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NUTRITIONAL STATUS AND GROWTH PATTERNS IN CHILDREN AGED UNDER 5 YEARS: A CROSS-SECTIONAL ANALYSIS USING WHO AND IAP CLASSIFICATIONS

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ABSTRACT

Background: Childhood malnutrition remains a critical public health concern, particularly in low- and middle-income countries. Variations in growth patterns during early childhood (6–60 months) are influenced by socioeconomic, demographic, and nutritional factors. Assessing weight status using standardized classifications such as WHO growth charts and Indian Academy of Pediatrics (IAP) criteria is essential for identifying undernutrition and overweight trends. **Aim & Objective:** This study aimed to evaluate the nutritional status of children aged 6–60 months using WHO and IAP growth standards and to analyze age-wise and socioeconomic disparities in weight distribution.

Materials and Methods: A cross-sectional study was conducted at Ananta Institute, involving 300 children aged 6–60 months. Weight-for-age was assessed using WHO Z-scores and IAP classification. Socioeconomic status (SES) was categorized using the modified Kuppuswamy scale. Data were analyzed for age-wise distribution, SES-based trends, and comparative nutritional status.

Results: Highest enrollment was in the 13–24 months (24.66%) and 25–36 months (24%) groups. 26.66% belonged to the upper-lower class, and 23% to the lower class. As per WHO classification, 66% had normal weight, 22.66% were underweight, 9.33% severely underweight, and 2% overweight. According to IAP classification, 66% were normal weight, 29% mildly undernourished, 4.66% moderately undernourished, and 3.66% severely undernourished.

Conclusion: The study highlights a significant burden of undernutrition, particularly in lower socioeconomic groups, with mild-to-moderate undernutrition prevalent in nearly one-third of participants. While most children fell within the normal range, disparities in growth patterns underscore the need for targeted nutritional interventions, especially in vulnerable populations.

Keywords: Child nutrition, WHO growth standards, IAP classification, underweight, socioeconomic status, preschool children.

INTRODUCTION

Growth is the concerted effect of a complex interaction of many regulatory factors with varying effects. Each individual has a genetic base with a definite growth potential, which may be regulated by these factors both in the prenatal period and in postnatal life. Hence, optimal growth can only be achieved when all these factors operate harmoniously.[1]

Anthropometry, or the measurement of body parameters, is used clinically to diagnose malnutrition and monitor child growth in populations. Routinely collected anthropometric measurements in children include weight, height or length, and head circumference. Obtained measurements are then compared to a reference population using the following sex-specific indices: weight-for-age (underweight), height-for-age (stunting), and weight-for-height (wasting).[2,3]

A growth curve is a powerful visual tool. It shows a child's size at certain ages and illustrates their growth rate or velocity over time, determined by the slope of the curve.[4] In the 1970s, the World Health Organization (WHO) developed growth charts to provide standardized references for assessing child growth globally. Based on extensive international datasets, these charts offered a more universal standard for evaluating growth patterns.[5,6] In India, the development of growth charts has been shaped by local health challenges, nutritional practices, and demographic factors. Key milestones and adaptations have been made to address the unique needs of Indian children, ensuring that growth charts remain relevant and effective in this context.

In the Indian context, local health challenges, nutritional practices, and demographic factors have influenced growth charts and their development. In 2006, India began adopting the WHO growth standards for children under five. These standards were designed to provide a universal benchmark for child growth. While widely used, they are often supplemented with local data to address specific regional health and nutritional challenges.[7,8]

The Indian Academy of Pediatrics (IAP) Growth Charts are specifically tailored to reflect the growth patterns of Indian children, making them an essential tool for pediatricians and healthcare providers nationwide. These charts are based on data collected from Indian children, ensuring their relevance to the local population. The original data for the IAP charts was gathered between 1989 and 1991, and the charts were updated in 2015 to incorporate more recent growth trends and ensure continued accuracy.

Overall, the IAP Growth Charts ensure that Indian children reach their full growth potential by providing a culturally and regionally relevant reference standard for growth monitoring. Their extended age range to 18 years also makes them particularly valuable for tracking growth during adolescence, a critical period for addressing potential issues related to nutrition, obesity, and overall health.[9]

The study, aims to examine the differences in nutritional classification among children aged 0-5 years using WHO and IAP growth charts. The primary hypothesis suggests significant variations between the two charts in identifying undernutrition, expected growth, and overweight conditions. Given that WHO charts are based on global data under optimal growth conditions, they may indicate higher undernutrition rates than IAP charts, which are specifically adapted to the Indian population. Conversely, the IAP charts might report a greater prevalence of overweight and obesity. These discrepancies may be more pronounced in specific age groups or socioeconomic segments, with IAP charts potentially aligning more closely with local clinical assessments of child health and development. This study seeks to determine which growth chart is a more accurate and practical tool for pediatric health monitoring in India.

MATERIALS AND METHODS

This hospital-based, cross-sectional observational study was conducted at the Out-patient and In-patient Departments of Pediatrics at Ananta Institute of Medical Sciences and Research Centre, Rajasamand, Rajasthan. The study spanned a period of eighteen months following approval from the Institutional Ethics Committee. The study population comprised children aged between six months and five years attending the pediatric outpatient or inpatient services during the study period. A sample size of 300 was calculated based on an expected underweight prevalence in children under five years, Children were selected through random sampling. Inclusion criteria included all children within the target age group whose parents provided informed consent. Children with chronic illnesses, clinically recognizable endocrine or systemic dysfunctions, those on long-term medications known to impair growth, and those whose parents did not consent were excluded from the study.

Data collection was carried out using a pre-designed questionnaire, and anthropometric measurements were taken at designated locations in the pediatric departments. The child's age in months was recorded, and weight was measured using age-appropriate calibrated digital scales. For children aged six months to two years, a digital baby scale was used with the child lying supine, and weight was recorded to the nearest 0.1 kg. In cases where the child was uncooperative, the caregiver was weighed with and without the child, and the child's weight was obtained by subtraction. For children aged two to five years, weight was recorded using a standing digital scale with the child standing still in

the center, and the weight reading was taken after stabilization.

Socioeconomic status (SES) was assessed using the Modified Kuppuswamy Scale (2022), which considers the occupation and income of the head of the family. A composite score was calculated, and participants were categorized into five socioeconomic classes: upper (26–29), upper middle (16–25), upper lower (11–15), lower middle (5–10), and lower (<5). Family income and occupational status were recorded through direct interviews with parents or guardians.

Each child's weight-for-age z-score was calculated using WHO growth standards. Based on the WHO classification, children were categorized as having normal weight (z-score between -2 and +2), underweight (z-score < -2), moderately underweight (z-score between -2 and -3), or severely underweight (z-score < -3). The Indian Academy of Pediatrics (IAP) classification of undernutrition was also applied, categorizing children based on their weight as a percentage of the median: >80% (normal), 71–80% (mild malnutrition), 61–70% (moderate malnutrition), and <60% (severe malnutrition).

Data were entered into a Microsoft Excel spreadsheet, with routine quality checks performed weekly for completeness and accuracy. Descriptive statistics, including frequencies and percentages, were used for categorical variables. Statistical analysis was conducted using appropriate software to explore the association between age, SES, and weight status among the study participants.

RESULTS

Table 1: Age-wise Distribution of Participants

S. No.	Age Group	Number
1.	6-12 months	31(10.33%)
2.	13-24 months (1-2 years)	74 (24.66%)
3.	25-36 months (2-3 years)	72 (24%)
4.	37-48 months (3-4 years)	68 (22.66%)
5.	49-60 months (4-5 years)	55 (18.33%)

Table 2: Socio-economic Status-wise Distribution of the Participants

S. No.	Socio-economic Status	Number
1.	Upper	25 (8.33%)
2.	Upper Middle	56 (18.66%)
3.	Lower Middle	70 (23.33%)
4.	Upper Lower	80 (26.66%)
5.	Lower	69 (23%)

Table 3: Distribution of Children as per their Weight According to WHO Growth Charts – Weight for Age (Z score) (N=300)

S. No.	Z Score-Category (WHO)	Number (%)
1.	Normal Weight (Between -2 SD TO +2 SD)	198 (66%)
2.	Underweight (Between -2 SD TO -3 SD SD)	68 (22.66%)
3.	Severe Underweight (Below -3SD)	28 (9.33%)
4	Overweight (Above +3 SD)	6 (2%)

Table 4: Age Group-wise Distribution of Weight for Age (Z score) of the Participants

Age Group	Normal Weight (Between -2 SD TO +2 SD)	Underweight (Between -2 SD TO -3 SD)	Severe Underweight (Below -3SD)	Overweight (Above +3 SD)
6-12 Months	20 (64.51%)	2 (6.45%)	9 (29.03%)	0
13-24 Months	41 (55.40%)	22 (29.72%)	10 (13.51%)	1 (1.35%)
25-36 Months	50 (69.44%)	17 (23.61%)	4 (5.55%)	1 (1.38%)
37-48 Months	47 (69.11%)	16 (23.52%)	4 (5.88%)	1 (1.47%)
49-60 Months	40 (72.72%)	11 (20%)	1 (1.81%)	3 (5.45%)

Table 5: Distribution of Children as per their Weight According to IAP Classification (N=300)

S. No.	IAP Classification	Number (%)
1.	Normal Weight (Above 80% of the Median)	198 (66%)
2.	Mild Undernutrition (Between 71% to 80% of the median)	77 (29%)
3.	Moderate Undernutrition (Between 61% to 70% of the median)	14 (4.66%)
4.	Severe Undernutrition (Below 60 % of the median)	11 (3.66%)

Table 6: Age Group-wise Distribution of Children as per their Weight According to IAP Classification

Age Group	Normal	Mild	Moderate	Severe
6-12 Months	15 (48.37%)	12 (38.70%)	3 (9.67%)	1 (3.22%)
13-24 Months	52 (70.27%)	20 (27.02%)	1 (1.35%)	1(1.35%)
25-36 Months	51 (70.83%)	14 (19.44%)	5 (6.94%)	2 (2.7%)
37-48 Months	41 (60.29%)	19 (17.64%)	2 (2.94%)	6 (8.82%)

49-60 Months	39 (70.90%)	12 (21.81%)	3 (5.45%)	1 (1.81%)

Table 7: Comparison of WHO and IAP Classification

Category	IAP Classification	WHO Classification	Fisher p-value	Odds Ratio	CI
Normal Weight	198 (66%)	198 (66%)	1.00	1.00	(0.71, 1.4
Mild Undernutrition	77 (29%)	NA	NA	NA	NA
Moderate Undernutrition	14 (4.66%)	68 (22.66%)	0.001	0.25	(0.14, 0.45)
Severe Undernutrition	11 (3.66%)	28 (9.33%)	0.04	0.38	(0.17, 0.89

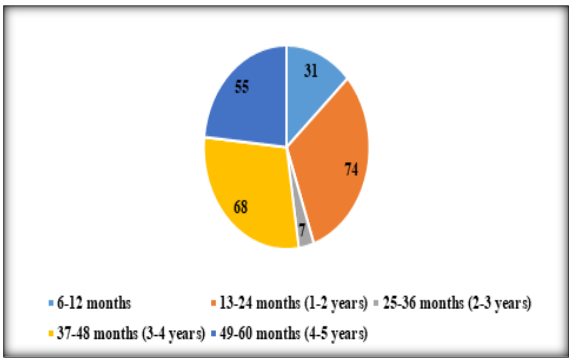

Figure 1: Age-wise Distribution of Participants

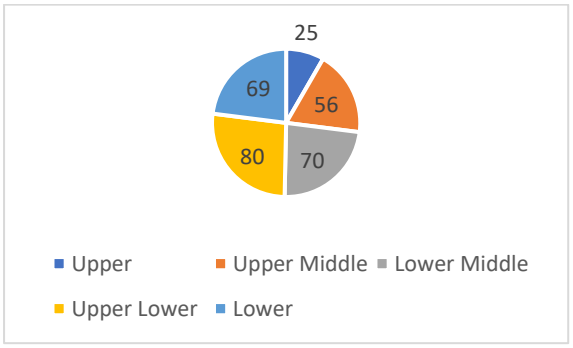

Figure 2: Socio-economic Status

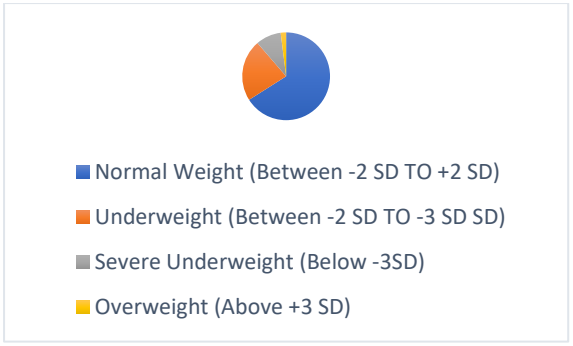

Figure 3: Weight According to WHO Growth Charts

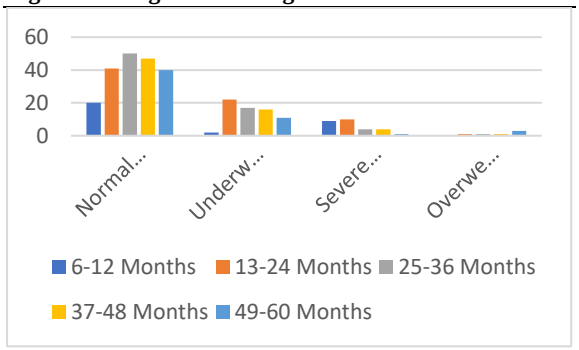

Figure 4: Age Group-wise Distribution of Weight for Age

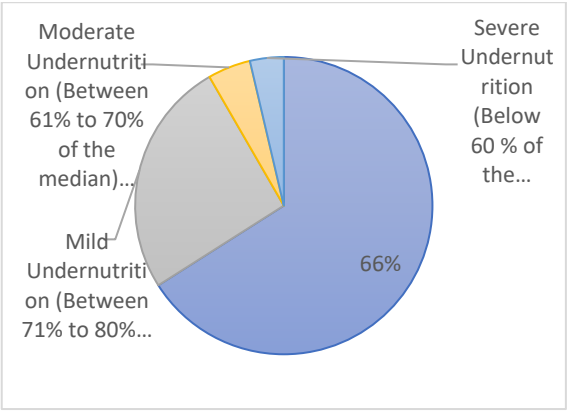

Figure 5: Weight According to IAP Classification

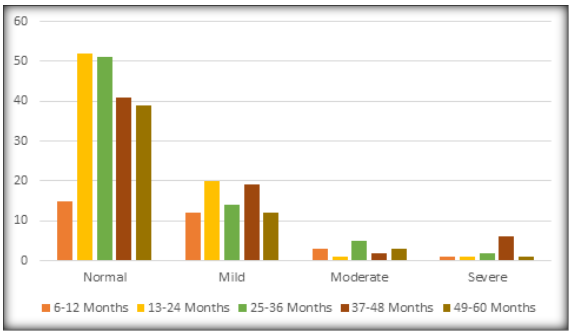

Figure 6: Age wise Weight According to IAP Classification

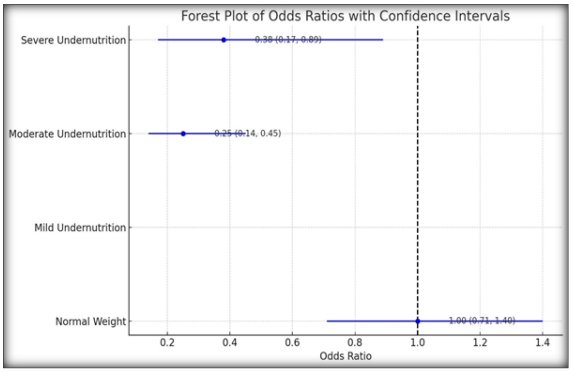

Figure 7: Comparison of WHO and IAP Classification

DISCUSSION

In the current study conducted at Ananta Institute, the age-wise distribution of participants showed the highest enrollment in the 13–24 months (24.66%) and 25–36 months (24%) age groups, followed by 37–48 months (22.66%), 49–60 months (18.33%), and the lowest in the 6–12 months group (10.33%).

This pattern reflects typical healthcare-seeking behavior during the toddler years when growth monitoring and immunizations are common. When compared to other pediatric growth studies, this distribution shows some variation. For instance, John et al. (2017) reported a more uniform age distribution, with each group comprising approximately 15–25%, possibly due to targeted early childhood interventions in Puducherry.[10] The WHO (2006) study maintained an even 20% representation across all age groups to create a balanced international growth reference standard.[7] The NFHS-5 (India) survey also showed fairly consistent representation across age groups, with a slightly lower percentage in the 6–12 months group (12%) and more representation among toddlers and preschoolers (22% each), reflecting its broad national coverage.[11] In contrast, Savitha M.R. et al. (2011) emphasized younger age groups, especially 6–24 months, which may indicate a focus on early malnutrition detection in Mysore.[12] Similarly, Kumar et al. (2014) observed a higher proportion in the 13–24 months group (26%), aligning with regional growth monitoring practices in Tamil Nadu.[13] Overall, the comparative analysis suggests that while most studies aim to capture growth data across the full 6–60 month range, differences in age group representation may stem from study objectives, healthcare-seeking patterns, or region-specific intervention strategies.

The majority of pediatric participants belonged to the lower socio-economic strata, with 26.66% from the upper lower class and 23% from the lower class, while only 8.33% came from the upper class. This indicates a focused inclusion of underprivileged populations, possibly reflecting regional demographics or the study's intent to assess growth patterns among vulnerable groups. Compared to other studies, similar trends were observed in the Brazilian Urban Area Study (2019), where 35% of participants belonged to the lower class and 30% to the lower middle class, highlighting a shared emphasis on economically disadvantaged groups.[14] In contrast, the study by Patel et al. (2019) in urban India reported a more dominant middle-class participation (50%) with only 10% from the upper class and 40% from the lower class, using broader SES categories.[15] On the other hand, the European Growth Study (2018) showed a reverse pattern, with a majority of participants from higher socio-economic backgrounds—25% from the upper class and 35% from the upper middle class—likely due to different demographic profiles and healthcare access in European countries.[16] These comparisons underscore how socio-economic composition can vary significantly across studies depending on geographic location, healthcare systems, and study objectives.

In the present study conducted at Ananta Institute, 66% of the children were found to have normal weight according to WHO growth charts, while 22.66% were underweight, 9.33% severely underweight, and 2% overweight. This distribution indicates a substantial burden of undernutrition, although the prevalence of normal weight is higher compared to several other Indian studies (Table 3). Table 4 presents the age group-wise distribution of participants' weight-for-age Z scores based on WHO growth standards. Across all age groups, most participants fall within the normal weight category, with the highest percentage (72.72%) in the 49-60 months group and the lowest (55.40%) in the 13-24 months group. Underweight prevalence ranges from 6.45% in the 6-12 months group to 29.72% in the 13-24 months group. Severe underweight is most common in the 6-12 months group (29.03%), while overweight children are only found in the 13-60 months' range, with the highest prevalence (5.45%) in the 49-60 months group.

Furthermore, children were also categorized based on the Indian Academy of Pediatrics (IAP) weight classification (Table 5). A majority, 66%, of the children fall into the normal weight category (above 80% of the median weight). About 29% of the children are classified as having mild undernutrition (71-80% of the median), while 4.66% fall under moderate undernutrition (61-70%). A small proportion, 3.66%, are classified as severely undernourished (below 60% of the median weight). The table presents the distribution of children across different age groups based on their weight according to the IAP classification. In the 6-12 months age group, 48.37% of children were classified as having normal weight, while 38.70% had mild undernutrition, 9.67% had moderate undernutrition, and 3.22% had severe undernutrition. For 13-24 months, the majority (70.27%) had normal weight, with 27.02% showing mild undernutrition and only 1.35% in moderate and severe categories.

In the 25-36 months group, 70.83% had normal weight, 19.44% had mild undernutrition, 6.94% had moderate undernutrition, and 2.7% had severe undernutrition. The 37-48 months group showed 60.29% of children with normal weight, 17.64% with mild undernutrition, 2.94% with moderate undernutrition, and a higher percentage (8.82%) of children with severe undernutrition.

In the 49-60 months' group, 70.90% of children had normal weight, 21.81% had mild undernutrition, 5.45% had moderate undernutrition, and 1.81% were severely undernourished. The highest proportion of children with severe undernutrition was observed in the 37-48 months group.

The Normal Weight category shows perfect agreement between IAP and WHO (Fisher p-value: 1.0, Odds Ratio: 1.0). The Mild under-nutrition category does not have a corresponding classification in WHO, so statistical tests are not applicable. The Moderate under-nutrition category shows a significant difference between IAP and WHO (p-value: 0.001, Odds Ratio: 0.25), indicating that the proportion of moderately malnourished children is higher in the WHO classification.

The Severe Undernutrition category also shows a significant difference (p-value: 0.04, Odds Ratio: 0.38), with a higher proportion of children classified as severely undernourished by the WHO. For instance, in the study by Deshmukh et al. (2007) in Anji, Maharashtra, only 52.6% of children were within the normal weight range, with a higher proportion of underweight (47.4%) and 16.9% classified as severely underweight.[17] Similarly, Seetharaman et al. (2007) reported that just 31.4% of children in the slums of Coimbatore were anthropometrically normal, with underweight children constituting a significant 46.7%.[18] Reddy et al. (2020) also documented high underweight prevalence among children in Pune, with 25.99% of boys and 21.68% of girls affected.[19] While the NHANES study by Mei Z. et al. (2008) did not specify exact percentages, it highlighted trends of lower underweight and higher overweight prevalence compared to CDC references, suggesting a contrasting nutritional landscape in high-income countries.[20] Collectively, these findings emphasize the persistent challenge of undernutrition in low- to middle-income settings, alongside a growing, though smaller, concern for overweight cases.

CONCLUSION

This study highlights critical trends in the nutritional status of children aged 6–60 months, revealing that while 66% of participants had normal weight according to both WHO and IAP classifications, a concerning 32–34% exhibited undernutrition (mild to severe). The disproportionate burden among lower socioeconomic groups underscores the interplay of economic disparities and childhood malnutrition. Notably, the higher enrollment of toddlers (13–36 months) aligns with peak vulnerability to growth faltering, emphasizing the need for targeted interventions during this window. The discordance between WHO and IAP classifications in moderate/severe undernutrition cases (9.33% vs. 8.33%) suggests the importance of context-specific growth monitoring tools. These findings advocate for: (1) community-based nutrition programs prioritizing marginalized populations, (2) parental education on complementary feeding during the toddler transition phase, and (3) longitudinal studies to assess the long-term impact of early undernutrition. Policy efforts should integrate socioeconomic empowerment with maternal-child health initiatives to break the intergenerational cycle of malnutrition observed in this cohort.

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