 data as 7.7%, a confidence level of 95%, and a margin of error (e) of 5%.[5,11]

$N = Z^2 (p \times q)/e^2$, Where, Z=1.96, p=0.077, q=1-p=0.923, e=0.05, $N= (1.96)^2 x (0.077 \times 0.923)/ (0.05)^2 = 109.21 \approx 110$.

The final sample size surveyed was 132 cases.

Data collection

A predesigned proforma was used for data collection which included the demographic parameters, feeding and immunization history, comorbidities, and anthropometric parameters. Demographic parameters included age, gender, religion, type of family, socioeconomic status (adapted from Modified Kuppuswamy Socioeconomic Status Scale, 2023), livelihood, and birth order.[12] Feeding history included history of providing exclusive breastfeeding (EBF) till 6 months and timely initiation of complementary feeding at 6 months. Immunization history included whether it was complete or incomplete to date.

Co-morbidities under study included diarrhoea, severe anemia, pneumonia, vitamin A deficiency, sepsis, urinary tract infections, vitamin D deficiency, worm infestation, enteric fever, tuberculosis, metabolic derangements, oedema, measles, and seizures.

Anthropometric parameters included weight in kilograms (kg), height/length in cm, and mid-upper arm circumference (MUAC) in cm. Body mass index (BMI) was calculated by dividing weight in kilograms by height in meters squared.

Measurements: WHO child growth standards median reference charts for weight-for-height/length Z-scores were used.[13] Children aged 6–59 months were classified as SAM if weight-for-height/length <–3 Z-scores of the WHO child growth standards median, or a mid-upper arm circumference (MUAC) <115 mm, or presence of bilateral pitting oedema.[3]

Children aged 6–59 months were classified as MAM if weight-for-height/length were between ≥ -3 SD and <-2 SD of the WHO Child Growth Standards median, or a mid-upper arm circumference (MUAC) ≥ 115 mm to <125 mm.[4] Severe anemia in children aged between 6 and 59 months was defined as <7g/dl as per WHO reference data.[14]

Statistical analysis

Data were entered on a Microsoft Excel sheet. Data analysis (mean, standard deviation, frequency, percentages, chi-square test) was done using SPSS software version 22. A p value <0.05 was considered significant.

RESULTS

The mean age in 6 - 12 months, 13 – 24 months, and 25 – 59 months age groups were 9.95 (2.41), 20.39 (3.09), and 43.18 (9.29) months respectively. The overall mean age of children from 6 – 59 months was 25.79 (15.68) months. The demographic parameters, feeding, and immunization history of children are summarized in Table 1.

Marasmus was seen in 102 (77.3%) and kwashiorkor was seen in 30 (22.7%) SAM children. Table 2 outlines the distribution of children based on comorbidities. The most common comorbidity was diarrhoea (93, 70.5%) followed by severe anemia (89, 67.4%), and pneumonia (83, 62.9%). The mean weight, height, mid-upper arm circumference (MUAC), and body mass index (BMI) were 6.94 (1.68) kg, 73.87 (8.73) cm, 10.65 (0.72) cm, and 12.58 (1.17) kg/m2 respectively. The mean weight for height Z-score (WHZ) was -3.31 (1.28). Of the total 132 patients, 68 (51.5%) presented with MAM and 64 (48.5%) with SAM. The distribution of children based on WHZ scores is shown in Figure 1.

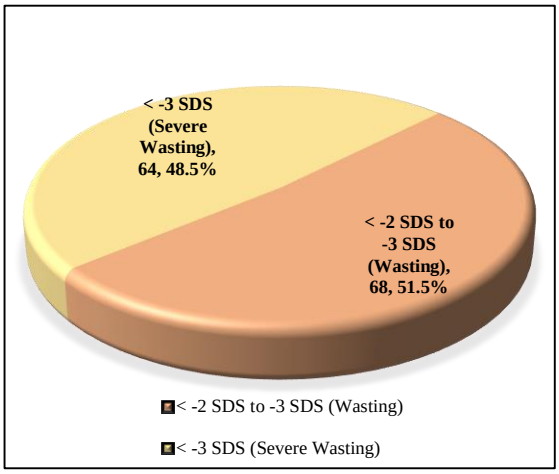

Figure 1: Distribution of children based on WHZ scores (n=132).

Table 3 outlines the association of wasting with demographic parameters. The association of wasting with feeding and immunization are summarized in Table 4.

Table 1: Distribution of children based on demographic, feeding, and immunization history (n=132).

Parameters		Number	%
Age groups	6 – 12 months	43	32.6
	13 – 24 months	38	28.8
	25 – 59 months	51	38.6
Gender	Male	61	46.2
	Female	71	53.8
Religion	Hindu	69	52.3
	Muslim	45	34.1
	Others	18	13.6
Type of family	Nuclear family	22	16.7
	Joint family	110	83.3
Livelihood	Rural	103	78
	Urban	29	22
Socioeconomic status*	Upper	3	2.3
	Upper middle	3	2.3
	Lower middle	35	26.5
	Upper lower	21	15.9
	Lower	70	53
Birth order	1	62	47
	2	44	33.3
	≥ 3	26	19.7
Exclusive breastfeeding till 6 months	Yes	43	32.6
	No	89	67.4
Complementary feeding started at 6 months	Yes	34	25.8
	No	98	74.2
Immunization status to date	Complete	35	26.5
	Incomplete	97	73.5

*Adapted from Modified Kuppuswamy Socioeconomic Status Scale, 2023

Table 2: Distribution of children based on comorbidities (n=132).

Comorbidities	Number	%
Diarrhea	93	70.5
Severe Anemia	89	67.4
Pneumonia	83	62.9
Vitamin A deficiency	79	59.8
Sepsis	72	54.6
Urinary tract infections	72	54.5
Vitamin D deficiency	47	35.6
Worm infestation	40	30.3
Enteric fever	39	29.5
Tuberculosis	38	28.8
Metabolic derangements	38	28.8
Edema	30	22.7
Measles	9	6.8
Seizures	9	6.8

Table 3: Association of wasting with demographic parameters (n=132)*.

Parameters		Wasting	Severe wasting	χ^2	P value
Age groups	6-12 months	9	34	55.878	<0.0001
	13-24 months	12	26		
	25-59 months	47	4		
Gender	Male	27	34	2.388	0.122
	Female	41	30		
Religion	Hindu	12	57	67.40	<0.0001
	Muslim	40	5		
	Others	16	2		
Type of family	Nuclear	9	13	1.189	0.276
	Joint	59	51		
Livelihood	Rural	52	51	0.199	0.656
	Urban	16	13		
Socioeconomic status	Upper	2	1	2.967	0.563
	Upper middle	1	2		
	Lower middle	17	18		
	Upper lower	14	7		
	Lower	34	36		
Birth order	1	32	30	0.097	0.953
	2	22	22		
	>=3	14	12		

* χ2 =Chi-square test value

Table 4: Association of wasting with feeding and immunization (n=132).

Parameters		Wasting	Severe wasting	χ^{2*}	P value
Exclusive breastfeeding till 6 months	Yes	30	13	8.506	0.004
	No	38	51		
Complementary feeding started at 6 months	Yes	23	11	4.772	0.029
	No	45	53		
Immunization status to date	Complete	25	10	7.562	0.006
	Incomplete	43	54		

DISCUSSION

Malnutrition is most prevalent in low- and middle-income nations, and children under five are particularly at risk. This study addresses the clinical profile and co-morbidities of children suffering from moderate and severe acute malnutrition and its association with demographics, feeding, and immunization practices. The mean age of children under study was 25.79 (15.68) months and the male-to-female ratio was 1:1.16 which was similar to the study by Ghimire et al, which reported the mean age of 24.3 (15.4) months and male-to-female ratio of 1:1.14 in their research.[15] In this study, severity of malnutrition was associated with younger age ($p<0.0001$) but no association was observed with gender ($p=0.122$). These findings of our study were in accordance with the study by Ghimire et al.[15]

In the present study, most of the children were Hindu by religion (69, 52.3%) followed by Muslims (45, 34.1%), and most lived in joint families (110, 83.3%) which was comparable to the study by David et al.[16] Malnutrition was more severe in the Hindu religion ($p<0.0001$) in the present study.

In contrast, David et al, in the bivariate analysis found that belonging to the Hindu religion was a protective factor, however, this was not the case in the multiple logistic models.[16] No association of malnutrition was seen with the type of family ($p=0.276$) in our study. In contrast, Ghimire et al reported that SAM was significantly associated with a family size of >5 members in multivariate analysis.[15] The majority of children in our study were from rural livelihoods (103, 78%) but no association of malnutrition was seen with either rural or urban livelihood ($p=0.656$). Similar to our study, Baskaran et al reported that 61% of SAM children were from rural areas.[10] Likewise, the Ghimire et al, study reported no association of SAM was seen with either rural or urban livelihood ($p=0.780$).[15]

The majority of children belonged to lower SES (70, 53%) in our study, however, no significant association was found between malnutrition and SES ($p=0.563$), which was akin to the David et al study ($p=0.603$).[16] Most children had first birth order (62, 47%) but no significant association of SAM was reported with birth order ($p=0.953$) in the present study. However, Hoq et al, study findings of the multivariate logistic regression show that having the first child and family access to a sanitary toilet protects against acute malnutrition for children.[17]

In our study, most of the children were not exclusively breastfed (89, 67.4%), and had delayed complementary feeding (98, 74.2%), and incomplete immunization status (97, 73.5%). Malnutrition was associated with those children who were not exclusively fed ($p=0.004$), who had delayed complementary feeding ($p=0.029$), and who had incomplete immunization ($p=0.006$) in the present study. Likewise, Hoq et al study reported inappropriate feeding practices as a primary cause of SAM.[17]

Similarly, the Kamatham et al study reported an association of SAM with a lack of exclusive breastfeeding for 6 months.[18] Sisodia et al study and Bansal et al study reported the importance of early initiation of breastfeeding and exclusive breastfeeding for 6 months, which can reduce morbidity and mortality in neonates and during infancy.[19,20] White et al, study concluded that the complementary feeding phase provides a chance to prevent all kinds of malnutrition.[21] Fatima et al reported that there were significant regional differences in the timely introduction of complementary feeding in India (42.7-84%).[7] Baskaran et al study also reported that 40.5% of SAM children were not immunized appropriately for their age.[10] In the present study, the most common comorbidity was diarrhoea (93, 70.5%) followed by severe anemia (89, 67.4%), pneumonia (8, 62.9%), vitamin A deficiency (79, 59.8%), sepsis (72, 54.6%), urinary tract infections (72, 54.5%), vitamin D deficiency (47, 35.6%), worm infestation (40, 30.3%), enteric fever (39, 29.5%), tuberculosis (38, 28.8%), metabolic derangements (38, 28.8%), oedema (30, 22.7%), measles (9, 6.8%), and seizures (9, 6.8%).

These comorbidities were comparable to studies by Baskaran et al and Arya et al, Sharma et al reported that seizures are most commonly seen in <6 years of age and the most common cause is febrile seizures.[10,22,23] Both humoral immunity and cell-mediated immunity are compromised in MAM and SAM children because of specific deficiencies in the phagocytic, mucosal defense mechanism, skin barrier, and free radical scavenging functions. As a result, children with MAM and SAM are more susceptible to potentially fatal infections such as acute gastroenteritis, pneumonia, sepsis, and UTIs.

The Government of India's flagship program to enhance children's nutritional outcomes is Poshan Abhiyaan, an all-encompassing program for holistic feeding.[24,25] The Indian government's other flagship program, Anaemia Mukt Bharat, uses a multi-sectoral and multi-stakeholder approach to eliminate anaemia using preventative and therapeutic measures and is a part of the National Nutrition Mission (Poshan Abhiyaan).[24,25] By establishing a convergent ecosystem to create and promote behaviors that foster health, well-being, and immunity, Poshan Abhiyaan aims to solve the issues of malnutrition by strategically changing the content and delivery of nutrition.[24,25] The program promotes India's efforts to achieve the Sustainable Development Goals.[25]

The results of the current study suggest that these initiatives be strengthened. Additionally, children who suffer from malnutrition should be evaluated in the community and timely referred to medical facilities for early diagnosis and treatment.

CONCLUSION

This study concluded that exclusive breastfeeding for the first 6 months of age, along with appropriate timely initiation of complementary feeding, and age-appropriate complete immunization would help reduce the prevalence of MAM and SAM. Early and effective co-morbidity identification is essential and will facilitate timely treatment. Nutritional programs need intensification to reduce MAM and SAM prevalence.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Lao TT, Wong LL, Hui SY, Sahota DS. Iron deficiency anaemia and atonic postpartum haemorrhage following labour. Reprod Sci. 2022;5:1-9.
2. Siekmans K, Fracassi P, Kato T, Seow TK, Carter D, Horton S, et al. Understanding the Links between Diet Quality, Malnutrition, and Economic Costs. Available at: https://www.who.int/news. Accessed on 21 August 2024.
3. Identification of severe acute malnutrition in children 6–59 months of age. Available at: https://www.who.int/tools/elena. Accessed on 12 August 2024.
4. World Health Organization. WHO guideline on the prevention and management of wasting and nutritional oedema (acute malnutrition) in infants and children under 5 years. World Health Organization; 2024. Available at: https://www.who.int/publications. Accessed on 13 August 2024.
5. National family health survey (NFHS-5). 2019-21. Government. Available at: https://www.mohfw.gov.in. Accessed on 25 August 2024.
6. Marwah A, Marwah PM. Clinical profile and major co-morbidities among hospitalized children with severe acute malnutrition: experience from a tertiary care teaching hospital of North India. Int J Contemp Pediat. 2021;8(1):30.
7. Fatima S, Bansal U, Suryavanshi P, Rathoria E. Complementary feeding practices in India and improvement strategies. International Journal of Scientific Research. 2021;10(3):29-32.
8. Bhandari D, Chib D, Mehta D. To assess the epidemiological risk factors and feeding practices in SAM children of Gorakhpur area. International J of Advanced Research. 2016;4(3):231-4.
9. Mado SM, Alegbejo JO, Aliyu I. Socio-demographic and immunization characteristics of siblings of children with severe acute malnutrition attending paediatric nutrition clinic of Ahmadu Bello University Teaching Hospital, Shika, Zaria. Sub-Saharan African J Med. 2019;6(3):129-33.
10. Baskaran VM, Naaraayan SA, Priyadharishini D. Comorbidities in children hospitalized with severe acute malnutrition. Indian Journal of Child Health. 2018;5(8):530-2.
11. Singh A, Rathoria E, Singh SK, Rathoria R, Yadav SK, Bansal U. Prevalence of overweight and obesity, and associations with socio-demographic and etiological factors. Int J Contemp Pediatr. 2024;11(10):1400–5.
12. Dalvi T, Kalghatgi S. A 2023 Update of Kuppuswamy Socioeconomic Status Classification Scale for the Indian Population. Journal of Indian Association of Public Health Dentistry. 2023;21(3):282-3.
13. WHO child growth standards and the identification of severe acute malnutrition in infants and children. World Health Organization; 2009. Available at: https://www.who.int/publications. Accessed on 17 August 2024.
14. Guideline on haemoglobin cutoffs to define anaemia in individuals and populations. who.int. World Health Organization. Available at: https://www.who.int/publications. Accessed on 21 August 2024.
15. Ghimire U, Aryal BK, Gupta AK, Sapkota S. Severe acute malnutrition and its associated factors among children under-five years: a facility-based cross-sectional study. BMC pediatrics. 2020;20:1-9.
16. David SM, Pricilla RA, Paul SS, George K, Bose A, Prasad JH. Risk factors for severe acute malnutrition among children aged 6–59 months: A community-based case-control study from Vellore, Southern India. Journal of Family Medicine and Primary Care. 2020;9(5):2237-43.
17. Hoq M, Ali M, Islam A, Banerjee C. Risk factors of acute malnutrition among children aged 6–59 months enrolled in a community-based programme in Kurigram, Bangladesh: a mixed-method matched case-control study. J of Health, Population and Nutri. 2019;38:1-7.
18. Kamatham Madhusudhan RP, Shireesha AR. Study of risk factors of severe acute malnutrition (SAM) in children 6 months to 5 years of age and evaluation of effect of micronutrient supplementation (WHO protocol) on serum zinc and magnesium levels: a case control study. Int J of Contemporary Pediatrics. 2017;4(4):1198.
19. Sisodia P, Rathoria R, Singh GK, Rathoria E, Bansal U. Quality Improvement Interventions in the Delivery Room to Improve the Early Initiation of Breastfeeding in Healthy Neonates: A Tertiary Hospital-Based Study. J of Neonatol. 2022;36(2):85-94.
20. Bansal U, Singh AP, Agrawal P, Rathoria E, Gupta NB, Ahuja R. Paediatricians' perspectives regarding breastfeeding during the Covid-19 pandemic: A cross-sectional study. Sri Lanka Journal of Child Health. 2022;51(4):37-49.

21. White JM, Bégin F, Kumapley R, Murray C, Krasevec J. Complementary feeding practices: Current global and regional estimates. Maternal & Child Nutrition. 2017;13:12505.
22. Arya AK, Lal P, Kumar P. Co-morbidities in children with severe acute malnutrition-A tertiary care centre experience. Int J Contemp Med Res. 2017;4(5):1086-8.
23. Sharma K, Rathoria E, Srivastava M, Singh SK, Bansal U, Singh S, et al. Clinico-etiological profile of seizures in the pediatric age group. Int J Contemp Pediatr 2024;11:1752-9.
24. Kumari G, Rathoria E, Khan FA, Singh SK, Lahari R, Rathoria R, et al. Prevalence of stunting, thinness and anaemia among adolescents and their association with demographics and dietary habits. Int J Contemp Pediatr 2024;11:1711-8.
25. Singh S, Rathoria E, Srivastava M, Rathoria R, Bansal U, Sharma K. Impact of maternal anemia on neonatal outcomes. Int J Contemp Pediatr. 2024;11:1781-7.

Cite this article as: Singh A, Rathoria E, Khan FA, Sattar A, Rathoria R, Bansal U, et al. Clinical profile and co-morbidities in children with moderate and severe acute malnutrition. Int J Contemp Pediatr 2025;12:266-72.