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Assessment of nutritional status and dietary intake among children in Samastipur District, Bihar

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ABSTRACT

Background: *Nutritional status during the preschool years is a key determinant of child growth, development, and long-term health. This study assessed the nutritional status, dietary diversity, food group consumption, and nutrient intake of preschool children aged 3–6 years in Samastipur district, Bihar.*

Methods: *A cross-sectional study was conducted among 90 preschool children selected from two schools in Pusa block. Data on socio-demographic characteristics, dietary intake using a 24-hour dietary recall, food group consumption, and anthropometric measurements were collected. Nutritional status was assessed using WHO Child Growth Standards based on weight-for-age (WAZ), height-for-age (HAZ), and weight-for-height (WHZ) Z-scores.*

Results: *All children consumed cereals, pulses, dairy products, fruits, and vegetables, while 95.6% consumed eggs and flesh foods, indicating good dietary diversity. Mean energy, protein, carbohydrate, and zinc intakes met or exceeded the recommended dietary allowances, whereas fat and iron intakes were below the recommendations. Anthropometric assessment revealed that 40.0% of children were underweight, including 6.7% moderately underweight, while 70.0% were stunted, with 47.8% classified as severely stunted. No cases of wasting were observed; however, 16.5% of children were overweight and 17.6% were obese, indicating the coexistence of chronic undernutrition and excess body weight.*

Conclusion: *The findings demonstrate a dual burden of malnutrition among preschool children, characterized by a high prevalence of stunting alongside overweight and obesity. These results highlight the need for integrated nutrition interventions that address chronic growth faltering, improve micronutrient intake, and promote healthy dietary and lifestyle practices among preschool children.*

Challenges and contribution: *The study's small sample size and use of a 24-hour dietary recall may limit the generalizability and accuracy of the findings. Despite these limitations, the study contributes important evidence on the nutritional status and dietary intake of preschool children by demonstrating the coexistence of a high prevalence of stunting and underweight with overweight and obesity, thereby highlighting the double burden of malnutrition and the need for integrated nutrition interventions.*

Keywords: *Nutritional Status; Children; Stunting; Underweight; Malnutrition; Dietary diversity; Nutrient intake.*

Introduction

Nutritional status is an important indicator of an individual's overall health and reflects the adequacy of nutrient intake, absorption, utilization and the body's physiological requirements. In preschool children, it is a critical determinant of physical growth, cognitive development, immune competence and overall well-being. Adequate nutrition during early childhood supports optimal growth and development, whereas poor nutritional status increases the risk of underweight, stunting, wasting, overweight, obesity, anemia, dental caries and other nutrition-related disorders.

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Since dietary habits established during the preschool years often persist into adulthood, early nutritional assessment and timely intervention are essential for promoting lifelong health and prevention of chronic diseases [2,5,12,13].

Childhood malnutrition continues to be a major public health concern worldwide, encompassing both undernutrition and overnutrition. Children's nutritional status is influenced by multiple factors, including dietary intake, socioeconomic status, parental education, household income, feeding practices, sanitation, and access to healthcare services. Persistent deficiencies in essential nutrients during early childhood adversely affect growth, cognitive performance, immune function and long-term health outcomes. Therefore, regular assessment of nutritional status is necessary for the early detection of nutritional problems, identification of vulnerable groups, implementation of appropriate nutrition interventions and public health strategies [5,13].

Nutritional assessment is a systematic process used to evaluate children's nutritional well-being through the assessment of growth, body composition, dietary intake and clinical indicators.

Anthropometric assessment, including measurements of weight, height or length, and Body Mass Index (BMI), is the most widely used method because it is simple, reliable and recommended by the World Health Organization for monitoring child growth. Dietary assessment, particularly the 24-hour dietary recall method, provides information on food consumption patterns, dietary diversity and nutrient intake, while nutrient intake assessment evaluates the adequacy of energy, macronutrients and micronutrients against age-specific dietary recommendations. In addition, assessment of food group consumption and dietary behavior, such as meal patterns and household food security, provides a comprehensive understanding of children's nutritional health. Together, these approaches facilitate the identification of nutritional deficiencies and excesses, support evidence-based nutrition interventions and enable monitoring of child growth and the effectiveness of nutrition programmes [2,5,12,13].

The World Health Organization (WHO) Child Growth Standards provide a standardized approach for assessing the nutritional status of children by expressing anthropometric measurements as Z-scores relative to a healthy reference population of the same age and sex [18]. Weight-for-Age Z-score (WAZ), Height-for-Age Z-score (HAZ) and Weight-for-Height Z-score (WHZ) are the principal WHO indicators used to identify underweight, stunting, wasting, overweight and obesity, thereby reflecting different dimensions of child growth and nutritional status [18]. The use of WHO Z-score indicators enables the early detection of growth faltering, facilitates comparisons of nutritional status across different populations and supports the monitoring and evaluation of child nutrition programmes [5,18]. Several recent studies have adopted WHO Z-score indicators to evaluate nutritional status and identify children at risk of malnutrition, highlighting their importance in nutritional surveillance, clinical assessment and public health interventions [2,12,13].

Materials and Method

The study was conducted in Pusa block located under Samastipur division in Bihar state. Under the block two schools were selected where young children 3-6 years were there as students. Three to six-year-old children were chosen from the schools. The selected students were screened by reviewing the registry, which included information on their age and children. The total number of children for the study was selected (N= 90), and additional mothers/caregivers were approached for information. Data collection was done using a structured questionnaire for getting socio-demographic status, anthropometric measurement and related information like family size, income, parents' occupation, food and dietary diversity, meal consumed etc. using 24-hour dietary recall method. Weight was measured barefoot in minimal clothing using a standard weighing balance placed on a flat stable surface. Standing height was measured in duplicate using a stadiometer. Each child was measured while standing barefoot on the stadiometer platform against the wall with their feet together, their bodies upright, and their arms relaxed at their sides. Daily nutrient intake (energy, carbohydrate, protein, fat, iron) were calculated from the 24 h dietary recall data and the same was used to analyze food group intake of the children. After entering the collected data into Microsoft Excel, IBM SPSS version 20 was utilized to evaluate it using descriptive statistics.

Result & Discussion

Table 1: Socio-demographic status

Characteristics	Category	Frequency(n)	Percentage (%)
Gender	Male	49	54.4
	Female	41	45.6
Religion	Hindu	81	90
	Muslim	9	10
	Other	0	0
Caste	General	41	45.6
	OBC	40	44.4
	SC	9	10.0
	ST	0	0
Family type	Joint	42	46.6
	Nuclear	48	53.4
	Extended	0	0
Family size	Small (1-4 members)	39	43.3
	Medium (5-7 members)	50	55.6
	Large (8-10 members)	1	1.1
Education of father	Primary	0	0
	Middle school	8	8.9
	High school	45	50.0
	College	37	41.1
Father's occupation	Government job	7	7.8
	Business	18	20.0
	Agriculture	46	51.1
	Others	19	21.1
Income per annum (Rupees)	below 40 thousand	3	3.3
	40 thousand - 1 lakh	83	92.2
	1lakh- 1.5 lakh	4	4.4
	above 1.5 lakh	0	0

Table 1 illustrates about the personal and socio-demographic status of the subjects. Among the 90 children included in the study, 54.4% (n = 49) were male, while 45.6% (n = 41) were female. The majority of the respondents belonged to the Hindu religion (90.0%), whereas 10.0% were Muslims. Regarding caste, 45.6% belonged to the General category, followed by 44.4% from Other Backward Classes (OBC) and 10.0% from Scheduled Castes (SC), with no respondents from the Scheduled Tribe (ST) category. With respect to family characteristics, 53.4% of the respondents belonged to nuclear families, while 46.6% belonged to joint families. More than half (55.6%) had a medium-sized family, followed by 43.3% from small families, whereas only 1.1% belonged to large families. The educational status of fathers showed that 50.0% had completed high school, 41.1% had attained a college education, and 8.9% had studied up to middle school, while none had only primary education. Agriculture was the predominant occupation of fathers (51.1%), followed by business (20.0%), other occupations (21.1%), and government service (7.8%). Most households (92.2%) had an annual income between ₹40,000 and ₹1 lakh, whereas 4.4% earned between ₹1 lakh and ₹1.5 lakh, and 3.3% had an annual income below ₹40,000.

Table 2: Food group intake

Food types (groups)	Frequency(n)	Percentage(%)
Cereals, grains, roots and tubers	90	100
Pulses, legumes and nuts	90	100
Dairy products (milk, yoghurt, cheese)	90	100
Fruits and vegetables	90	100
Flesh foods (meat, fish, poultry, liver or other organs)		
Yes	86	95.6
No	4	4.4
Eggs		
Yes	86	95.6
No	4	4.4

Food group consumption is illustrated in table 2 where all children (100%) consumed cereals, grains, roots and tubers, pulses, legumes and nuts, dairy products, and fruits and vegetables. Consumption of flesh foods (meat, fish, poultry, liver or other organ meats) was reported by 95.6% of the respondents, while 4.4% did not consume these foods. Similarly, 95.6% of the children consumed eggs, whereas 4.4% reported no egg consumption. These findings indicate a high level of dietary diversity with respect to the major food groups among the study participants.

Table 3: Nutrient intake

Nutrients	Mean ± SD	EAR/RDA
Energy (kcal)	3890.07±546.00	1110 (1-3y) * 1360 (4-6y) *
Protein (g)	31.15±6.64	12.5 (1-3y) 16.0 (4-6y)
Carbohydrate (g)	121.14±26.05	100-130
Fat (g)	21.77±6.94	25
Iron (mg)	6.17±0.55	8 (1-3y) 11 (4-6y)
Zinc (mg)	5.23±0.38	3.3 (1-3y) 4.5 (4-6y)

**Energy adequacy was calculated using the Estimated Average Requirement (EAR) as recommended by ICMR-NIN (2020) because ICMR-NIN no longer provides an RDA for energy*

Table 3 presents the mean daily nutrient intake of the respondents in comparison with the ICMR EAR/RDA recommendations. The mean daily energy intake was substantially higher than the recommended EAR. The mean protein intake was 31.15 ± 6.64 g/day, exceeding the RDA of 12.5 g/day for children aged 1–3 years and 16.0 g/day for those aged 4–6 years. The mean carbohydrate intake (121.14 ± 26.05 g/day) was within the recommended range of 100–130 g/day, whereas the mean fat intake (21.77 ± 6.94 g/day) was slightly lower than the recommended intake of 25 g/day. Regarding micronutrients, the mean iron intake was lower than the recommended intake of 8 mg/day for children aged 1–3 years and 11 mg/day for those aged 4–6 years. In contrast, the mean zinc intake was exceeding the recommended intake for both age groups (3.3 mg/day for 1–3 years and 4.5 mg/day for 4–6 years).

Table 4: Nutritional status WAZ

Category	z- score	Frequency (n)	Percentage (%)
Severe underweight	< -3	0	0
Moderate underweight	-3.00 to -2.01	6	6.7
Mild underweight	-2.00 to -1.01	30	33.3
Normal	≥ -1.00	54	60

Table 5: Nutritional status HAZ

Category	z- score	Frequency(n)	Percentage(%)
Severe stunting	< -3	43	47.8
Stunting	≥ -3 and < -2	20	22.2
Normal	≥ -2	27	30

Table 6: Nutritional status WHZ

Category	z- score	Frequency(n)	Percentage(%)
Obesity	> +3.00	16	17.6
Overweight	> +2.00 to ≤ +3.00	15	16.5
Normal	≥ -2.00 to ≤ +2.00	59	64.8
Wasting	≥ -3.00 to < -2.00	0	0
Severe wasting	< -3.00	0	0

The nutritional status of the respondents was assessed using the WHO Child Growth Standards based on Weight-for-Age Z-score (WAZ), Height-for-Age Z-score (HAZ) and Weight-for-Height Z-score (WHZ). As shown in Table 4, the majority of the children (60.0%, n = 54) had a normal WAZ (≥ −1.00). However, 33.3% (n = 30) were mildly underweight and 6.7% (n = 6) were moderately underweight, while no child was classified as severely underweight (< −3 SD). These findings indicate that although most children had normal body weight for their age, 40.0% were affected by varying degrees of underweight.

According to Table 5, height-for-age assessment revealed a high prevalence of chronic undernutrition. Nearly half of the respondents (47.8%, n = 43) were severely stunted (< −3 SD), while 22.2% (n = 20) were moderately stunted (≥ −3 to < −2 SD). Only 30.0% (n = 27) had normal height-for-age (≥ −2 SD). Overall, 70.0% of the children were stunted, indicating a substantial burden of long-term growth faltering among the study population.

The WHZ classification presented in Table 6 showed that 64.8% (n = 59) of the respondents had normal weight-for-height (≥ −2 to ≤ +2 SD). However, 16.5% (n = 15) were overweight (> +2 to ≤ +3 SD), and 17.6% (n = 16) were obese (> +3 SD). No cases of wasting or severe wasting were observed. These findings suggest that while acute undernutrition was absent in the study population, a considerable proportion (34.1%) of children were affected by excess body weight.

The current study discovered that 40.0% of children were underweight, with 33.3% being mildly underweight and 6.7% being moderately underweight. No child was extremely underweight. This prevalence is higher than that reported by [14] who discovered an underweight prevalence of 14.8% among children in Sub-Saharan Africa, and [11] who found 29.4% among Pakistani children. However, it is lower than the 50.3% prevalence reported by [6] for Muslim children in Nepal. The higher prevalence observed in the present study may be related to the predominantly low household income of the study population, despite adequate dietary diversity, indicating that socioeconomic factors may continue to influence children's nutritional status [4,10].

The study found a very high prevalence of stunting (70.0%), with 47.8% of children severely stunted and 22.2% moderately stunted, indicating a significant burden of chronic malnutrition. This prevalence is much greater than that reported by [11] (44.4%), [14] (32.9%), [7] (49.4%), [1] (14.4%), and [9] (37.6%). The higher prevalence of stunting in the current study could be attributed to long-term nutritional deprivation during the first 1,000 days of life, recurring childhood illnesses, and socioeconomic constraints that impede linear growth even when current dietary diversity appears acceptable. Similar observations were reported by [5], who emphasized that parental education, household income and childcare practices are important determinants of child growth.

There were no cases of wasting found in the current study and 64.8% of the children had normal weight-for-height. This data contrasts with those of [19], [8], [3] and [15], who found wasting prevalences of 14.7%, 6.2%, 17.5% and 28.0%, respectively. The absence of wasting in the current study could be attributed to the children's great nutritional diversity, as all participants ingested cereals, pulses, dairy products, fruits and vegetables, with over 95% also eating eggs and flesh items. These findings suggest that although acute malnutrition was not evident, chronic nutritional deficiencies affecting linear growth remained a significant concern.

Despite the absence of wasting, the current study found 16.5% overweight and 17.6% obesity, implying that more than one-third of the children were overweight.

These figures are significantly higher than those published by [14], who discovered an overweight prevalence of only 2.5%, as well as [16], who found 12.61% overweight and 7.54% obesity among low-income Brazilian youngsters. The coexistence of a high prevalence of stunting and excess body weight suggests a double burden of malnutrition, which is increasingly being documented in developing nations undergoing nutritional transition.

The nutritional evaluation revealed that all children consumed the major food groups, with the mean intake of calories, protein, carbs and zinc meeting or exceeding the ICMR-NIN requirements, but fat and iron intake remaining below the required amounts. These findings differ from those of [15] and [17], who identified poor dietary diversity and household food insecurity as key causes to child malnutrition. However, the persistence of high stunting despite a diverse diet implies that current food consumption may not be sufficient to explain children's nutritional status. Inadequate nutrition during infancy, frequent illnesses, poor environmental sanitation, and socioeconomic hardship may all have led to reduce linear growth, as noted by [5].

Overall, the findings show that the children in the current study face a twin burden of malnutrition, with ongoing chronic undernutrition and a rising prevalence of overweight and obesity. These findings highlight the importance of integrated nutrition programs that not only enhance micronutrient intake and avoid growth stunting, but also promote good food patterns and lifestyle habits to lower the incidence of children overweight and obesity.

Conclusion

The present study revealed that although preschool children exhibited good dietary diversity and adequate intake of most macronutrients, a substantial proportion remained affected by chronic undernutrition, with 70.0% of children being stunted and 40.0% underweight. In contrast, no cases of wasting were observed, while 34.1% of the children were either overweight or obese, indicating the presence of a double burden of malnutrition. The coexistence of chronic growth faltering and excess body weight suggests that adequate food consumption alone may not ensure optimal nutritional status and that socioeconomic factors, dietary quality, micronutrient deficiencies and early-life nutrition may play important roles. Therefore, comprehensive nutrition programmes focusing on growth monitoring, improved micronutrient intake, nutrition education for caregivers, promotion of healthy eating habits and regular anthropometric assessment are essential to improve the nutritional status and overall health of preschool children.

Future scope of the study

The present study provides crucial evidence on children's nutritional status and food intake. However, further studies with larger and more diverse samples will help achieve conclusions that are indicative of the greater community. Future research could look at the long-term relationship between dietary consumption, micronutrient adequacy, socioeconomic variables and growth outcomes, particularly given the high frequency of stunting and the presence of overweight and obesity in this study. Longitudinal studies could also help identify factors contributing to chronic growth faltering from early childhood.

Additionally, intervention-based studies evaluating nutrition education, dietary modification, micronutrient supplementation and healthy lifestyle practices may help determine effective strategies for addressing the double burden of malnutrition among preschool children.

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Conflict Of Interest

Authors have declared that no competing interests exist.

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