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Association of stunting with low birth weight, socio economic indicators and feeding practices among children aged 1 to 5 years in southern districts of West Bengal, India

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ABSTRACT

Introduction

Stunting remains a serious nutritional and community health issue within children under five years of age, reflecting long-term nutritional insufficiency and its detrimental effects on physical growth, cognitive development, and overall health. Although various nutrition and child health programs have been implemented, the burden of stunting remains substantial in several regions of India, including West Bengal. Persistent socio-economic inequalities, suboptimal feeding practices, and inadequate maternal care contribute to this ongoing challenge. In this context, this individual study was conducted to assess the burden of stunting and to identify the factors associated with it in children aged 1–5 years in the North 24 Parganas district of West Bengal.

Methodology

A community related observational study was conducted involving 542 children aged 12–59 months. Data on socio-demographic characteristics, feeding practices, and maternal factors were collected using a predesigned questionnaire. Anthropometric measurements were taken following standard procedures, and Height-for-Age Z-scores (HAZ) were calculated utilizing WHO growth standards. Stunting was classified as moderate (HAZ < −2 SD) and severe (HAZ < −3 SD). Data were analyzed using chi-square test.

Results

The predominance of stunting was 24.0%, including 17.0% moderate and 7.0% severe cases. Significant associations were observed between stunting and birth weight, maternal occupation, birth order, family type, and family income ($p < 0.05$). Female children showed a relatively higher burden of stunting compared to males. Mean HAZ scores differed significantly across age groups ($F = 1.488$, $p = 0.013$).

Conclusion

Stunting remains a significant public health concern in the study area, influenced by socio-demographic and household factors. Strengthening nutrition interventions focusing on maternal awareness, child feeding practices, and socio-economic improvement is essential to reduce the burden.

KEYWORDS:

Stunting, HAZ, Under-five children, Nutritional status, West Bengal

I. BACKGROUND

Stunting in early childhood represents a critical manifestation of prolonged nutritional deprivation and remains a major public health concern worldwide. It develops due to sustained exposure to inadequate nutrition, recurrent infections, and limited access to essential health services during the early years of life [1, 6]. This condition, identified by low height-for-age, reflects long-term growth failure and cumulative disadvantage beginning from the prenatal period and continuing through early childhood [2]. Globally, an estimated 144 million of children below five years are impacted by stunting, accounting for nearly 21% of this population [2]. India contributes substantially to this global burden. On the basis of National Family Health Survey-5, about 35.5% of children below five years are stunted; indicating only gradual improvement compared to earlier survey rounds [3]. In West Bengal, the prevalence remains high with 33.8% of children below five impacted, highlighting the persistent challenge of undernutrition in the state [3]. The consequences of stunting extend beyond impaired physical growth, influencing cognitive development, educational performance, immune function, and productivity in adulthood, thereby perpetuating intergenerational cycles of poverty and poor health [1]. Despite the implementation of national programmes such as

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POSHAN Abhiyaan and Integrated Child Development Services, disparities continue to exist across socio-economic and regional groups [4]. Variations observed within districts further emphasize the role of household environment, maternal characteristics, and social inequalities in shaping child growth outcomes [5].The causes of stunting are multifactorial, including insufficient dietary consumption , unsuitable infant and young child feeding practices, recurrent infections, low birth weight, and poor maternal nutritional status [6]. Additionally, social and demographic determinants such as mother's education, occupation, household income, family structure, and birth order significantly influence child nutritional status [2]. Therefore, this study focuses on assessing the occurrence of stunting and examining its association with socio-demographic and health-related variables among children aged 1–5 years in the study population. The findings are expected to support the development of targeted strategies aimed at improving child nutrition and overall health outcomes.

II. METHODOLOGY:

Research design:

A community-based cross-sectional investigation was undertaken to examine the magnitude and determinants of stunting among children aged 1–5 years. The study was conducted between January and December 2025 in North 24 Parganas district of West Bengal, an area comprising both urban and rural populations with varied socio-economic and cultural characteristics.

The target group consisting of children aged 12–59 months permanently staying in the study area, along with their mothers or primary caregivers. Only children who had been living in the district for a considerable period were considered eligible. Children suffering from severe illness during the period of data collection, those with known chronic or congenital conditions, and participants for whom consent was not obtained from caregivers were not involved in the study.

The study subjects were chosen utilizing a simple random sampling technique. Initially, a list of households with eligible children was prepared to form the sampling frame. From this list, participants were chosen randomly, ensuring that each eligible child had an equal probability of selection. The process of selection continued until the needed sample size was acquired.

Sample size:

The study sample estimation was performed using the standard prevalence calculation formula applicable to cross-sectional studies:

$$\mathbf{n = Z^2 \times (p \times q) / d^2}$$

Where:

n = necessary sample size

Z = 1.96 at 95% confidence level

p = estimated prevalence of stunting (33.8% or 0.338 based on NFHS-5 data)

q = 1 − p = 0.662

d = sampling error or allowable error (5% or 0.05)

$n = (1.96)^2 \times 0.338 \times 0.662 / (0.05)^2$

n = 344

Considering a possible 10% non-response rate, the necessary sample size was adjusted, resulting in the inclusion of 542 participants in the study.

Data Collection:

Following a detailed explanation of the study purpose and procedures, informed consent was collected from the parents or primary caregivers of eligible children. Findings were then obtained from 542 children aged 12–59 months using a predesigned schedule.

Anthropometric measurements were obtained using standardized techniques. Children's weight and height were assessed while they were dressed in light clothes and barefoot , utilizing a standard anthropometric scale (accurate up to 0.1 cm) and a calibrated digital weighing scale (accurate up to 0.1 kg), respectively. For children below two years of age, those unable to stand, or those with a height below 85 cm, an infantometer was used to measure recumbent length. The age of each child in completed months and sex were also documented.

Stunting was assessed using height-for-age Z-scores (HAZ), calculated by utilizing WHO Anthro - software- version 3.2.2. Children with HAZ values less than −2 standard deviations from the WHO reference median were categorized as stunted, while those less than −3 standard deviations were classified as severely stunted.

Data on child and caregiver characteristics were obtained through face-to-face interviews using a predesigned questionnaire. Information was collected on socio-demographic characteristics (including maternal education and occupation), birth-related factors (for instance birth weight and birth sequence), and child feeding practices. Feeding-related variables included exclusive breastfeeding (defined as the provision of only breast milk during the first six months of life),

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Colostrum feeding, and the child's self-feeding behavior.

III. RESULT

Table 1 shows that mean Height-for-Age Z-scores (HAZ) differed significantly across the ages within children aged 12–59 months (n = 542) (F = 1.488, p = 0.013).The highest HAZ mean observed among children aged 36–47 months (−0.966 ± 2.418) and the lowest among 48–59 months (−1.162 ± 1.361). The difference in mean HAZ across age groups was statistically significant (F = 1.488, p = 0.013). This indicates that HAZ differs significantly across age groups.

Table -1 Comparison of Mean Height-for-Age Z-scores (HAZ) across Age Groups among Children Aged 12–59 Months (n = 542)

Age groups (months)	N	Mean HAZ ± SD (Height for Age Z score)	F –value	P value
12-23	120	-1.067 ± 1.425	**1.488**	**0.013**
24-35	125	-1.112 ± 1.596		
36-47	122	-0.966 ± 2.418		
48-59	185	-1.162 ± 1.361		
Total	**542**			

Table 2 showed that among the 542 children, 76.0% were normal, 17% stunted, and 7.0% severely stunted. A higher proportion of boys (80.0%) were normal compared to girls (71.0%).Females showed a higher prevalence of stunting (20.0%) than males (14.0%).
Similarly, severe stunting was more common among females (8.0%) than males (6.0%).
Overall, female children had a higher percentage of both stunting and severe stunting compared to males.

Table-2 Distribution of Stunting Categories by Sex among Children Aged 12–59 Months

Stunting category	Male(n)		Female(n)		Total	
Normal	242	(80.0)	171	(71.0)	413	(76.0)
Stunted	42	(14.0)	49	(20.0)	91	(17.0)
Severely stunted	18	(6.0)	20	(8.0)	38	(7.0)
Total	**302**		**240**		**542**	

(Chi-square value- .875, P value- .646)

Table 3 demonstrated that several socio-demographic factors, including birth weight (χ^2 = 227.648, $p < 0.01$), maternal occupation (χ^2 = 142.696, $p < 0.01$), birth order (χ^2 = 19.327, $p < 0.03$), family type (χ^2 = 10.204, $p < 0.03$), and family income (χ^2 = 15.072, $p < 0.05$), showed a significant association with the child's sex. A notably higher proportion of female children were born with low birth weight compared to males, indicating a potential gender disparity in early life health and nutritional profile. Birth sequence also showed a significant pattern, including male children more frequently being first-born, while higher birth orders were more common among females, suggesting possible differences in care and resource allocation within households.
Family structure further revealed significant differences, ($p<0.05$) as male children were more likely to belong to nuclear families, whereas female children were more represented in joint families. Additionally, family income exhibited a significant association, with female children predominantly concentrated in the lower and middle income groups, reflecting underlying socio-economic inequalities.
Maternal occupation also showed a significant association; however, the majority of mothers were homemakers. This may influence child health through increased time availability for childcare and feeding practices, although limited financial independence could restrict access to adequate nutrition and healthcare services.
Overall, these findings highlight the influence of socio-economic and household-level factors on child characteristics, emphasizing the need for targeted interventions addressing gender disparities and improving child health and nutrition outcomes.

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Table- 3 Distribution of Socio-Demographic Characteristics by Sex among Children Aged 12–59 Months

Characteristics	Male (n=302)		Female (n=240)		Chi-square value	P- value
Birth weight						
<2.5kg	79	(26.0)	86	(36.0)	**227.648**	**< 0.01**
>2.5kg	223	(74.0)	154	(64.0)		
Mother occupation						
Employed or Working	44	(15.0)	38	(16.0)	**142.696**	**< 0.01**
Not woking or home maker	258	(85.0)	202	(84.0)		
Mother education						
No formal education	15	(5.0)	22	(9.0)		
Primary education	24	(8.0)	25	(10.0)		
Secondary education	220	(73.0)	151	(63.0)	20.183	.912
Tertiary education	43	(14.0)	42	(18.0)		
Birth order						
1	199	(66.0)	122	(51.0)	**19.327**	**< 0.03**
2-3	98	(32.0)	116	(46.0)		
>4	5	(2.0)	2	(1.0)		
Family type						
Joint	156	(52.0)	156	(65.0)	**10.204**	**< 0.03**
Nuclear	146	(48.0)	84	(35.0)		
Family Income						
<10,000	24	(8.0)	11	(5.0)		
10,000-20,000	140	(46.0)	187	(78.0)	**15.072**	**< 0.05**
20,000- 30,000	95	(31.0)	11	(5.0)		
30,000-40,000	25	(8.0)	21	(9.0)		
>40,000	18	(6.0)	10	(4.0)		

Table - 4 presents the distribution of young child feeding practices by sex among children aged 12–59 months (n = 542). Self-feeding behavior was significantly higher among female children (55.0%) compared to males (25.0%), while a greater proportion of male children were not self-feeders (75.0%) ($\chi^2 = 8.196$, $p < 0.01$). Colostrum feeding and exclusive breastfeeding were widely practiced among both male and female children. Similarly, the frequency of snack consumption did not differ significantly between male and female children, with a considerable proportion in both groups consuming snacks daily. The snacks consumed were predominantly energy-dense processed foods, including packet chips, cakes, biscuits, and chocolates.

Table-4 Distribution of Young Child Feeding Practices by Sex among Children Aged 12–59 Months

Characteristics	Male(n=302)		Female(n=240)		Chi-square value	P- value
Self feeder					**8.196**	**<0.01**
Yes	75	(25.0)	133	(55.0)		
No	227	(75.0)	107	(45.0)		

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Colostrum given					.271	.873
Yes	187	(62.0)	191	(79.0)		
No	115	(38.0)	49	(21.0)		
Exclusive breast feeding					1.634	.442
Yes	204	(68.0)	85	(35.0)		
No	98	(32.0)	155	(65.0)		
Frequency of snacks					3.581	.466
None	46	(15.0)	96	(40.0)		
1-2 days	43	(14.0)	55	(23.0)		
3-4 days	56	(19.0)	10	(4.0)		
>5 days	5	(2.0)	4	(2.0)		
Everyday	152	(50.0)	75	(31.0)		

IV. DISCUSSION

Stunting is a condition of prolonged undernutrition characterized by low height-for-age, reflecting prolonged nutritional deprivation and recurrent infections during early childhood.[7-9] The present study demonstrates that stunting persist as a main public health concern among children aged 12–59 months in North 24 Parganas district of West Bengal, with an overall prevalence of 24% (17% moderately stunted and 7% severely stunted). This burden is comparable to recent national estimates, indicating that despite ongoing interventions, the decline in stunting in India has been gradual and uneven. [10]

The significant ($p < 0.05$) variation in mean HAZ across age groups in the present study supports existing evidence that growth faltering tends to worsen with increasing age possibly due to cumulative nutritional deficiencies and repeated infections [11,12]. Similar findings have been reported in district-level analyses of National Family Health Survey (NFHS) data, which emphasize that age-specific vulnerability plays a crucial role in child growth outcomes [2].

Sex-wise distribution showed that female children (28%) had a comparatively higher burden of stunting than males (20%). This pattern suggests possible gender-related disparities in nutritional status and intra-household food distribution, which have also been documented in studies from developing countries. [13, 14]

Several socio-demographic factors demonstrated significant (p<) associations. Low birth weight was more prevalent among female children, suggesting early-life nutritional disadvantage, which is a well-established predictor of stunting.[15,16] A cross-sectional analysis from Indonesia also identified low birth weight as a key determinant of stunting in early childhood.[17] . According to a study conducted in Mumbai, India low birth weight is a strong predictor of stunting in early childhood. [18]

Birth order also showed a significant ($p<0.05$) association, with female children more often belonging to higher birth orders. This finding supports the resource dilution hypothesis, which suggests that as the number of siblings' increases, the resources available to each child decrease, thereby negatively affecting nutritional status. [19] According to a study conducted in Tanzania reported the similar kind of outcome of children of higher birth order were at increased risk of stunting, likely due to reduced resource allocation within larger families. [19] As per a study conducted in India Demonstrates that higher birth order is negatively associated with height-for-age (HAZ), indicating increased risk of stunting. [21]

Family type showed a significant association with child sex ($p < 0.05$), with a higher proportion of female children belonging to joint families and male children to nuclear families, indicating that household structure may influence patterns of care and resource allocation. In joint families, the sharing of food and care giving among multiple members may reduce per-child resource availability, thereby increasing the risk of stunting. [22, 23]

A statistically significant relationship between family income and child sex ($p < 0.05$) indicates that Children residing in economically disadvantaged households are more susceptible to stunting, as limited financial resources often restrict

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access to adequate nutrition, quality healthcare, and healthy living environments, a finding consistently reported in previous studies examining socio-economic determinants of child growth.[23,] Similar to the present study, a multination study evidence identifies household wealth as a key determinant of stunting.[24]

Maternal occupation emerged as a significant factor, with most mothers being homemakers. While this may allow greater time for childcare, limited financial autonomy could restrict access to adequate nutrition and healthcare, a dual influence also noted in earlier studies [10]

Among feeding practices, self-feeding behavior showed a significant association ($p < 0.05$) with sex, with male children more likely to practice self-feeding. Differences in care giving practices and autonomy may explain this variation, although evidence on this aspect remains limited [24]. Other feeding practices such as Colostrum feeding and exclusive breastfeeding were relatively consistent across sexes, aligning with findings from similar populations [25]

Overall, the findings highlight that stunting is influenced by a complex interplay of biological, socio-economic, and household-level factors [26, 27]. Addressing these determinants through targeted interventions focusing on maternal awareness, economic improvement, and equitable childcare practices is essential to reduce the burden of stunting [28-33]

V. CONCLUSION

The study findings indicate that female children experience a higher burden of stunting, reflected by reduced age specific height, compared to male children. Key socio-demographic factors, including low birth weight, birth order, family type, maternal occupation, and family earning, were significantly linked with stunting ($p < 0.05$). Furthermore, socio-economic disparities and variations in care giving practices appear to influence linear growth outcomes. These results underscore the need for interventions focusing on maternal awareness, and promoting equitable childcare practices to mitigate the burden of stunting.

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