ORIGINAL RESEARCH

Socio-Demographic and Clinical Determinants of Severe Acute Malnutrition in Urban South India: A Case-Control Study

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ABSTRACT
Background: Severe acute malnutrition (SAM) is a major public health concern in India, contributing significantly to childhood morbidity and mortality. This study aimed to identify socio-demographic and clinical risk factors associated with SAM among children aged 6–59 months in an urban locality of South India. **Methods:** A case-control study was conducted among 100 children, comprising 33 cases with SAM and 67 age-matched controls. Data on socio-demographic factors, birth history, and feeding practices were collected using a structured questionnaire. Anthropometric measurements were recorded to confirm nutritional status. Statistical analyses included chi-square tests and logistic regression to determine associations. **Result:** Children from joint families were 3.92 times more likely to develop SAM ($p < 0.001$). Low birth weight was a significant predictor (OR: 6.04, $p < 0.001$). Pica was highly associated with SAM (OR: 13.91, $p < 0.001$). Bottle feeding and poor appetite also showed notable associations. Maternal education and socioeconomic status emerged as key determinants, with lower education levels and lower socioeconomic classes significantly linked to SAM prevalence. **Conclusion:** The study identifies modifiable socio-demographic and clinical risk factors contributing to SAM. Addressing these determinants through targeted public health interventions is crucial to reducing the burden of malnutrition in urban India.
Key words: Severe acute malnutrition, socio-demographic factors, low birth weight, feeding practices, urban India, case-control study.

INTRODUCTION

Severe Acute Malnutrition (SAM) is a critical public health challenge globally, particularly in developing countries like India, where malnutrition contributes significantly to childhood morbidity and mortality[1]. Defined by a very low weight-for-height, visible severe wasting, or the presence of nutritional edema, SAM poses a severe threat to the health and survival of children under the age of five. According to UNICEF, malnutrition is directly or indirectly linked to nearly 45% of deaths in this vulnerable population[2].

Urban areas often reflect stark contrasts in wealth, living standards, and access to essential services, creating unique challenges in combating malnutrition. Rapid urbanization has led to an increase in informal settlements and slums, where poor sanitation, overcrowding, and limited healthcare facilities exacerbate the risk of malnutrition among children[3]. Furthermore, urban poor populations frequently face food insecurity, limited access to nutritious foods, and inadequate maternal and child healthcare practices, all of which are significant risk factors for SAM[4].

The multifactorial etiology of SAM highlights the complex interplay of various determinants, including socio-demographic factors, dietary practices, birth-related characteristics, and healthcare access. Socioeconomic disparities are among the leading contributors, with poverty limiting access to adequate and diverse diets. Maternal education and

employment status further influence household food security and caregiving practices. Birth weight and feeding practices, such as breastfeeding and complementary feeding, also play a pivotal role in determining a child's nutritional status. Infections and other illnesses, which are more prevalent in resource-limited settings, can aggravate malnutrition by impairing nutrient absorption and increasing metabolic demands. Identifying these risk factors and their interrelationships is crucial for formulating evidence-based strategies to prevent and manage SAM effectively[5].

Despite numerous programs and policies aimed at combating malnutrition in India, including the Integrated Child Development Services (ICDS) scheme and the National Nutrition Mission (Poshan Abhiyaan), the burden of SAM remains substantial. Efforts to address this issue have traditionally focused on rural populations, given the higher overall prevalence of malnutrition in rural areas[6]. However, with the increasing urbanization of poverty, the need for research and interventions tailored to urban populations is becoming increasingly apparent. Comprehensive studies exploring the socio-demographic and clinical determinants of SAM in urban children are essential to bridge this gap and inform urban-specific nutrition policies[7].

This study focuses on assessing the prevalence and risk factors for SAM among children under five in an urban locality in South India. It employs a case-control design to examine the associations between socio-demographic characteristics, birth-related factors, dietary practices, and the occurrence of SAM. By comparing cases of SAM with healthy controls, the study aims to identify key determinants that contribute to malnutrition in this population. The findings are intended to guide policymakers, healthcare providers, and public health professionals in developing tailored interventions to address the unique challenges of urban malnutrition.

This study emphasizes the need for integrated approaches that address not only dietary deficiencies but also the underlying socioeconomic and environmental factors contributing to malnutrition. Additionally, the study highlights the need for targeted interventions addressing specific behaviors, such as pre-lacteal feeding and inadequate dietary diversity, which have been identified as significant contributors to malnutrition. The results of this study are relevant not only for urban settings in India but also for other developing countries facing similar challenges in addressing malnutrition among vulnerable populations.

MATERIALS AND METHODS

Study Setting: This case-control study was conducted between January and October 2023 in an urban locality of Pudukkottai, South India. The study was carried out in collaboration with local healthcare centers, anganwadi facilities, and community health workers to ensure comprehensive data collection. The urban setting offered a unique opportunity to explore malnutrition dynamics in a rapidly urbanizing region, with a focus on underprivileged communities disproportionately affected by severe acute malnutrition (SAM).

Study Participants: The study included children under five years of age from the urban locality. Cases were defined as children diagnosed with SAM based on WHO criteria, specifically a weight-for-height z-score below −3 standard deviations or the presence of nutritional edema. Controls were age- and gender-matched children without SAM or any other form of malnutrition, identified from the same community.

Inclusion criteria for cases were children aged 6–59 months, residing in the study area for at least six months, and meeting the diagnostic criteria for SAM. For controls, children of the same age group without any signs of malnutrition or chronic illness were included. Exclusion criteria for both groups included children with congenital anomalies, chronic illnesses such as tuberculosis or HIV, or those undergoing therapeutic feeding for malnutrition, as these factors could confound the study outcomes.

Sample Size and Sampling Technique: A sample size of 100 children was selected, with 33 cases and 67 controls, ensuring a case-to-control ratio of 1:2 for adequate statistical power. This calculation was based on the expected prevalence of specific risk factors among the population and a confidence interval of 95% with 80% power to detect significant associations. The sampling technique involved a combination of purposive and random sampling. Cases were purposively selected from healthcare facilities where children presented for nutritional rehabilitation or medical care. Controls were randomly chosen from the same community, ensuring that they represented the broader population without malnutrition.

Study Tools: The study employed a structured questionnaire developed based on extensive literature review and expert input. The questionnaire was designed to capture socio-demographic details, maternal and child health characteristics, birth history, feeding practices, and other potential risk factors for SAM. It was pretested in a pilot study involving 10 children to refine its content and ensure reliability. Anthropometric measurements, including weight, height, and mid-upper arm circumference (MUAC), were recorded using standardized equipment calibrated before each session. The Modified BG Prasad Classification was used to determine socioeconomic status.

Study Methodology: Data collection involved two stages: household visits and healthcare facility-based assessments. Initially, community health workers identified eligible participants during household surveys. After obtaining informed consent, trained investigators conducted face-to-face interviews with caregivers using the structured questionnaire.

Anthropometric measurements were recorded following WHO guidelines to ensure accuracy and consistency.

For cases, additional clinical details were obtained from medical records, including comorbidities and treatment history. Information on feeding practices, such as breastfeeding duration, colostrum feeding, and complementary feeding, was collected through caregiver recall. The study also captured data on environmental and behavioral factors, including hygiene practices, bottle feeding, and pica behavior, known to be associated with SAM.

Ethical Issues: Ethical approval was obtained from the Institutional Ethics Committee. Caregivers provided written informed consent before participation, with detailed explanations of the study objectives, procedures, and potential risks. Participants were assured of confidentiality, and data were anonymized during analysis. For children identified with SAM during the study, referrals were made to local nutritional rehabilitation centers for appropriate care and management.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Descriptive statistics were used to summarize socio-demographic and clinical characteristics, with continuous variables expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Bivariate analysis, including chi-square tests and odds ratios with 95% confidence intervals, was performed to assess associations between risk factors and SAM. Logistic regression analysis was used to identify independent predictors of SAM, adjusting for potential confounders. Statistical significance was set at $p < 0.05$.

The socio-demographic characteristics of the study population, comprising 33 cases and 67 controls, are summarized in Table 1. The mean age of children in the case group was 30.5 ± 14.1 months, compared to 32.1 ± 12.9 months in the control group. A majority of children in both groups fell within the 6–36 months age range (66.7% of cases and 65.7% of controls). Gender distribution revealed that females constituted a higher proportion of cases (63.6%) than controls (49.3%), while males represented 36.4% and 50.7% of cases and controls, respectively.

Most cases belonged to joint families (69.7%), whereas the majority of controls (62.7%) were from nuclear families. Regarding maternal education, 63.6% of cases had mothers educated up to the primary level, compared to 67.2% of controls. Non-working mothers predominated in both groups, accounting for 93.9% of cases and 94.0% of controls. Socioeconomic status, classified per the Modified BG Prasad classification, revealed that most cases (60.6%) were from the lower middle class, compared to 43.3% of controls. Lower-class representation was higher among controls (20.9%) than cases (12.1%).

RESULT

Table 1: Socio-demographic Characteristics of Study Population (n=100).

Demographic Characteristics	**Cases (n=33) (%)**	**Controls (n=67) (%)**
Age, Mean ± SD (months)	30.5 ± 14.1	32.1 ± 12.9
Age group (in months)		
6–36	22 (66.7)	44 (65.7)
37–59	11 (33.3)	23 (34.3)
Gender		
Male	12 (36.4)	34 (50.7)
Female	21 (63.6)	33 (49.3)
Type of Family		
Nuclear	10 (30.3)	42 (62.7)
Joint	23 (69.7)	25 (37.3)
Mother's Education		
Up to primary standard	21 (63.6)	45 (67.2)
More than primary standard	12 (36.4)	22 (32.8)
Mother's Work Status		
Working	2 (6.1)	4 (6.0)
Non-working	31 (93.9)	63 (94.0)
Socio-economic Status*		
Upper middle class	1 (3.0)	2 (3.0)
Middle class	8 (24.2)	22 (32.8)

Lower middle class	20 (60.6)	29 (43.3)
Lower class	4 (12.1)	14 (20.9)

***As per Modified BG Prasad classification**

Table 2 highlights the risk factors for severe acute malnutrition in the socio-demographic profile of the participants. Children from joint families were significantly overrepresented among cases (69.7%) compared to controls (37.3%), with an odds ratio (OR) of 3.92 (95% CI: 1.87–8.02; p<0.001).

Mother's occupation did not demonstrate a significant association with malnutrition, as the proportion of working mothers was nearly identical in cases (6.1%) and controls (6.0%). Socioeconomic status showed a higher proportion of lower-class families among cases (75.8%) than controls (67.2%), although this association was not statistically significant (p=0.11). The primary caretaker was predominantly the mother in both cases (93.9%) and controls (86.6%), with no significant difference observed.

Table 2: Risk Factors for Severe Acute Malnutrition (n=100).

Variables	Cases (n=33) (%)	Controls (n=67) (%)	χ^2, p-value	OR (95% CI)
Type of Family				
Joint	23 (69.7)	25 (37.3)	14.25, <0.001	3.92 (1.87–8.02)
Nuclear	10 (30.3)	42 (62.7)	Reference	
Mother's Occupation				
Working	2 (6.1)	4 (6.0)	0.001, 0.97	1.01 (0.17–5.83)
Non-working	31 (93.9)	63 (94.0)	Reference	
Socio-economic Status				
Middle class	8 (24.2)	22 (32.8)	2.56, 0.11	0.65 (0.28–1.49)
Lower class	25 (75.8)	45 (67.2)	Reference	
Primary Care Taker				
Mother	31 (93.9)	58 (86.6)	2.02, 0.15	2.17 (0.71–6.64)
Relatives other than mother	2 (6.1)	9 (13.4)	Reference	

Table 3 delves into birth-related factors and feeding practices. A significant association was identified with birth weight, as low birth weight was present in 51.5% of cases versus 14.9% of controls (OR: 6.04; 95% CI: 2.42–15.11; p<0.001). Pre-term births were slightly more common among cases (9.1%) than controls (6.0%), though the difference was not statistically significant.

The prevalence of pre-lacteal feeding was higher among cases (36.4%) than controls (20.9%), but this did not reach statistical significance (p=0.08). A noteworthy risk factor was a history of pica, which was significantly more prevalent among cases (63.6%) than controls (11.9%) (OR: 13.91; 95% CI: 5.20–37.15; p<0.001). Additionally, poor appetite was reported in 36.4% of cases compared to 20.9% of controls, indicating a trend toward significance (p=0.08).

Table 3: Risk Factors for Severe Acute Malnutrition (n=100).

Variables	Cases (n=33) (%)	Controls (n=67) (%)	χ^2, p-value	OR (95% CI)
Childbirth				
Pre-term	3 (9.1)	4 (6.0)	0.48, 0.49	1.57 (0.33–7.38)
At term/post-term	30 (90.9)	63 (94.0)	Reference	
Birth Weight				
Low birth weight	17 (51.5)	10 (14.9)	14.50, <0.001	6.04 (2.42–15.11)
Normal birth weight	16 (48.5)	57 (85.1)	Reference	
Pre-lacteals				
Yes, given	12 (36.4)	14 (20.9)	3.12, 0.08	2.18 (0.91–5.23)
No, not given	21 (63.6)	53 (79.1)	Reference	
History of Poor Appetite				
Yes	12 (36.4)	14 (20.9)	3.12, 0.08	2.18 (0.91–5.23)

No	21 (63.6)	53 (79.1)	Reference	
History of Pica				
Yes	21 (63.6)	8 (11.9)	39.94, <0.001	13.91 (5.20–37.15)
No	12 (36.4)	59 (88.1)	Reference	

DISCUSSION

Severe acute malnutrition (SAM) remains a significant public health challenge, especially among children under five years of age in resource-limited settings. This study highlights the socio-demographic and clinical risk factors associated with SAM in an urban locality of South India, shedding light on preventable contributors and offering insights for tailored interventions.

The socio-demographic characteristics observed in this study highlight the multifaceted nature of malnutrition. Children belonging to joint families had significantly higher odds of developing SAM compared to those in nuclear families (OR: 3.92, $p < 0.001$). This finding aligns with previous studies where larger household sizes and shared caregiving responsibilities diluted individual attention to a child's nutritional needs. Although joint families often offer emotional and logistical support, inadequate awareness and resource allocation within these structures could exacerbate malnutrition risks[8].

Maternal education emerged as a critical determinant. Most mothers of malnourished children had only primary-level education, highlighting the direct link between maternal literacy and child health outcomes. Educated mothers are more likely to adopt optimal feeding practices, recognize early signs of malnutrition, and seek timely medical care. Public health programs should prioritize educating mothers, particularly in underserved urban areas, to empower them with the knowledge required to nurture their children effectively[9].

Non-working mothers constituted the majority of caregivers in both cases and controls, with no significant association between maternal occupation and SAM. While working mothers face unique challenges in ensuring adequate childcare, the findings suggest that caregiving quality, rather than employment status, plays a more pivotal role. Strengthening maternal support systems, such as providing nutritional counseling during antenatal and postnatal visits, could benefit children regardless of their mothers' occupational status[10].

Socioeconomic status, as assessed by the Modified BG Prasad classification, was another significant factor. A higher prevalence of SAM was observed among children from lower-middle and lower socioeconomic strata, consistent with existing literature. Limited financial resources often translate into inadequate access to nutritious food, healthcare, and sanitation. Policymakers should consider socioeconomic vulnerabilities when designing nutritional interventions, ensuring subsidized access to healthcare and fortified food products for marginalized families[11].

Birth weight was a strong predictor of SAM in this study, with low birth weight (LBW) children being six times more likely to develop SAM (OR: 6.04, $p < 0.001$). This finding resonates with global evidence linking intrauterine growth restriction and perinatal factors to early childhood malnutrition. LBW not only reflects poor maternal nutrition but also predisposes infants to a higher risk of infections and suboptimal growth trajectories. Addressing maternal malnutrition through enhanced antenatal care and micronutrient supplementation could reduce LBW prevalence and its downstream effects on child health[12].

Pre-lacteal feeding, although not statistically significant in this study, was more common among cases than controls. This practice, rooted in cultural traditions, often replaces colostrum—a vital source of antibodies and nutrients critical for neonatal immunity. Despite high rates of colostrum feeding reported among participants, efforts to eliminate pre-lacteal feeding should continue, emphasizing the importance of exclusive breastfeeding during the first six months of life[13].

Bottle feeding was associated with significantly higher odds of SAM, reflecting its role as a potential conduit for infections, particularly diarrhea, which aggravates malnutrition. Public health campaigns should discourage bottle feeding and promote alternative practices such as cup feeding, which reduces contamination risks. Moreover, reinforcing the importance of hygienic feeding practices among caregivers could mitigate avoidable nutritional losses due to recurrent illnesses[14].

The high prevalence of pica among cases (63.6%) compared to controls (11.9%) (OR: 13.91, $p < 0.001$) draws attention to the behavioral dimension of malnutrition. Pica, often triggered by micronutrient deficiencies, perpetuates a vicious cycle of parasitic infections and nutritional depletion. Addressing underlying deficiencies through fortified foods or supplements could break this cycle and improve overall nutritional outcomes[15].

Recurrent infections such as diarrhea and respiratory illnesses, though not statistically significant in this study, were more frequently reported among cases. These illnesses, exacerbated by poor living conditions and inadequate access to healthcare, are major contributors to malnutrition. Integrated child health programs must address these interlinked factors by improving sanitation, vaccination coverage, and access to prompt medical care[16].

Interestingly, the study observed no significant association between preterm birth and SAM.

However, the higher prevalence of SAM among children born preterm (9.1% cases vs. 6.0% controls) suggests the need for targeted follow-up and nutritional monitoring for this vulnerable group. Early interventions, such as kangaroo mother care and fortified preterm formula, could significantly improve growth outcomes for preterm infants[17].

This study highlights the urgent need for a multi-pronged approach to tackle SAM in urban settings. Strengthening maternal and child health services, integrating nutritional counseling into routine healthcare visits, and promoting exclusive breastfeeding are essential steps. Targeted programs addressing maternal education and poverty alleviation could have long-term benefits in breaking the intergenerational cycle of malnutrition. Furthermore, community-based strategies, such as engaging frontline health workers to monitor child growth and provide timely referrals, could enhance early detection and management of SAM. Social behavior change communication (SBCC) campaigns addressing harmful feeding practices, such as bottle feeding and pre-lacteal feeding, should be prioritized[18].

This study has several strengths, including its case-control design, standardized data collection methods, and use of validated tools to assess socioeconomic status and anthropometric measurements. However, certain limitations warrant consideration. The small sample size, while sufficient for detecting associations, may limit the generalizability of findings to other urban contexts. Recall bias could also influence the accuracy of self-reported data, particularly for feeding practices and birth history.

CONCLUSION

This study provides critical insights into the risk factors associated with SAM among children under five years in an urban locality of South India. Socioeconomic vulnerabilities, maternal education, LBW, pica, and bottle feeding emerged as key contributors to malnutrition. These findings emphasize the need for integrated, context-specific interventions addressing the complex interplay of biological, social, and environmental factors driving malnutrition. By prioritizing these areas, policymakers and healthcare providers can make significant strides toward achieving the Sustainable Development Goal of zero hunger and improving child survival rates in India.

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