

## STUDY ON ASSESSMENT OF NUTRITIONAL STATUS OF TERM INFANTS ATTENDING SNCU FOLLOW-UP CLINICS.

Abhishek Kumar Sahu<sup>1</sup>, Rashmi Randa<sup>2</sup>, Sharmila Ramteke<sup>3</sup>, Aapurti Awasthi<sup>4</sup>, Kumari Pinky<sup>5</sup>, Manjusha Goel<sup>6</sup>

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### Corresponding Author:

Dr. Abhishek Kumar Sahu,  
Email: sahua4713@gmail.com

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<sup>1</sup>Post graduate, Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh, India.  
<sup>2</sup>Associate Professor, Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

<sup>3</sup>Associate Professor, Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

<sup>4</sup>Post graduate, Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

<sup>5</sup>Post graduate, Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

<sup>6</sup>Professor, Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh, India.

### ABSTRACT

**Background:** This study assesses nutritional status of term infants aged 2 months to 1 year attending Special Newborn Care Unit (SNCU) follow-up clinics and identifies influencing factors. **Materials and Methods:** A cross-sectional study conducted from July 2022 to March 2024 evaluated nutritional status using anthropometric measurement weight, length, weight for length, MUAC and head-circumference. Data were analyzed using Statistical Package for Social Sciences (SPSS). **Result:** Among 168 term infants, stunting was the most prevalent, affecting 32.7% (n=55) of infants, followed by wasting at 25.0% (n=42). Severe acute malnutrition (SAM) is reported in 8.3% (n=14) of cases, while 22.0% (n=37) of infants are classified as underweight. Significant associations were found between low birth weight and both stunting (p=0.028) and underweight (p=0.001), underweight and breastfeeding (p=0.003), underweight and hospital stay (p=0.009). **Conclusion:** The present study found that prevalence of SAM and wasting slightly higher in high risk SNCU term graduates than in normal population of <5 years children. Prevalence of underweight was seen more in LBW, non exclusive breastfed infants and those having longer hospital stay during neonatal period. So, these infants need to be carefully monitored and closely followed.

## INTRODUCTION

India, a nation known for its rich cultural tapestry and a burgeoning population, faces a critical challenge in ensuring the health and well-being of its youngest citizens. Infant nutrition, a crucial determinant of public health, stands at the nexus of healthcare, socio-economic disparities, and public policy, representing a pivotal battleground in the effort to combat preventable diseases and mortality among infants. India has very high rates of stunting (31.7%) and wasting (18.7%). Overweight affected an estimated 5.6% or 37 million children under 5 globally in 2022.<sup>[1]</sup> Prevalence of SAM in India is 7.7% as per most recent NFHS-5 survey (2019-2021).<sup>[2]</sup> Special Newborn Care Units (SNCUs) have emerged as sanctuaries of hope, providing specialized medical care to neonates and infants, especially those born prematurely or with low birth weights. These units, staffed with skilled healthcare professionals and equipped with advanced medical technologies, offer

a beacon of optimism for these vulnerable newborns. After receiving initial treatment in SNCUs, infants are seen in follow-up clinics. These clinics serve as crucial points of contact for ongoing care and monitoring. The transition from acute medical intervention to sustained healthcare, often accompanied by nutritional support, marks a pivotal juncture in these infants' lives.<sup>[3]</sup> Malnutrition not only endangers the immediate health of infants but also casts a long shadow, hampering physical and cognitive development and compromising the nation's human capital potential.<sup>[4]</sup> By meticulously examining this period, this study aims to provide nuanced insights into the factors influencing infant nutrition, thereby paving the way for targeted interventions and policy formulations. We aimed to assess nutritional status of term infants 2 months to 1 year of age attending SNCU follow up clinic and to identify factors affecting their nutritional status.

## MATERIALS AND METHODS

This study was done in SNCU Follow up clinic, Department of Pediatrics of a tertiary care medical college in central India during the study period July 2022 to March 2024 as a cross-sectional study. Infants 2 months to 1 year of age born at full term gestation 37 weeks to 41+6 weeks, attending SNCU Follow Up Clinic were included whereas infants with major congenital anomalies and infants with birth Weight less than 1.5 kg were excluded.

Sample Size was calculated

Population Proportion =0.44

d=Margin of Error i.e.=7.5%

The sample size was estimated to be 168.

Infants who fulfilled the inclusion criteria established for the study were assessed once between the age of 2 month to 1 year .Comprehensive demographic details and relevant data were collected in predesigned proforma including name, age, sex, father's name, mother's name, date of birth, date of assessment, birth weight, cause of hospitalization, duration of stay, diagnosis, birth weight, vaccination status of each infants was recorded along with infant feeding practices and socio-economic status.

The nutritional status of the infants was evaluated by doing anthropometric measurements, including weight, length, weight for length, MUAC and head circumference. Nutritional Indicators such as SAM, stunting, wasting, underweight were assessed according to WHO guideline.<sup>[5]</sup>

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SAM          | <p>&lt;6 months of age</p> <ol style="list-style-type: none"> <li>1. Weight for length below -3SD on the WHO Growth Standard,</li> <li>2. And/ or Presence of bipedal edema,</li> <li>3. And/or visible severe wasting.</li> </ol> <p>6 to 59 months of age</p> <ol style="list-style-type: none"> <li>1. Weight for length below -3SD on WHO Growth Standard,</li> <li>2. And/ or presence of bipedal edema.</li> <li>3. And/or visible severe wasting.</li> <li>4. And/or Mid upper arm circumference. (MUAC) below 11.5 cm</li> </ol> |
| Underweight  | weight for age <-2SD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Stunting     | length for age <-2SD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Wasting      | Weight for length <-2SD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Microcephaly | head circumference <-3SD for age and sex                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

### WHO SAM definition,<sup>[5]</sup>

Parents were counseled accordingly and referred to NRC in case needed.

Statistical analysis-Statistical analysis was performed using Statistical Package for Social Sciences(SPSS) program to interpret the collected data. Continuous variables were presented as mean & SD. Categorical variables were presented as absolute numbers and percentage. Categorical variable were analyzed using either chi square test or Fisher's exact test. P value of less than 0.05 was considered significant.

## RESULTS

168 infants recruited. The majority of infants fall into the age range of 2-3 months, comprising 40.5% of the total sample, followed by the age group of 4-6 months, constituting 31.0%. [Figure 1]

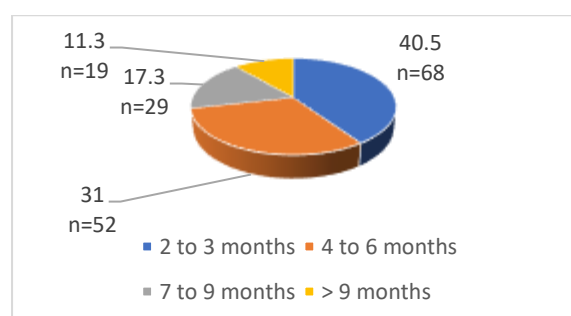


Figure 1: Age distribution of study population

The study found male predominance (71.4%) and more than half of the patients belonged to lower middle socioeconomic class. About 69.6% mothers were educated till high school. Neonatal hyperbilirubinemia was the most common cause of admission (30.4%) and 62.5% had a hospitalization duration of 0-7 days. About 35.1% infants had history of low birth weight and 1.2% were unvaccinated. History of Exclusive breast feeding was observed in 86.3%. [Table 1]

Stunting was the most prevalent, affecting 32.7% of infants, followed by wasting at 25.0%. Severe acute malnutrition (SAM) is reported in 8.3% of cases, while 22.0% of infants are classified as underweight. There were 80 (47.6%) patients who were having normal nutrition. [Figure 2]

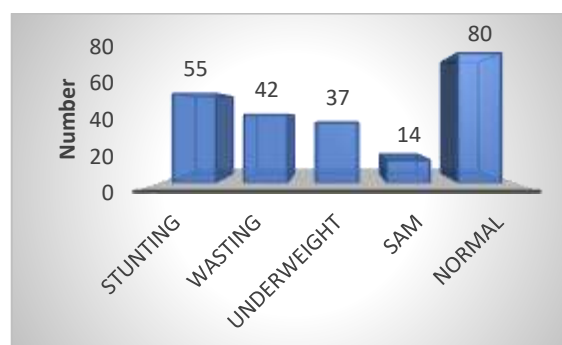


Figure 2: Prevalence of different nutritional finding

**Table 2: Baseline characteristics of study population**

| Baseline characteristics |                                 | No. of patients<br>(n=168) | Percentage |
|--------------------------|---------------------------------|----------------------------|------------|
| Sex                      | Female                          | 48                         | 28.6       |
|                          | Male                            | 120                        | 71.4       |
| Socioeconomic status     | Lower                           | 22                         | 13.1       |
|                          | Upper Lower                     | 40                         | 23.8       |
|                          | Lower Middle                    | 88                         | 52.4       |
|                          | Upper Middle                    | 14                         | 8.3        |
|                          | Upper                           | 50                         | 29.8       |
| Maternal education       | Illiterate                      | 6                          | 3.6        |
|                          | High school                     | 117                        | 69.6       |
|                          | Till 12 <sup>th</sup>           | 52                         | 31.0       |
|                          | Graduate                        | 43                         | 25.6       |
|                          | Post graduate                   | 10                         | 6.0        |
| Diagnosis                | Perinatal asphyxia              | 27                         | 16.1       |
|                          | Neonatal hyperbilirubinemia     | 51                         | 30.4       |
|                          | Sepsis                          | 36                         | 21.4       |
|                          | Meningitis                      | 13                         | 7.7        |
|                          | Transient tachypnoea of newborn | 14                         | 8.3        |
|                          | Meconium aspiration syndrome    | 15                         | 8.9        |
|                          | Pneumonia                       | 12                         | 7.1        |
| SNCU Stay                | 0-7                             | 105                        | 62.5       |
|                          | 7-14                            | 37                         | 22.0       |
|                          | >14                             | 26                         | 15.5       |
| Birth weight             | LBW                             | 59                         | 35.1       |
|                          | Macrosomia                      | 2                          | 1.2        |
|                          | Normal                          | 109                        | 64.9       |
| Vaccination              | Unvaccinated                    | 2                          | 1.2        |
|                          | Vaccinated till age             | 166                        | 98.8       |
|                          | Partial vaccinated              | 0                          | 0.0        |
| Exclusive breast feeding | No                              | 23                         | 13.7       |
|                          | Yes                             | 145                        | 86.3       |

**Table 3: Association of nutritional findings with sociodemographic variables**

| Sociodemographic variables |                              | Stunting  | Wasting   | SAM      | Underweight | Normal    |
|----------------------------|------------------------------|-----------|-----------|----------|-------------|-----------|
| Age (months)               | 2-3 (n=68)                   | 18 (26.5) | 22 (32.4) | 9 (13.2) | 13 (19.1)   | 32 (47.1) |
|                            | 4-6 (n=52)                   | 15 (28.8) | 9 (17.3)  | 2 (3.8)  | 9 (17.3)    | 28 (53.8) |
|                            | 7-9 (n=29)                   | 13 (44.8) | 6 (20.7)  | 1 (3.4)  | 11 (37.9)   | 12 (41.4) |
|                            | >9 (n=19)                    | 9 (47.4)  | 5 (26.3)  | 2 (10.5) | 4 (21.1)    | 8 (42.1)  |
|                            | P value                      | 0.148     | 0.272     | 0.209    | 0.152       | 0.682     |
| Sex                        | Female (n=48)                | 14 (29.2) | 14 (29.2) | 4(8.3)   | 10 (20.8)   | 19(39.5)  |
|                            | Male (n=120)                 | 41 (34.2) | 28 (23.3) | 10(8.3)  | 27 (22.5)   | 61(50.8)  |
|                            | P value                      | 0.533     | 0.439     | 0.435    | 0.814       | 0.187     |
| Socioeconomic status       | Lower (n=22)                 | 5 (22.7)  | 2 (9.1)   | 0 (0)    | 4 (18.2)    | 14(63.6)  |
|                            | Upper Lower (n=40)           | 16 (40)   | 13 (32.5) | 4(10.0)  | 6 (15.0)    | 16(40.0)  |
|                            | Lower Middle (n=88)          | 31 (35.2) | 22(25)    | 9(10.2)  | 25 (28.4)   | 42(47.8)  |
|                            | Upper Middle (n=14)          | 2 (14.3)  | 4(28.5)   | 1(7)     | 2 (14.3)    | 8 (57.3)  |
|                            | Upper (n=2)                  | 1 (50)    | 1 (50)    | 0 (0)    | 0 (0)       | 0 (0)     |
|                            | P value                      | 0.292     | 0.312     | 0.589    | 0.344       | 0.263     |
| Maternal education         | Illiterate (n=6)             | 3 (50)    | 1 (16.7)  | 0 (0)    | 1 (16.7)    | 1 (16.7)  |
|                            | High school (n=117)          | 29 (24.8) | 20 (17.1) | 8(6.8)   | 19 (16.2)   | 41(35.1)  |
|                            | Till 12 <sup>th</sup> (n=52) | 11 (21.2) | 10 (19.2) | 4(7.7)   | 7 (13.5)    | 20(38.5)  |
|                            | Graduate (n=43)              | 11 (25.6) | 9 (20.9)  | 0 (0)    | 6 (13.9)    | 17(39.5)  |
|                            | Post graduate (n=10)         | 1 (10)    | 2 (20)    | 2 (20)   | 4 (40)      | 1 (10)    |
|                            | P value                      | 0.384     | 0.978     | 0.065    | 0.104       | 0.441     |

Table 3 showed no significant association of nutritional status with sociodemographic variables in our study ( $p>0.05$ ).

**Table 4: Association of nutritional finding with neonatal parameters**

| Neonatal parameters |                             | Stunting  | Wasting   | SAM      | Underweight | Normal   |
|---------------------|-----------------------------|-----------|-----------|----------|-------------|----------|
| Birth weight        | LBW (n=57)                  | 26 (45.6) | 20 (35.1) | 6(10.5)  | 22 (38.6)   | 15(26.3) |
|                     | Macrosomia (n=2)            | 0 (0)     | 0 (0)     | 0 (0)    | 0 (0)       | 2(100.0) |
|                     | Normal (n=109)              | 29 (26.6) | 22 (20.2) | 8(7.3)   | 15 (13.7)   | 63(57.8) |
|                     | P value                     | 0.028*    | 0.078     | 0.711    | 0.001*      | <0.001*  |
| Vaccination         | Unvaccinated (n=2)          | 1 (50)    | 1 (50)    | 0 (0)    | 1 (50)      | 1 (50)   |
|                     | Vaccinated till age (n=166) | 54 (32.5) | 41 (24.7) | 14 (8.4) | 36 (21.7)   | 79(47.6) |

|                                    |                             |           |           |         |           |          |
|------------------------------------|-----------------------------|-----------|-----------|---------|-----------|----------|
|                                    | Partial vaccinated<br>(n=0) | 0 (0)     | 0 (0)     | 0 (0)   | 0 (0)     | 0 (0)    |
|                                    | P value                     | 0.601     | 0.411     | 0.688   | 0.337     | 0.946    |
| Exclusive breast<br>feeding        | No (n=23)                   | 8 (34.7)  | 5 (21.0)  | 4(17.3) | 9 (39.1)  | 13(56.5) |
|                                    | Yes (n=145)                 | 47 (32.4) | 37 (25.5) | 10(6.9) | 28(19.3)  | 68(46.9) |
|                                    | P value                     | 0.433     | 0.567     | 0.308   | 0.003*    | 0.271    |
| Duration of<br>SNCU stay<br>(days) | 0-7 (n=126)                 | 30 (23.8) | 21 (16.7) | 5(3.9)  | 16 (12.7) | 54(42.8) |
|                                    | 7-14 (n=59)                 | 17 (28.8) | 11 (18.6) | 3(5.1)  | 12 (20.3) | 16(27.1) |
|                                    | >14 (n=43)                  | 8 (18.6)  | 10 (23.3) | 6(13.9) | 9 (20.9)  | 10(23.2) |
|                                    | P value                     | 0.184     | 0.301     | 0.143   | 0.009*    | 0.413    |

[\* Denotes significant p value]

Statistical analysis indicates significant associations between birth weight and stunting ( $p=0.028$ ) as well as underweight ( $p=0.001$ ), suggesting that infant having low birth weight had higher chances of having stunting and underweight in 1st year of life. We observed a significant association only for underweight and breastfeeding status ( $p=0.003$ ). Specifically, underweight prevalence is 39.1% among non-breastfed infants compared to 19.3% among breastfed infants. These results suggest that while breastfeeding status may influence underweight status, other factors may contribute to the variation in nutritional outcomes among infants attending the clinic. We observed a significant association only for underweight and duration of stay ( $p=0.009$ ). Specifically, underweight prevalence is 12.7% among infants hospitalized for 0-7 days, 20.3% for 7-14 days, and 20.9% for more than 14 days, suggesting lower prevalence of underweight in those who have short duration of hospitalization. [Table 4]

## DISCUSSION

Study reveals prevalence rate of malnutrition among term infants attending the clinic, with stunting affecting 32.7% ( $n=55$ ), wasting at 25.0% ( $n=42$ ), severe acute malnutrition (SAM) at 8.3% ( $n=14$ ), and underweight at 22.0% ( $n=37$ ) with only 47.6% ( $n=80$ ) having normal nutrition. These findings underscore the significant burden of nutritional challenges faced by infants within our study population. Comparing our study with Bhatia et al., we saw a similar concern regarding underweight prevalence among infants. They reported that 35.7% prevalence of underweight, which was notably higher than our study.<sup>[6]</sup> This discrepancy could be attributed to differences in study sample (875 babies in fani affected districts of Odisha) as well as inclusion of preterm babies. According to NFHS-5 survey, under 5 years of age total stunted children were 35.5% (more than our study), wasted 19.3% (lesser to 25%), severely wasted 7.7% (lesser than our result) and underweight 32.1% (more than our results) as this was generalized population.<sup>[2]</sup>

In comparing our study findings with those of Chawla et al., which focused on children aged 1-5 years in rural areas of Haryana, India, similar rates of underweight (38.3%) and stunting (41.3%) were observed, emphasizing the pervasive burden of malnutrition across different parts of India.<sup>[7]</sup>

Despite lower percentages of stunting (29.2%), wasting (29.2%), SAM (8.3%), and underweight (20.8%) in females compared to males, with corresponding figures of 34.2%, 23.3%, 8.3%, 22.5%; no significant associations are found between sex distribution and these nutritional outcomes ( $p$ -values  $>0.05$ ). Studies done by Thurstans et al. have shown contrasting result that the male disadvantage in undernutrition might be more pronounced among younger children, with variations in sex ratios observed with age.<sup>[8]</sup> Study done by Bork on 7319 babies of 2 to 39 months of age at rural Senegalese population found a significant interaction between age and sex, with higher rates of stunting in boys (24.4%) than in girls (19.4%).<sup>[9]</sup> Similarly, Moestue et al study observed in rural Bangladesh on 504358 babies of age group 6 to 59 months that girls had higher WHO z-scores than boys, greatest in under 6–11-month age group, where prevalence of stunting is 44% for boys ( $n=22713$ ) and only 36% for girls ( $n=26759$ ) but this nutritional advantage diminished with age.<sup>[10]</sup> The lack of consistency across studies underscores the heterogeneity in how the relationship between sex and undernutrition is influenced by age. study reveals significant associations between LBW and stunting. i.e. 45.6% ( $p=0.028$ ) i.e. as well as underweight i.e. 38.6% ( $p=0.001$ ), with LBW infants demonstrating higher rates of these conditions compared to normal birth weight infants i.e. 26.6% stunting and 13.7% underweight. Also Study done by Rahman et al on 7530 babies under 5 years of age in Bangladesh found higher prevalence of malnutrition in children with LBW than those with normal birthweights (stunting: 51% vs 39%; wasting :25% vs 14% and underweight: 52% vs 33%).<sup>[11]</sup>

Study reveals variations in stunting, wasting, SAM, and underweight across different socioeconomic status (SES) categories, although no significant associations are detected between SES and nutritional outcomes ( $p$ -value  $>0.05$ ). However, from this study is that established risk factors for child malnutrition, including maternal education, and socioeconomic status, did not alter the relationship between low birth weight (LBW) and malnutrition. This finding holds significant implications. It suggests that even if a mother is educated, the household has favorable socioeconomic conditions, once a baby is born underweight, their risk of experiencing malnutrition during the first year of life remains elevated compared to a baby with normal birth weight. This finding is similar study of Rahman et al in which they observed association were not

modified by factors known to reduce the prevalence of malnutrition, such as higher education of mother, better household socio-economic conditions and longer birth interval.<sup>[11]</sup>

Study found a significant association between underweight status and breastfeeding, with a higher prevalence of underweight among non-breast fed infants (39.1%) compared to breastfed ones (19.3%) ( $p=0.003$ ). Similar results were seen in study done by Ibrahim et al done in Khartoum state, Sudan on 768 household they showed only 21% and 7.7% prevalence of underweight and wasting in breast fed babies 41.5% and 24.4% in non-breast fed babies.<sup>[12]</sup> which suggest that breastfeeding generally reduces the risk of undernutrition due to its superior nutrient content and immune protection. However, no significant associations were found for stunting, wasting, or severe acute malnutrition (SAM) in our study.

The variation in findings could be attributed to differences in study settings, populations, and methodologies. Our study population may have unique socio-economic, cultural, or healthcare factors influencing outcomes. Breastfeeding is important, but other factors, including complementary feeding, maternal nutrition, and socio-economic conditions, must be considered to fully address malnutrition in infants. This aligns with research indicating that breastfeeding alone may not prevent all forms of malnutrition, particularly in contexts where complementary feeding practices, maternal nutrition, and socio-economic factors play. This aligns with the findings from Nisar et al., done in 294 participants at District Headquarter Hospital, Sargodha in Pakistan where children who were breastfed were less likely to experience severe malnutrition compared to those who were not breastfed.<sup>[13]</sup> These results underscore the significance of breastfeeding as a cost-effective measure to reduce malnutrition, echoing the World Health Organization's recommendation for exclusive breastfeeding for the first six months.<sup>[14]</sup>

In the context of India's Universal Immunization Program evaluated by Anekwe et al., which saw only 32% of babies being completely immunized, it's important to consider the potential impact of vaccination on child anthropometry.<sup>[15]</sup> The study reported a reduction in the height-for-age deficit among children below 4 years of age by 22–25%, and a reduction in the weight-for-age deficit by 15%. While the specific contribution of vaccination to these growth benefits remains uncertain, the findings support the idea of vaccination programs as "high-return investments" for child health

However, our study reveals no significant association of nutritional status and vaccination of infants. This might be because only 2 infants were unvaccinated in our study population.

Study found a significant association between underweight status with duration of hospital stay. With duration of stay 0-7 days underweight prevalence is 12.7%, for 7-14 days is 20.3% and for

more than 14 days is 20.9%. Suggested that those having longer duration of stay were most like to experience underweight in first year of life those attending SNCU follow up clinic. Not much study done on duration of SNCU stay with nutritional outcome.

One limitation of the study is the reliance on clinic attendance data, which may introduce selection bias as those not presenting in follow up clinic were missed. Follow up was done only once in first year of life by taking anthropometry and serial follow up not done to assess growth. The study's focus on a single clinic setting may limit the applicability of findings to other healthcare settings or geographic regions with different healthcare access and nutritional profiles.

## CONCLUSION

Study highlights the critical need to assess the nutritional status of term infants attending SNCU follow up clinics, given India's high burden of childhood malnutrition. Our study showed that prevalence of SAM and wasting slightly higher in high risk SNCU term graduates. Prevalence of underweight was seen more in LBW, non-exclusive breastfed infants and those having longer duration of stay in hospital during neonatal period. So, these infants need to be carefully monitored and followed. By examining various anthropometric measures and influencing factors, we provided insights into the prevalence and determinants of malnutrition in highrisk group of term infants discharge from SNCU. These findings collectively emphasize the urgent need for tailored interventions to address the multifaceted factors contributing to undernutrition across diverse communities.

### Ethical Consideration

Written informed consent was obtained from parents of each infant. Parents of the infants were thoroughly informed about the study, and written informed consent was obtained from all participants. Institutional Ethical Clearance obtained. (Letter No 32113/MC/IEC/2022).

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