

## Original Research Article

# A cross-sectional study on nutritional assessment of under-five children of brick kiln workers in a rural area of West Bengal

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### ABSTRACT

**Background:** Undernutrition among under-five children remains a major public health concern in India, particularly among marginalized populations such as brick-kiln workers. These families often live in vulnerable conditions with poor access to healthcare, nutrition, and sanitation, placing children at high risk of underweight, stunting, and wasting. This study aimed to assess the nutritional status among under-five children of brick-kiln workers in a rural area of West Bengal and to identify factors associated with these conditions.

**Methods:** A community-based cross-sectional study was conducted among 220 under-five children residing in brick kilns of a rural block in West Bengal. Data were collected using a pretested structured questionnaire. Nutritional status was assessed following WHO guidelines. Multivariable logistic regression was used to identify factors associated with undernutrition.

**Results:** Among the 220 children studied, 35.6% were underweight, 41.2% stunted, and 24.3% wasted. Severe acute malnutrition (SAM) as per MUAC was present in 5.6% of children. Significant factors associated with underweight included female gender (AOR = 1.9, 95% CI: 1.08-3.45) and lower maternal education (AOR = 1.65, 95% CI: 1.43-3.21). Stunting was significantly associated with increasing child age (AOR = 1.09, 95% CI: 1.06-1.13) and low maternal education (AOR = 2.1, 95% CI: 1.6-4.1).

**Conclusions:** The prevalence of undernutrition in children of brick-kiln workers was high. Female gender, low maternal education, age, and poverty were major determinants. Targeted, inclusive, and community-based interventions are urgently needed to address nutritional needs of this vulnerable population.

**Keywords:** Brick-kiln workers, Children, Malnutrition, Stunting, Wasting

### INTRODUCTION

Malnutrition remains a significant public health concern, especially among under-five children in low- and middle-income countries, where it contributes substantially to morbidity, mortality, and impaired cognitive and physical development.<sup>1</sup> The World Health Organization (WHO) recognizes underweight, stunting, and wasting as key indicators of undernutrition in children under five years of age, reflecting chronic and acute nutritional deprivation.<sup>2</sup> According to the Global Nutrition Report

2021, approximately 149.2 million children under five are stunted, 45.4 million are wasted, and 38.9 million are overweight globally, signifying a triple burden of malnutrition.<sup>3</sup>

India, home to the largest child population in the world, bears a disproportionate burden of childhood undernutrition. As per the National Family Health Survey-5 (NFHS-5), conducted during 2019-21, 35.5% of Indian children under five are stunted, 19.3% are wasted, and 32.1% are underweight.<sup>4</sup> West Bengal, though

slightly better than the national average, still faces considerable nutritional challenges with 34.2% stunted, 20.3% wasted, and 31.6% underweight children under five years of age.<sup>4</sup> These figures are particularly alarming in vulnerable and marginalized communities, where socio-economic deprivation, poor sanitation, inadequate maternal care, and food insecurity converge to exacerbate undernutrition. Among such vulnerable populations, brick-kiln workers represent an occupationally and socially marginalized group. Predominantly located in rural and peri-urban areas, brick-kiln industries in India are largely unregulated, informal, and seasonal, employing millions of migrant laborers under harsh working and living conditions.<sup>5</sup> Families, including women and children, often migrate from impoverished districts and states in search of temporary livelihood, residing in makeshift settlements without access to basic amenities like clean water, sanitation, or healthcare.<sup>6</sup> The children of these laborers frequently suffer from inadequate nutrition, limited healthcare access, poor immunization coverage, and absence of early childhood care, making them highly susceptible to undernutrition and related morbidities.<sup>7</sup>

The brick-kiln sector in West Bengal employs a substantial migrant workforce, particularly in its rural districts. These laborers typically belong to socio-economically disadvantaged groups such as Scheduled Castes (SC), Scheduled Tribes (ST), and Other Backward Classes (OBCs), and are often engaged in bonded or semi-bonded labor arrangements, perpetuating cycles of poverty and ill-health.<sup>8</sup> Children accompanying their families to these sites are frequently excluded from Anganwadi services and other community-based nutrition programs, thereby missing critical windows of nutritional support during the first 1,000 days of life.<sup>9</sup>

Underweight, stunting, and wasting are not only direct consequences of insufficient food intake and disease but also indirect outcomes of inadequate maternal education, poor sanitation, low birth weight, repeated infections, lack of immunization, and improper infant and young child feeding (IYCF) practices.<sup>10,11</sup> Research suggests that these forms of undernutrition often co-exist and interact, compounding their negative effects on child survival and development. For instance, wasting indicates acute malnutrition and a high risk of death, while stunting reflects long-term nutritional deprivation, impairing physical and cognitive growth. Underweight, which can be a result of both, serves as an overall indicator of a child's nutritional status.<sup>12</sup> Despite the known vulnerability of brick-kiln communities, limited research exists specifically addressing the nutritional status of under-five children in these populations in India, and even less so in West Bengal. Most existing studies have focused on general rural populations or urban slums, thereby failing to capture the unique nutritional vulnerabilities of migrant laborers and their children.<sup>13</sup> Moreover, the seasonal nature of employment in brick-kilns leads to disruption in continuity of care under public

health programs, such as the Integrated Child Development Services (ICDS) and Poshan Abhiyaan, which are otherwise critical to addressing child undernutrition.<sup>14</sup>

Understanding the prevalence and determinants of underweight, stunting, and wasting among children of brick-kiln workers is essential for tailoring appropriate public health interventions. Given their marginalized status, these children often fall through the cracks of conventional government services, necessitating targeted policies to ensure their nutritional rights. Identification of associated factors such as maternal literacy, exclusive breastfeeding, hygiene practices, food security, and access to health services will allow for context-specific recommendations that can inform programmatic and policy-level changes.

Therefore, the present study aimed to assess the prevalence of underweight, stunting, and wasting among under-five children of brick-kiln workers in a rural area of West Bengal, and to identify the associated factors influencing their nutritional status. The findings are expected to contribute valuable evidence to bridge the knowledge gap in this underserved population, enabling the formulation of inclusive nutrition-sensitive and nutrition-specific interventions.

## METHODS

### *Study design and setting*

A community-based cross-sectional study was conducted to assess the prevalence of underweight, stunting, and wasting and their associated factors among under-five children of brick-kiln workers. The study was carried out in selected rural brick-kiln sites in Singur, Rural Field Practice area of AIIHPH, Kolkata situated in Hooghly district of West Bengal, India. The brick-kilns were chosen purposively based on accessibility, availability of worker settlements, and willingness of kiln owners to facilitate data collection.

### *Study period*

This study was conducted between September 2024 to November 2024.

### *Study population*

The study population consisted of children aged 0–59 months (under-five years) residing with their families at the brick-kiln sites. Only those children whose parents had been working in the brick-kilns for at least one season (minimum 3 months) were included. Children who were severely ill at the time of the survey or whose anthropometric measurements could not be taken due to medical contraindications or lack of consent were excluded from the study.

### Sample size and sampling technique

Assuming the prevalence ( $p$ ) of underweight among under-five children as 38% (based on NFHS-5 data for vulnerable populations), a 95% confidence level ( $Z = 1.96$ ), and an 8% absolute precision ( $d$ ), the required sample size was calculated using standard Cochran's formula came as 147.<sup>4</sup> Considering a 10% non-response rate the final sample size came to be 162.

A multistage sampling technique was used. First, five brick-kiln clusters were selected randomly from a list obtained from the local labor office. Within each kiln cluster, a household listing of worker families with under-five children was prepared, and eligible children were selected using simple random sampling until the required sample size was met proportionally from each cluster.

### Data collection tools and techniques

A pre-designed, pre-tested, semi-structured interview schedule was used to collect data from the mothers or primary caregivers of the children. The schedule included sections on socio-demographic profile like age, gender, parental education, per-capita monthly family income, type of housing, type of family and recent history of illness in past 14 days.

Anthropometric measurements were taken using standardized equipment and WHO-recommended techniques. Weight was measured using a digital pediatric weighing scale with 100 g accuracy. Length/height assessment depended on age: for children <2 years, recumbent length was measured using an infantometer, while for children  $\geq 2$  years, standing height was measured using a stadiometer. Age was verified from birth certificates or immunization cards; where these were unavailable, maternal recall was used with the aid of local event calendars.

Measurements were converted into Z-scores (weight-for-age, height-for-age, and weight-for-height) using WHO Anthro software (version 3.2.2). The following definitions were used: underweight was defined as weight-for-age Z-score (WAZ) < -2 SD, stunting as

height-for-age Z-score (HAZ) < -2 SD, and wasting as weight-for-height Z-score (WHZ) < -2 SD. Mid-upper arm circumference was also estimated, and interpreted as follows: severe acute malnutrition <11.5 cm, moderately acute malnutrition 11.5 to 12.5 cm, and normal nutritional status >12.5 cm.

### Data management and statistical analysis

Collected data were checked daily for completeness and consistency. Data entry and cleaning were performed using Microsoft Excel, and statistical analysis was carried out using SPSS software version 16.0. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize the data. The prevalence of underweight, stunting, and wasting was presented with 95% confidence intervals. Associations between nutritional outcomes and independent variables were assessed using Chi-square tests or Fisher's exact tests as appropriate. Multivariate analysis using binary logistic regression was performed to identify independent predictors of undernutrition. Variables with  $p$ -value <0.05 in univariate analysis were included in the multivariate model. A  $p$ -value of <0.05 was considered statistically significant.

## RESULTS

The median age of the study participants was 35 months (IQR=25-46 months). Males comprised of 45.1% study participants and 74.7% were Hindus. 83 (51.2%) belonged to nuclear family. 53.1% of the mothers and 35.8% fathers were illiterate. The median per-capita monthly family income was 2102.8 INR (IQR=1577.5-2732.8 INR). 49.4% participants lived in kutch housing and 60.5% had history of recent illness in the past 14 days. The socio-demographic characteristics of the study participants have been described in Table 1.

Almost 40% participants were under-weight (signified both acute and chronic malnutrition), 41.2% had stunting (signified the presence of chronic malnutrition) and 24.3% had wasting (signified the presence of acute malnutrition). As per mid-upper arm circumference (MUAC), 5.6% had severe undernutrition (Figure 1).

**Table 1: Socio-demographic characteristics among the study participants (n=162).**

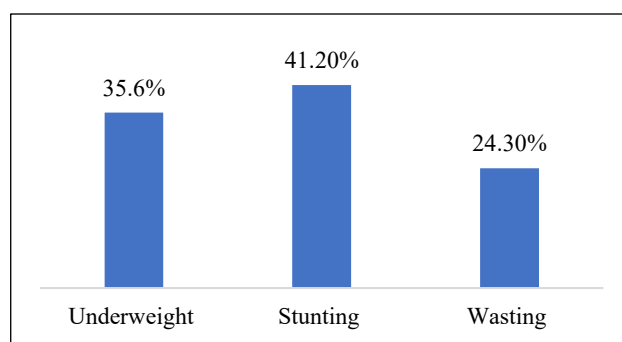
Variables	Categories	Frequency	Percentage
Age (in completed months)	12-23	38	23.5
	24-35	44	27.2
	36-47	49	30.2
	48-59	31	19.1
Gender	Male	73	45.1
	Female	89	54.9
Religion	Hinduism	121	74.7
	Islam	36	22.2
	Others	5	3.1
Caste	General	38	23.5

Continued.

Variables	Categories	Frequency	Percentage
	Scheduled caste	37	22.8
	Scheduled tribe	49	30.2
	Other backward caste	38	23.5
<b>Birth order</b>	1	37	22.8
	2	42	25.9
	3	45	27.8
	4	38	23.5
<b>Type of family</b>	Nuclear	79	48.8
	Joint	83	51.2
<b>Mother's education</b>	Illiterate	86	53.1
	Primary	26	16.0
	Secondary	46	28.4
	Higher secondary	4	2.5
<b>Father's education</b>	Illiterate	58	35.8
	Primary	47	29.0
	Secondary	51	31.5
	Higher secondary	6	3.7
<b>Type of housing</b>	Kuccha	80	49.4
	Pucca	15	9.3
	Semi-pucca	67	41.4
<b>H/o recent illness in past 14 days</b>	Present	98	60.5
	Absent	64	39.5
<b>Migration status</b>	Yes	120	74.1
	No	42	25.9

Multivariable logistic regression analysis showed that female gender (AOR=1.9, 95%CI=1.08-3.45) and primary and below mother's education status (AOR=1.65, 95% CI=1.43-3.21) as influencers of underweight.

Stunting was significantly associated with increasing age (AOR=1.09, 95% CI=1.06-1.13), primary and below mother's education status (AOR=2.1, 95%CI = 1.6-4.1). Decreasing per-capita monthly family income acted as a significant predictor of wasting (Table 2).



**Figure 1: Distribution of the study participants according to their nutritional status (n=162).**

**Table 2: Factors associated with nutritional status of the study participants (n=162).**

Variables	Categories	Underweight		Stunting		Wasting	
		OR (95%CI)	AOR (95% CI)	OR (95%CI)	AOR (95% CI)	OR (95%CI)	AOR (95% CI)
<b>Increasing age</b>		1.02 (0.8-1.3)		1.21 (1.1-1.32)	1.09 (1.06-1.13)	1.1 (0.9-1.16)	
<b>Gender</b>	Male	1 (Ref)	1 (Ref)	1 (Ref)		1 (Ref)	
	Female	2.11 (1.36-4.36)	1.9 (1.08-3.45)	0.64 (0.56-1.4)		2.3 (1.12-4.32)	1.4 (0.78-2.54)
<b>Mother's education</b>	Primary and below	2.3 (1.96-4.21)	1.65 (1.43-3.21)	3.4 (2.3-5.6)	2.1 (1.6-4.1)	1.32 (0.77-2.6)	
	Above primary	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	
<b>Father's</b>	Primary	2.1 (1.3-3.1)	1.23 (0.8-	1.32 (0.56-		2.14 (1.22-	1.56 (0.87-

Continued.

Variables	Categories	Underweight		Stunting		Wasting	
		OR (95%CI)	AOR (95% CI)	OR (95%CI)	AOR (95% CI)	OR (95%CI)	AOR (95% CI)
education	and below		2.4)	1.99)		3.21)	2.4)
	Above primary	1 (Ref)	1 (Ref)	1 (Ref)		1 (Ref)	1 (Ref)
<b>Decreasing per-capita monthly family income</b>		1.22 (1.11-2.3)	1.08 (0.9-1.3)	1.11 (0.8-1.64)		1.6 (1.3-2.4)	1.2 (1.07-1.44)

## DISCUSSION

This study was undertaken to assess the prevalence of underweight, stunting, and wasting among under-five children of brick-kiln workers in a rural area of West Bengal and to identify the associated socio-demographic and environmental determinants. The results reveal a high burden of malnutrition, with more than half of the children underweight (35.6%), over 40% stunted (41.2%), and over 24.3% wasted. These findings are more or less similar to the national averages reported in the National Family Health Survey (NFHS-5), which states that in rural West Bengal, 32.8% of under-five children are underweight, 34.5% are stunted, and 20.3% are wasted.<sup>4</sup>

The higher prevalence among children of brick-kiln workers can be attributed to the socio-economic vulnerabilities and harsh living conditions characteristic of this population. Brick-kiln workers often live in temporary settlements, with poor access to health services, safe water, and sanitation, and have limited income and social protection all contributing to a greater risk of undernutrition.<sup>15,16</sup>

### Underweight

In this study, 35.6% of the children were underweight, indicating a combination of chronic and acute malnutrition. Notably, the multivariable logistic regression revealed that female gender (AOR = 1.9, 95% CI = 1.08-3.45) and lower maternal education (primary and below) (AOR = 1.65, 95% CI = 1.43-3.21) were significantly associated with underweight.

The association between female gender and underweight is reflective of a gender bias in intra-household food distribution and health care access, which has been documented in several Indian studies.<sup>17,18</sup> Girls are often more vulnerable to malnutrition due to lower priority in food allocation, care-seeking behaviour, and cultural preferences for sons.<sup>19</sup>

The role of maternal education as a determinant of child nutrition is well-established. Mothers with lower education levels may lack knowledge of appropriate infant feeding practices, hygiene, and disease prevention, which are critical for child health.<sup>20</sup> Education empowers mothers to make informed health and nutritional decisions and better utilize health services.<sup>21</sup>

### Stunting

The prevalence of stunting in this study (41.2%) is particularly concerning as it indicates chronic malnutrition, which is associated with long-term physical and cognitive development deficits. Our study found a significant association between increasing child age and stunting (AOR = 1.09, 95% CI = 1.06-1.13), and again with lower maternal education (AOR = 2.1, 95% CI = 1.6-4.1).

The age-related increase in stunting may reflect the cumulative effect of prolonged nutritional deprivation, poor weaning practices, and recurrent infections over time. Research suggests that growth faltering begins early in life particularly during the first two years and if unaddressed, leads to irreversible stunting.<sup>22</sup> Older children in the study may have faced sustained exposure to suboptimal environments without adequate interventions.

Maternal education again emerges as a major determinant, reinforcing findings from earlier studies in India and globally.<sup>23,10</sup> Mothers with minimal education are less likely to follow proper feeding schedules, maintain hygiene, and recognize danger signs in illness, thereby increasing risk for chronic malnutrition in their children.

### Wasting

Wasting, an indicator of acute malnutrition, was prevalent in 24.3% of the children studied. The study found that a decrease in per-capita monthly family income was significantly associated with wasting, highlighting the immediate impact of poverty on child nutrition. This is consistent with national and international evidence which shows that household income is a strong predictor of child nutritional outcomes.<sup>24</sup>

Low-income families are often unable to afford sufficient and diverse food, which results in energy deficits and rapid weight loss in children, particularly during episodes of illness. Additionally, families working in brick-kilns often lack job security, experience seasonal unemployment, and live in precarious shelters without refrigeration, clean water, or sanitation, increasing susceptibility to diarrheal diseases and infections that contribute to wasting.<sup>25,26</sup>

### Severe Acute Malnutrition (SAM)

The finding that 5.6% of children had severe undernutrition according to MUAC warrants urgent public health attention. MUAC is a simple and reliable screening tool for identifying children at immediate risk of mortality due to severe acute malnutrition. SAM requires timely identification and management, preferably in a facility or through a community-based therapeutic program.<sup>27</sup>

### Socioeconomic and environmental determinants

This study also reveals the broader socioeconomic context of malnutrition among brick-kiln workers. Over half the households lived in kutchas, and more than 60% of children had a recent history of illness, reflecting the poor environmental conditions in which these families live. These factors create a vicious cycle where poor sanitation and housing contribute to disease, which in turn exacerbates undernutrition, particularly in children with already compromised immunity.<sup>28</sup>

Moreover, the median per capita monthly family income of ₹2102.8 places most of these families below the poverty line, further limiting access to nutritious food, health services, and education. In line with UNICEF's conceptual framework of undernutrition, which emphasizes the interplay of immediate, underlying, and basic causes of malnutrition, the findings of this study underscore the multifactorial nature of child undernutrition.<sup>11</sup>

A major strength of this study is its focus on a marginalized and understudied population, which often remains invisible in national nutrition surveys. Using WHO guidelines and standardized tools ensures the reliability of the anthropometric assessments. However, the study has limitations. Being cross-sectional, it cannot establish causal relationships. Additionally, recall bias may affect maternal reports of age and illness history. Seasonal variations in income and food availability were not accounted for, which might influence nutritional outcomes.

### CONCLUSION

The study reveals a high prevalence of underweight, stunting, and wasting among children under five years living in brick-kiln settings in rural West Bengal. Gender, maternal education, age, and household income were key determinants. These findings highlight the urgent need for inclusive, multi-sectoral interventions tailored to the needs of migrant labor communities to address both the immediate and structural drivers of undernutrition.

### Recommendations

The high burden of malnutrition in this population suggests a critical need for targeted interventions. Mobile

health units and Anganwadi services can be expanded to cover migrant brick-kiln populations. Special schemes under the Integrated Child Development Services (ICDS) and National Nutrition Mission (POSHAN Abhiyaan) must include seasonal migrants, who are often excluded from existing public health databases due to lack of permanent residence or identity proof.<sup>9</sup> Additionally, there is a pressing need to enhance maternal education through community-based awareness programs focusing on nutrition, hygiene, and child care. Providing nutritional supplements, regular health check-ups, and treatment for common infections could also help break the cycle of illness and malnutrition.

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