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Original Article

Socio-Demographic Risk Factors Associated with Severe Acute Malnutrition In Children

Dr. Niraj Lakhmawar[1], Dr. Abhijeet Shinde[2], Dr. Poonam Patil[3], Dr. Suresh Waydande[4], Dr. Sunil Natha Mhaske[5]

[1]Junior Resident, [2]Associate Professor, [3]Assistant Professor, [4]Professor and Head, Department of Paediatrics, [5]Professor Paediatrics and Dean, DVVPF's Medical College and Hospital, Ahilyanagar-414111, Maharashtra, India

Abstract:

Background: Severe Acute Malnutrition (SAM) remains a significant public health concern in India, particularly in Maharashtra, where malnutrition contributes to high child mortality rates. SAM is associated with delayed growth, impaired cognitive development, and increased susceptibility to infections. Despite government initiatives, its prevalence continues to rise, necessitating a deeper understanding of its socio-demographic and environmental determinants. **Objective:** This study aims to investigate socio-demographic, maternal, environmental, and nutritional risk factors associated with SAM among children aged 6–59 months in Maharashtra and to inform targeted interventions to reduce malnutrition prevalence. **Methodology:** A cross-sectional observational study was conducted on 100 children diagnosed with SAM, using WHO diagnostic criteria. Data were collected through structured questionnaires and medical record reviews. Variables analyzed included socio-demographic characteristics, maternal and child healthcare factors, environmental conditions, and nutritional practices. **Results:** The highest prevalence of SAM was observed in children aged 13–24 months (40%), coinciding with weaning and dietary transitions, followed by 6–12 months (30%). Male children (55%) were more affected than females (45%). A significant association was noted with higher birth order, as children with birth order greater than two comprised 50% of cases. Low birth weight (<2.5 kg) was present in 60% of SAM cases, emphasizing the importance of maternal and neonatal health. Poor maternal healthcare was a critical contributor, with 60% of mothers lacking antepartum care and 70% lacking postnatal care. Maternal education played a pivotal role; 55% of affected children had illiterate mothers. Socioeconomic disparities were evident, as 70% of SAM cases occurred in lower socioeconomic classes. **Conclusion:** This study highlights the multifaceted determinants of SAM in Maharashtra, underscoring the need for interventions targeting vulnerable age groups, maternal education, and healthcare accessibility.

Key words: Severe Acute Malnutrition, SAM, Child Nutrition, Maternal Health

Introduction:

Malnutrition among children remains a widespread issue in developing regions, particularly in sub-Saharan Africa and South-East Asia, including India. Nearly half of all child deaths are attributed to malnutrition, with approximately 3 million children under five dying from malnutrition globally each year.[1] The major health impacts of malnutrition in children include delayed physical growth, impaired motor skills, poor cognitive development, and increased susceptibility to severe infectious diseases. Severe acute malnutrition (SAM) is recognized as both a medical and social disorder, with affected children facing a ninefold higher risk of mortality compared to well-nourished children. In India, an estimated 8.1 million children under five suffer from SAM.[2] Furthermore, malnutrition is implicated in 61% of diarrheal deaths and 52% of pneumonia deaths.[3]

Children with SAM require inpatient care, ideally in specialized units such as Nutrition Rehabilitation Centres (NRCs), which are equipped with skilled personnel and resources for both medical and nutritional therapy.[4] According to WHO guidelines, SAM is diagnosed using criteria such as a mid-upper arm circumference (MUAC) below 115 mm, a weight-for-height/length z-score (WHZ) below -3 SD of the WHO Child Growth Standards, the presence of bilateral nutritional pedal edema, or visible severe wasting.[5]

Corresponding Author: *Dr. Niraj Lakhmawar*

Email ID: *- lakhmawarnn@gmail.com*

Address: *Department of Paediatrics, DVVPF's Medical College and Hospital, Ahilyanagar - 414111, Maharashtra, India*

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Cases of SAM with complications necessitate treatment and follow-up at NRCs.[5]

Adequate nutrition is crucial for health, survival, quality of life, and overall well-being[4]. Proper nutrition during early childhood is essential for healthy growth, organ development, a robust immune system, and cognitive development. Malnutrition not only hinders cognitive abilities but also perpetuates poverty by reducing individuals' productivity.[6] A mother's nutritional status is directly linked to her child's health; undernourished mothers are more likely to give birth to low-birth-weight infants, perpetuating a cycle of undernutrition from infancy to adolescence and into the next generation. Undernutrition is more prevalent in lower-income groups, while milder forms are sometimes seen in higher-income groups. Encouraging appropriate child feeding practices plays a key role in preventing and managing malnutrition while ensuring proper growth.[7]

According to the National Family Health Survey-5 (NFHS-5), eight percent of children in India are affected by SAM.[8] Maharashtra is among the leading states in India in addressing child nutrition and development. It was the first state to establish a dedicated Nutrition Mission, the Rajmata Jijau Mother-Child Health and Nutrition Mission (RJMCHN Mission), focusing on improving maternal and child nutrition.[9] Recognizing the high prevalence of wasting among children under five and its detrimental effects on survival, growth, and development, the Maharashtra Government launched an initiative in 2008 to manage SAM cases at three levels. Supported initially by NHM funds and later by state funds, the program provided community-level care for uncomplicated cases through Village Child Development Centres (VCDCs) and managed complicated cases at facilities such as Child Treatment Centres (CTCs) in rural hospitals and NRCs in district and sub-district hospitals.[9] Despite these measures, the prevalence of SAM in Maharashtra increased from 9.4% to 10.9% between NFHS-4 and NFHS-5.[10]

Given the severe complications associated with SAM, it is critical to examine its trends and significant predictors over these survey periods. However, limited studies have specifically explored this concern in Maharashtra.

Methodology:

Study design: Cross-sectional observational study

Study population:

1.Inclusion criteria:

- Children aged 6–59 months diagnosed with SAM, as per who criteria
- Parents /guardian who provided informed consent for participation in the study.

2.Exclusion criteria:

- Children with congenital anomalies or chronic illnesses unrelated to malnutrition.
- Parents /guardian not willing to participate.

Sample size: A total of 100 children with SAM were included in the study.

Study setting: The study was conducted in tertiary care center,

Data collection: Data were collected using a structured questionnaire and medical record review, capturing information on:

1.Socio-demographic factors:

- Family income (classified using the kuppuswamy ses scale).
- Parental education and occupation.
- Household size and birth order of the child.

2.Maternal and child health:

- Birth weight (<2.5 kg or ≥2.5 kg).
- Antenatal care (number of antenatal visits, iron/folic acid supplementation).
- Postpartum care (received/not received within 48 hours).
- Immunization status of the child.

3.Environmental factors:

- Access to clean drinking water and sanitation facilities.
- Distance to the nearest healthcare facility.

4.Nutritional practices:

- Breastfeeding (exclusive breastfeeding duration).
- Introduction of complementary feeding.

Results:

Table 1: Distribution According To Age

Subjects	Frequency	Percentage (%)
6–12months	30	30
13–24 Months	40	40
25–36 Months	20	20
37–59 Months	10	10
Total	100	100

The study reveals that children in the age group of 13–24 months are most affected by severe acute malnutrition (SAM), accounting for 40% of the cases. This age corresponds to the weaning period and dietary transitions, making children more vulnerable to malnutrition. The prevalence decreases with age, with children aged 6–12 months accounting for 30%, 25–36 months for 20%, and 37–59 months for 10%, suggesting better resilience and nutritional improvements over time.

Table 2: Distribution According To Gender

Gender	Frequency	Percentage (%)
Male	55	55
Female	45	45
Total	100	100

There is a slight male predominance in malnutrition cases, with boys constituting 55% of the total and girls 45%. This could reflect cultural or behavioral differences in food allocation or healthcare access within households.

Table 3: Distribution According To Birth Order

Birth Order	Frequency	Percentage (%)
1	30	30
2	20	20
>2	50	50
Total	100	100

Birth order is a significant risk factor, with children from families having more than two siblings comprising 50% of the cases. Firstborn children make up 30% of the cases, and second-borns account for 20%. The high prevalence in larger families may be attributed to resource dilution, where limited resources are insufficient to meet the nutritional needs of all children.

Table 4: Distribution According To Birth Weight

Birth Weight	Frequency	Percentage (%)
<2.5kg	60	60
>2.5kg	40	40
Total	100	100

Low birth weight (<2.5 kg) is strongly associated with SAM, accounting for 60% of the cases. This finding highlights the importance of prenatal care and maternal nutrition, as low birth weight is a critical determinant of child health and development.

Table 5: Distribution According to Antepartum & Postnatal Care

	Antepartum Care	Postnatal Care
Not Received	60 (60%)	70 (70%)
Received	40 (40%)	30 (30%)
Total	100	100

The study shows that 60% of the children belong to mothers who did not receive antepartum care, and 70% belong to mothers who did not receive postnatal care. This lack of maternal and child healthcare services during crucial periods significantly increases the risk of malnutrition in children.

Table 6: Distribution According To Mothers Education

Gender	Frequency	Percentage (%)
Illiterate:	55	55
Primary Education:	30	30
Secondary/ Higher:	20	20
Total	100	100

Maternal education plays a vital role in child nutrition, with 55% of malnourished children having illiterate mothers. Children of mothers with primary education constitute 30% of the cases, while those with mothers who have secondary or higher education account for only 20%. This indicates that maternal literacy and awareness positively impact child health.

Table 7: Distribution According To Socioeconomic Status

Socioeconomic Status	Frequency	Percentage (%)
Upper Class	1	1
Upper Middle Class:	5	5
Lower Middle Class:	24	24
Upper Lower Class	35	35
Lower Class	35	35
Total	100	100

Socioeconomic disparities are evident, as 70% of the cases come from lower-income groups (35% each from the upper-lower and lower classes). Only 1% of the cases are from the upper class, and 5% from the upper-middle class, emphasizing that economic hardships significantly contribute to malnutrition.

Table 8: Distribution According To Family Size

Family Size	Frequency	Percentage (%)
Small	10	10
Medium	30	30
Large	60	60
Total	100	100

Large family size is strongly associated with malnutrition, as 60% of the cases are from large families, compared to 30% from medium-sized families and 10% from small families. This highlights the strain on resources and the challenge of providing adequate nutrition in bigger households.

Table 9: Distribution According Access To Healthcare

Healthcare	Frequency	Percentage (%)
Less Than 5 Km	30	30
More Than 5 Km	70	70
Total	100	100

Healthcare access is a major barrier, with 70% of the cases coming from families living more than 5kilometers away from healthcare facilities. This lack of accessibility exacerbates malnutrition by delaying or preventing timely medical interventions.

Table 10: Distribution According To Immunization Status

Immunization Status	Frequency	Percentage (%)
Completed	40	40
Not Completed/Not Taken	60	60
Total	100	100

Incomplete or absent immunization is prevalent among malnourished children, with 60% falling into this category. Only 40% of the children had completed their immunizations, indicating that gaps in immunization coverage leave children vulnerable to infections that aggravate malnutrition.

Table 11: Distribution According To Access To Clean Drinking Water

Clean Drinking Water	Frequency	Percentage (%)
Yes	40	40
No	60	60
Total	100	100

Clean drinking water is lacking for 60% of the children, further contributing to malnutrition through waterborne diseases and infections. Only 40% of families have access to clean drinking water, indicating a significant public health challenge.

Table 12: Distribution According To SANITATION

Sanitation	Frequency	Percentage (%)
Open defaecation	65	65
Proper sanitation facilities	35	35
Total	100	100

Poor sanitation practices are another critical factor, with 65% of the families practicing open defecation. Only 35% have access to proper sanitation facilities. This lack of hygiene increases the risk of infections and illnesses, further compounding malnutrition issues.

Discussion:

Our study on socio-demographic risk factors associated with Severe Acute Malnutrition (SAM) in children in Maharashtra revealed critical insights. The highest prevalence of SAM was observed in children aged 13–24 months (40%), followed by those aged 6–12 months (30%). The prevalence decreased with age, with only 10% of cases recorded in the 37–59 months age group. These findings highlight the vulnerability of younger children, particularly during the weaning period. Gender distribution in our study showed a higher prevalence of SAM among males (55%) compared to females (45%), which contrasts with the findings of Bilal Ahmad Najar et al., who reported that SAM was more common among females in all age groups, with females comprising 60% of cases overall.[11]

In terms of birth order, our study found that 50% of SAM cases were among children with a birth order greater than two, while firstborns and second-borns accounted for 30% and 20%, respectively.

Similarly, Bilal Ahmad Najar et al. reported a higher prevalence (37%) of SAM among children with a birth order of three or higher, suggesting resource constraints in larger families. Low birth weight (<2.5 kg) was a significant factor in our study, associated with 60% of SAM cases, underscoring the importance of addressing maternal and neonatal health.

Maternal education was a critical determinant in our study, with 55% of mothers being illiterate and only 20% having secondary or higher education. This aligns with Bilal Ahmad Najar et al., who reported 64.28% of mothers as illiterate and only 17% having secondary or higher education. Socioeconomic status also played a significant role in both studies. In our study, 35% of cases were from lower-class families, and another 35% were from upper-lower-class households. Similarly, Bilal Ahmad Najar et al. found that 64.57% of SAM cases occurred in families from the lowest socioeconomic class.[11]

Environmental and healthcare-related factors further exacerbated the prevalence of SAM. In our study, 70% of families lived more than 5 km away from healthcare facilities, and 60% of children had incomplete or no immunization. This aligns with Bilal Ahmad Najar et al., who found that only 56% of children were fully immunized, while 43% were partially or unimmunized.[11] Poor sanitation and lack of access to clean drinking water were prominent in our findings, with 65% of families practicing open defecation and 60% lacking access to clean drinking water.

In our study on Severe Acute Malnutrition (SAM) in children in Maharashtra, the age distribution revealed that the highest prevalence was in children aged 13–24 months (40%), followed by 6–12 months (30%). The prevalence decreased in older age groups, with 25–36 months at 20% and 37–59 months at 10%. These findings align closely with the study by Rajkumari Rupabati Devi, which reported the highest prevalence in the 12–24 months age group (31.81%), followed by 6–12 months (28.57%). Both studies highlight that children aged 6–24 months are the most vulnerable due to their rapid growth needs and dependency on complementary feeding.

In terms of gender distribution, our study found a higher prevalence among males (55%) compared to females (45%). However, Rajkumari Rupabati Devi's study reported the opposite trend, with females being more affected in all age groups.[12] For example, in the 6–12 months group, her study found 19 female cases compared to 13 male cases. These contrasting findings may reflect regional and cultural differences in childcare practices and require further exploration.

Birth order was another significant factor in both studies. In our study, children with a birth order greater than two constituted 50% of SAM cases, compared to 30% for first-born children. Similarly, Rajkumari Rupabati Devi's study found that children with a birth order of three or higher accounted for 37% of cases.[12] These findings suggest that higher birth order may strain family resources, increasing the risk of malnutrition.

Low birth weight (<2.5 kg) was identified as a critical risk factor in our study, with 60% of SAM cases occurring in this group. While not explicitly addressed in the other study, this observation aligns with existing evidence linking low birth weight to poor health outcomes, including malnutrition. Furthermore, inadequate maternal healthcare was a notable issue in our study, where 60% of mothers did not receive antepartum care, and 70% lacked postnatal care. These gaps in maternal healthcare likely contribute significantly to the incidence of SAM.

Maternal education also emerged as a critical determinant of child nutrition. In our study, 55% of mothers were illiterate, and only 20% had secondary or higher education. Similarly, Rajkumari Rupabati Devi's study reported that 64.28% of mothers were illiterate, with only 6.25% having higher education. Both studies underscore the importance of maternal education in improving childcare practices and reducing the risk of malnutrition.

Socioeconomic status was another major risk factor identified in both studies. In our study, 70% of SAM cases were from lower and upper-lower socioeconomic classes, while Rajkumari Rupabati Devi's study reported 64.57% of cases in the lowest socioeconomic class. This demonstrates how poverty limits access to adequate nutrition, healthcare, and sanitation, exacerbating malnutrition.

Immunization status further highlighted disparities in healthcare access. In our study, only 40% of children were fully immunized, while 60% had incomplete or no immunization. In contrast, Rajkumari Rupabati Devi's study found that 56% of children were fully immunized, with only 16.96% unimmunized.[12] The higher rate of incomplete immunization in our study points to regional gaps in healthcare delivery and awareness.

The comparison between our study and Ajeet Singh Bhadoria's study on severe acute malnutrition (SAM) reveals important insights into sociodemographic and health-related risk factors.[13] Regarding study population characteristics, our study analyzed data from 100 children, predominantly under three years old, with 30% aged 6–12 months and 40% aged 13–24 months. The gender distribution in our study was 55% males and 45% females. In contrast, Bhadoria's study had a much larger sample size of 18,463 children, with a mean age of 32.6 ± 15.4 months, and a similar gender distribution of 53.4% males and 46.6% females.[13] Both studies indicate a slight male preponderance, though our study focuses on younger children, a critical period for malnutrition.

In terms of nutritional indicators, our study did not directly quantify SAM prevalence but identified associated risk factors such as low birth weight (60%), poor antenatal (60%) and postnatal care (70%), and immunization gaps (60%). Bhadoria's study, on the other hand, reported SAM prevalence at 2.2% and moderate acute malnutrition (MAM) at 13.7%, using weight-for-height (WFH), weight-for-age (WFA), height-for-age (HFA), and BMI-for-age Z-scores.[13] Bhadoria's detailed Z-score classifications provide a precise measurement of malnutrition prevalence, which our study could incorporate to offer a comparable nutritional assessment.[13]

Examining sociodemographic risk factors, our study found that larger families (60%), low maternal education (55% illiterate), and low socioeconomic status (70% in the lower and upper lower classes) were significant contributors to SAM. Additionally, 70% of households in our study were located more than 5 km from healthcare facilities, and poor sanitation (65% practicing open defecation) and lack of clean drinking water (60%) further compounded the risk. Bhadoria's study similarly identified male gender, lower parental education, nuclear family structure, lower socioeconomic status, and the occupation of the head of the household as significant risk factors for SAM, with multivariate analysis confirming these as independent predictors. While Bhadoria's study emphasized paternal education and family structure, our study highlighted the impact of maternal education, healthcare access, and hygiene practices as critical determinants of malnutrition.[13]

Our study revealed a slightly higher proportion of males (55%) compared to females (45%), indicating a mild male predominance. In contrast, the study by David et al. observed an equal gender distribution, with males and females each comprising 48.1% of the population.[14] This difference could reflect regional or cultural variations in healthcare access or reporting biases, which may lead to differences in the gender distribution of malnutrition cases. Age distribution in our study highlighted early childhood as a critical period for malnutrition, with 30% of participants aged 6–12 months and 40% aged 13–24 months, indicating that the majority were under two years of age. David et al. did not analyze the distribution of age as a separate variable, which limits insights into age-specific vulnerabilities.[14] This underscores the importance of focusing on younger age groups where the risk of malnutrition is often highest.

Regarding residence, David et al. reported a higher proportion of participants residing in urban areas (72.2% cases and 76.4% controls), with fewer participants from rural areas David et al.'s urban dominance could reflect the study's location or its sampling methods, and including similar data in our study could provide valuable comparative insights.[14] Socioeconomic indicators indirectly reflected living conditions. David et al. found that a higher proportion of cases lived in pucca houses (66.7%) compared to controls (48.1%), while mixed housing was more common in controls (44.3% vs. 13% in cases).[14] This suggests that housing quality might not be directly associated with malnutrition but reflects broader socioeconomic disparities. Including housing data in our study could enrich the analysis.

Family structure was assessed differently in the two studies. Our study categorized family size, revealing that 60% of participants belonged to large families (more than six members). David et al. emphasized family type, noting that nuclear families were more common among controls (57.5%) compared to cases (46.3%), while extended families were more frequent among cases (27.8%) than controls (5.7%). Both findings highlight the role of family dynamics in malnutrition, with our study suggesting resource dilution as a factor in larger families and David et al. focusing on the support systems in different family structures.

Socioeconomic status (SES) was a significant determinant in both studies. In our study, the majority of participants belonged to lower socioeconomic classes, with 35% each in the upper lower and lower classes, and only 1% in the upper class. Similarly, David et al. reported most participants in Class IV SES (42.6% cases and 42.5% controls), with a higher proportion of cases in Class V (22.2% vs. 7.5% in controls). Both studies underscore the strong association between lower SES and malnutrition, emphasizing the need for targeted interventions in economically disadvantaged populations.

Parental education was another critical factor. Maternal illiteracy in our study was alarmingly high (55%), with only 20% of mothers achieving secondary or higher education. David et al. also noted that illiteracy or primary education was more common among mothers in cases (29.7%) than controls (26.4%). Higher maternal education was more frequent among controls in both studies. These findings highlight the pivotal role of maternal education in preventing malnutrition and the greater burden of illiteracy in our study population.

Conclusion:

This study highlights that Severe Acute Malnutrition (SAM) in Maharashtra is driven by a combination of socio-demographic, maternal, environmental, and nutritional factors. Younger children, particularly those aged 6–24 months, are most vulnerable, with low maternal education, poor healthcare access, and socioeconomic disparities significantly contributing to the risk. Environmental challenges such as poor sanitation, lack of clean drinking water, and immunization gaps further exacerbate the issue. Addressing these interconnected factors through targeted interventions, improved healthcare access, and public health initiatives is essential to reduce the prevalence and impact of SAM.

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