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Trends and determinants of child undernutrition in Bangladesh: Evidence from nationally representative surveys

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Abstract

Background

Despite notable improvements in maternal and child health, child undernutrition remains a persistent public health challenge in Bangladesh. Evidence regarding long-term structural trends and determinants using pooled, nationally representative data remains limited. This study aimed to assess the 15-year trends and key determinants of child undernutrition in Bangladesh.

Methods

We analyzed pooled cross-sectional data from five rounds of the Bangladesh Demographic and Health Survey (BDHS) spanning 2007 to 2022. The study included 32,851 children aged 0–59 months. Child undernutrition was defined as a composite binary measure incorporating stunting, wasting, and underweight. Temporal trends were evaluated using the Cochran–Armitage test, and multivariable logistic regression was applied to identify significant determinants.

Results

The overall prevalence of child undernutrition declined significantly from 54.6% in 2007 to 35.2% in 2022 (p-trend < 0.001), though reductions in acute wasting were notably stagnant in recent years. Multivariable analysis revealed that children from the poorest households, those with uneducated mothers, and those utilizing unimproved sanitation facilities had significantly higher odds of undernutrition. Furthermore, maternal undernutrition, inadequate antenatal care (ANC) utilization, home deliveries, and short birth intervals were strongly associated with early childhood nutritional failure.

Conclusion

While Bangladesh has achieved substantial long-term reductions in child undernutrition, critical socioeconomic and environmental disparities remain. Accelerating progress requires integrated policy interventions that prioritize maternal education, expand community-level WASH infrastructure, and improve maternal healthcare utilization to protect the most vulnerable pediatric populations.

1. Introduction

Child undernutrition remains one of the most persistent public health challenges worldwide, particularly in low- and middle-income countries (LMICs). Commonly manifesting as stunting, wasting, and underweight, early childhood undernutrition is a profound determinant of both immediate survival and long-term human capital formation [1–3]. Globally, undernutrition underlies nearly 45% of all deaths among children under five. Beyond immediate mortality, early nutritional deficits precipitate irreversible constraints on physical growth, cognitive development, educational attainment, and adult economic productivity [1, 4]. Despite concerted global efforts to alleviate this burden, progress remains unevenly distributed, with South Asia continuing to

account for a disproportionate share of stunted and underweight children due to deeply entrenched structural and socioeconomic inequities [5–7] .

Within this regional landscape, Bangladesh has achieved notable improvements in maternal and child health over the past two decades, driven by expanded primary healthcare, improved immunization coverage, and broad poverty reduction initiatives. Nevertheless, child undernutrition remains highly prevalent and is characterized by substantial disparities across household wealth, rural-urban residence, parental education, and maternal health indicators [8–10]. The immediate causes of undernutrition—such as inadequate dietary intake and recurrent childhood illnesses—are intrinsically linked to underlying socioeconomic vulnerabilities, including household food insecurity, unimproved sanitation, and inadequate utilization of maternal healthcare services [11, 12]. As Bangladesh undergoes significant demographic and health transitions, understanding how these multifaceted determinants continuously shape child nutritional outcomes is critical.

Despite the high burden of undernutrition, current empirical evidence in Bangladesh is largely derived from single-round, cross-sectional surveys or studies examining relatively short time horizons. Such methodological approaches are inherently limited in their capacity to capture long-term structural changes or to evaluate the persistence of socioeconomic and maternal inequalities over time. Consequently, there is a critical need for longitudinal perspectives that can quantify long-term temporal trends and identify the structural determinants that consistently drive childhood nutritional failure across multiple survey waves.

To address this critical gap in the literature, this study aims to assess the long-term trends and robust determinants of child undernutrition in Bangladesh over a 15-year period. By pooling nationally representative data from five consecutive rounds of the Bangladesh Demographic and Health Survey (BDHS) conducted between 2007 and 2022, this research provides a highly powered, comprehensive evaluation. The objective is to identify persistent disparities and average associations across the socioeconomic spectrum, thereby offering actionable, policy-relevant insights to accelerate the reduction of child undernutrition and support targeted public health interventions.

2. Methods

2.1 Study design and data source

This study used a repeated cross-sectional design, pooling data from five consecutive rounds of the Bangladesh Demographic and Health Survey (BDHS) conducted in 2007, 2011, 2014, 2017–18, and 2022. The BDHS is a nationally representative survey implemented by the National Institute of Population Research and Training (NIPORT) under the global DHS program. Each survey round employed a two-stage stratified cluster sampling design. In the first stage, enumeration areas (EAs) were selected with probability proportional to size, followed by an equal probability systematic selection of households in the second stage. Standardized DHS procedures were used to obtain anthropometric measurements for children under five years of age.

2.2 Study population and sample size

The base population comprised children aged 0–59 months living with their mothers at the time of each survey. A complete-case analysis approach was adopted; children lacking valid anthropometric

measurements or with missing information on key explanatory covariates were excluded from the final analytical sample. The final pooled analytical sample consisted of 32,851 children, distributed across the survey rounds as follows: 5,312 (2007), 7,860 (2011), 7,318 (2014), 8,109 (2017–18), and 4,252 (2022). Pooling the survey rounds maximized statistical power and facilitated the assessment of long-term macro-level trends across the 15-year period.

2.3 Outcome variable

The primary outcome was child undernutrition, defined as a dichotomous composite indicator. Following the World Health Organization (WHO) Child Growth Standards, anthropometric failure was identified across three domains: stunting (height-for-age Z-score [HAZ] < − 2 standard deviations [SD]), wasting (weight-for-height Z-score [WHZ] < − 2 SD), and underweight (weight-for-age Z-score [WAZ] < − 2 SD). A child was classified as "undernourished" if they presented with at least one of these anthropometric deficits, and "not undernourished" otherwise [13, 14]

2.4 Explanatory variables

Explanatory variables were selected a priori based on existing literature and data availability in the BDHS [15–19]. These variables were grouped into four domains. Child-level factors included age, sex, recent fever, breastfeeding status, birth order, birth interval, and type of birth. Household-level factors comprised administrative division, place of residence, household wealth index, source of drinking water, and type of toilet facility. Maternal characteristics included education level, employment status, body mass index (BMI), media exposure, number of antenatal care (ANC) visits, place of delivery, and mode of delivery. Paternal characteristics were assessed using father's education level.

2.5 Statistical analysis

Descriptive statistics summarized the baseline characteristics of the pooled sample. Bivariate associations between explanatory variables and child undernutrition were evaluated using Pearson's chi-square test. Temporal trends (2007–2022) in undernutrition prevalence were quantified using the Cochran–Armitage test for trend, generating Z-scores and corresponding p-values [20, 21]. To identify independent determinants of undernutrition, multivariable logistic regression models were fitted to the pooled dataset. The survey year was included as a fixed effect covariate in the models to adjust for unobserved between-survey macroeconomic and contextual variations. Results are presented as adjusted odds ratios (AORs) with 95% confidence intervals (CIs). Variance inflation factors (VIF) were examined to ensure no significant multicollinearity existed among the predictors. Crucially, all point estimates, standard errors, and regression models were adjusted for the complex survey design—incorporating sample weights, primary sampling units (clustering), and strata—adhering strictly to DHS analytical guidelines [22]. [23]. Analyses were executed using R statistical software (version 4.8.2), with statistical significance defined at $p < 0.05$.

2.6 Ethical considerations

This study involved secondary data analysis of fully anonymized, publicly available datasets. The original BDHS protocols were reviewed and approved by the Institutional Review Board of ICF International and the National Research Ethics Committee of the Bangladesh Medical Research Council (BMRC). No further ethical clearance was required for this analysis[22].

3. Results

3.1 Baseline Characteristics and Bivariate Associations

Table 1 presents the bivariate associations between child undernutrition and selected child, household, maternal, and paternal characteristics within the pooled sample. Child undernutrition varied significantly by age, with prevalence increasing from infancy to early childhood and peaking among children aged 24–47 months ($p < 0.001$). No statistically significant difference was observed by sex of the child ($p = 0.789$). Children who experienced recent fever had a significantly higher prevalence of undernutrition compared with those without fever ($p < 0.001$).

Significant disparities were observed across household characteristics. Undernutrition prevalence differed by administrative division, place of residence, and household wealth quintile, with higher prevalence concentrated among rural children and those from poor households ($p < 0.001$). Access to an unimproved toilet facility was significantly associated with undernutrition, whereas the source of drinking water showed no statistically significant association in the bivariate analysis.

Several maternal characteristics were significantly associated with child undernutrition. Higher prevalence was observed among children of mothers with no formal education, underweight BMI, no media access, fewer antenatal care visits, delivery without caesarean section, and home delivery (all $p < 0.001$). Maternal working status was not significantly associated with child undernutrition.

Children born after a short birth interval (< 2 years) and those of higher birth order had significantly higher prevalence of undernutrition ($p < 0.001$). Type of birth and breastfeeding status were not significantly associated with undernutrition. Paternal education showed a significant inverse association, with the highest prevalence observed among children whose fathers had no formal education ($p < 0.001$).

Table 1
Bivariate associations between child, household, maternal, and paternal characteristics and child undernutrition in Bangladesh

Variables	Total	Undernutrition		p-value
		No (%)	Yes (%)	
Child Characteristics				
Age of Child				
< 6	3115	2095 (67.3)	1020 (32.7)	< 0.001
6–8	1729	1192 (68.9)	537 (31.1)	
9–11	1713	1091 (63.7)	622 (36.3)	
12–23	6483	3319 (51.20)	3164 (48.8)	
24–35	6420	3089 (48.1)	3331 (51.9)	
36–47	6647	3264 (49.1)	3383 (50.9)	
48–59	6680	3504 (52.5)	3176 (47.5)	
Sex of Child				
Male	16309	8760 (53.7)	7549 (46.3)	0.789
Female	15466	8284 (53.6)	7182 (46.4)	
Had Fever				
No	20425	11296 (55.3)	9129 (44.7)	< 0.001
Yes	11329	5738 (50.6)	4591 (49.4)	
Household Characteristics				
Division				
Barisal	3771	1928 (51.1)	1843 (48.9)	< 0.001
Chittagong	6033	3156 (52.3)	2877 (47.7)	
Dhaka	5469	3024 (55.3)	2445 (44.7)	
Khulna	3658	2220 (60.7)	1438 (39.3)	
Mymensingh	4208	2226 (53.8)	1942 (46.2)	
Rajshahi	4115	2169 (52.7)	1946 (47.3)	
Rangpur	3809	1909 (50.0)	1905 (50.0)	
Sylhet	1724	887 (51.5)	837 (48.5)	
Residence				

Variables	Total	Undernutrition		p-value
		No (%)	Yes (%)	
Child Characteristics				
Urban	10635	6278 (59.0)	4357 (41.0)	< 0.001
Rural	22152	11276 (50.9)	10876 (49.1)	
Wealth Index				
Poor	13125	5755 (43.8)	7370 (56.2)	< 0.001
Middle	6057	3221 (53.2)	2836 (46.8)	
Rich	12593	8068 (64.1)	4525 (35.9)	
Sources of Drinking Water				
Improved	28044	14999 (53.5)	13045 (46.5)	0.623
Unimproved	4743	2555 (53.9)	2188 (46.1)	
Type of Toilet Facility				
Improved	17491	10336 (59.1)	7155 (40.9)	< 0.001
Unimproved	10321	4639 (44.9)	5682 (55.1)	
Maternal Characteristics				
Maternal Education				
No education	4751	1809 (38.1)	2942 (61.9)	< 0.001
Primary	9104	4144 (45.5)	4960 (54.5)	
Secondary	14088	8260 (58.6)	5828 (41.4)	
Higher	3830	2831 (73.9)	999 (26.1)	
Maternal Working Status				
No	23884	12843 (53.8)	11041 (46.2)	0.399
Yes	7889	4199 (53.2)	3690 (46.8)	
Body Mass Index				
Underweight	7019	2807 (40.0)	4212 (60.0)	< 0.001
Normal weight	18623	9983 (53.6)	8640 (46.4)	
Overweight	1978	3423 (68.8)	1555 (31.2)	
Obesity	1056	783 (74.1)	273 (25.9)	
Media Access				

Variables	Total	Undernutrition		p-value
		No (%)	Yes (%)	
Child Characteristics				
No	12016	5521 (45.9)	6495 (54.1)	< 0.001
Yes	19733	11512 (58.3)	8221 (41.7)	
Delivery by Caesarean Section				
No	18937	9197 (48.6)	9740 (51.4)	< 0.001
Yes	5314	3637 (68.4)	1677 (31.6)	
No. of ANC Visits				
0	5210	2061 (39.6)	3149 (60.4)	< 0.001
1	3183	1582 (49.7)	1601 (50.3)	
2	3279	1837 (56.0)	1442 (44.0)	
3	3050	1734 (56.9)	1316 (43.1)	
4 & more	7289	4689 (64.3)	2600 (35.7)	
Place of Delivery				
Home	15751	7261 (46.1)	8490 (53.9)	< 0.001
Hospital	4857	3119 (64.2)	1738 (35.8)	
Birth Interval (Years)				
< 2 Years	2359	1026 (43.5)	1333 (56.5)	< 0.001
2 Years & more	17746	9318 (52.5)	8428 (47.5)	
Birth Order				
First	11595	6660 (57.4)	4935 (42.6)	< 0.001
Second	9693	5434 (56.1)	4259 (43.9)	
Third	5339	2794 (52.3)	2545 (47.7)	
Fourth & more	5148	2156 (41.9)	2992 (58.1)	
Type of Birth				
Single	209	95 (45.5)	114 (54.5)	0.395
Multiple	227	94 (41.4)	133 (58.6)	
Breastfeeding Status				
No	11804	6404 (54.3)	5400 (45.7)	0.092

Variables	Total	Undernutrition		p-value
		No (%)	Yes (%)	
Child Characteristics				
Yes	19971	10640 (53.3)	9331 (46.7)	
Paternal Characteristics				
Paternal Education				
No education	7414	3006 (40.5)	4408 (59.5)	< 0.001
Primary	9651	4728 (49.0)	4923 (51.0)	
Secondary	9577	5692 (59.4)	3885 (40.6)	
Higher	4920	3494 (71.0)	1426 (29.0)	

3.2 Trends in Child Undernutrition, 2007–2022

Table 2 summarizes the temporal trends in child undernutrition between 2007 and 2022. The Cochran–Armitage test for trend indicated a significant decline in undernutrition across most demographic and socioeconomic subgroups, reflected by negative Z-scores and statistically significant p-values. Across child age groups, undernutrition declined over time, with the highest pooled prevalence consistently observed among children aged 24–47 months. Significant downward trends were observed among both male and female children. Undernutrition also declined among children with and without recent fever, although pooled prevalence remained higher among the fever-affected cohort.

Declines were observed across all key household characteristics (division, residence, and wealth status). Despite reductions in both urban and rural areas, pooled prevalence remained higher among rural children and those from poor households throughout the 15-year period. Downward trends were also observed across WASH indicators and key maternal factors, including maternal education, maternal nutritional status, and maternal health service utilization. In contrast, the trend among hospital deliveries was not statistically significant.

Figure 1 shows the prevalence of stunting, underweight, wasting, and overall undernutrition among children under five across the five BDHS rounds. Overall undernutrition declined markedly from approximately 54% in 2007 to 35% in 2022. Similar substantial declines were observed for stunting and underweight. However, wasting showed a considerably smaller reduction, with a decline between 2014 and 2017–18 followed by a slight increase in 2022, highlighting a stagnant trajectory for acute malnutrition. Detailed prevalence estimates along with their corresponding 95% confidence intervals are provided in Supplementary Table S1.

Table 2
Trends and pooled child undernutrition in Bangladesh between 2007 and 2022.

Variables	2007	2011	2014	2017-18	2022	Pooled Undernutrition (95% CI)	Z-score	p-value
Child Characteristics								
Age of Child								
< 6	37.58 (33.28, 41.88)	33.78 (30.22, 37.34)	32.86 (28.97, 36.75)	31.74 (28.77, 34.71)	27.90 (23.75, 32.06)	32.74 (31.10, 34.40)	-2.38	0.0143
6–8	38.85 (33.46, 44.24)	35.23 (30.47, 40.00)	28.83 (24.34, 33.31)	27.41 (23.06, 31.75)	23.71 (18.23, 29.18)	31.06 (28.88, 33.24)	-3.405	< 0.001
9–11	41.31 (35.32, 47.31)	41.78 (37.10, 46.47)	41.15 (36.33, 45.96)	27.89 (23.39, 32.40)	26.72 (21.20, 32.24)	36.31 (34.03, 38.59)	-3.85	< 0.001
12–23	53.56 (50.63, 56.50)	58.03 (55.50, 60.56)	50.00 (47.45, 52.55)	41.85 (39.46, 44.24)	37.36 (34.01, 40.71)	48.80 (47.59, 50.02)	-7.766	< 0.001
24–35	61.22 (58.34, 64.10)	57.80 (55.28, 60.32)	52.60 (50.02, 55.18)	45.75 (43.30, 48.21)	39.32 (35.99, 40.66)	51.88 (50.66, 53.11)	-8.657	< 0.001
36–47	61.07 (58.17, 63.96)	56.60 (54.27, 58.93)	53.71 (51.13, 56.28)	42.42 (39.95, 44.89)	36.65 (33.40, 39.91)	50.90 (49.69, 52.10)	-9.99	< 0.001
48–59	58.08 (55.12, 61.05)	53.61 (51.21, 56.00)	50.34 (47.77, 52.92)	37.94 (35.58, 40.29)	36.38 (33.17, 39.59)	47.54 (46.35, 48.74)	-9.751	< 0.001
Sex of Child								
Male	54.80 (52.91, 56.69)	51.23 (49.66, 52.80)	49.16 (47.52, 50.80)	39.51 (38.01, 41.00)	34.62 (32.58, 36.66)	46.29 (45.52, 47.05)	-13.002	< 0.001
Female	53.94 (52.03, 55.85)	53.72 (52.12, 55.32)	47.34 (45.66, 49.02)	39.09 (37.52, 40.65)	35.16 (33.06, 37.26)	46.44 (45.65, 47.22)	-13.046	< 0.001
Had Fever								
No	52.76 (51.06, 54.46)	50.68 (49.26, 52.10)	45.97 (44.50, 47.45)	38.03 (36.71, 39.35)	35.36 (33.58, 37.13)	44.70 (44.01, 45.38)	-13.869	< 0.001
Yes	57.05 (54.88,	55.41 (53.59,	52.18 (50.25,	41.81 (39.93,	33.75 (31.17,	49.35 (48.43, 50.27)	-11.852	< 0.001

Note. Values are prevalence (%) with 95% confidence intervals. Z-scores and p-values are from the Cochran–Armitage test for trend.

Variables	2007	2011	2014	2017-18	2022	Pooled Undernutrition (95% CI)	Z-score	p-value
Child Characteristics								
Age of Child								
	59.22)	57.23)	54.12)	43.70)	36.32)			
Household Characteristics								
Division								
Barisal	58.65 (55.03, 62.27)	55.06 (51.75, 58.36)	51.73 (48.35, 55.12)	38.86 (35.59, 42.12)	36.49 (32.26, 40.73)	48.87 (47.28, 50.47)	-7.488	< 0.001
Chittagong	54.88 (51.96, 57.80)	52.69 (50.20, 55.18)	50.89 (48.22, 53.56)	39.57 (36.90, 42.24)	34.56 (31.12, 38.01)	47.68 (46.43, 48.95)	-7.992	< 0.001
Dhaka	53.89 (51.00, 56.78)	54.32 (51.64, 57.01)	43.15 (40.41, 45.90)	33.68 (30.95, 36.41)	30.64 (26.98, 34.31)	44.71 (43.39, 46.02)	-9.8	< 0.001
Khulna	46.12 (42.27, 49.97)	44.51 (41.28, 47.73)	42.24 (38.81, 45.68)	31.24 (28.15, 34.34)	29.33 (25.13, 33.54)	39.31 (37.73, 40.89)	-5.789	< 0.001
Mymensingh	-	-	-	44.10 (40.97, 47.23)	39.05 (38.87, 43.22)	46.15 (44.64, 47.66)	-4.127	< 0.001
Rajshahi	54.73 (51.44, 58.03)	45.35 (42.16, 48.54)	44.97 (41.73, 48.21)	37.88 (34.63, 41.12)	30.99 (26.53, 35.45)	47.29 (45.76, 48.82)	-8.392	< 0.001
Rangpur	-	53.45 (50.38, 56.52)	45.72 (42.46, 48.97)	36.42 (33.36, 39.48)	34.22 (30.02, 38.41)	50.01 (48.43, 51.60)	-10.578	< 0.001
Sylhet	58.00 (54.83, 61.17)	59.81 (57.07, 62.54)	57.58 (54.71, 60.46)	50.68 (47.82, 53.53)	43.96 (39.79, 48.12)	48.55 (46.19, 50.91)	-2.598	0.0094
Residence								
Urban	47.52 (45.27, 49.77)	46.78 (44.78, 48.78)	42.07 (40.03, 44.12)	34.50 (32.72, 36.27)	32.84 (30.33, 35.35)	40.97 (40.03, 41.90)	-8.905	< 0.001
Rural	58.45 (56.83, 60.08)	55.19 (53.87, 56.51)	51.21 (49.81, 52.61)	41.89 (40.57, 43.21)	36.07 (34.33, 37.81)	49.10 (48.44, 49.76)	-16.926	< 0.001

Note. Values are prevalence (%) with 95% confidence intervals. Z-scores and p-values are from the Cochran–Armitage test for trend.

Variables	2007	2011	2014	2017-18	2022	Pooled Undernutrition (95% CI)	Z-score	p-value
Child Characteristics								
Age of Child								
Wealth Index								
Poor	64.83 (62.80, 66.85)	63.22 (61.53, 64.90)	59.16 (57.35, 60.98)	47.87 (46.17, 49.57)	43.21 (40.85, 45.58)	56.15 (55.30, 57.00)	-13.451	< 0.001
Middle	56.24 (53.15, 59.32)	53.42 (50.85, 55.10)	50.85 (47.21, 52.49)	38.09 (35.56, 40.62)	33.74 (30.51, 36.97)	46.82 (45.57, 48.08)	-9.38	< 0.001
Rich	43.17 (41.08, 45.26)	40.67 (38.10, 42.43)	36.39 (34.59, 38.18)	30.61 (28.98, 32.24)	26.63 (24.45, 28.81)	35.93 (35.09, 36.77)	-9.871	< 0.001
Sources of Drinking Water								
Improved	54.72 (53.28, 56.16)	52.81 (51.61, 53.10)	48.19 (46.95, 49.43)	39.55 (38.39, 40.71)	34.61 (33.06, 36.05)	46.52 (45.93, 47.10)	-17.706	< 0.001
Unimproved	54.18 (50.75, 57.60)	51.41 (48.41, 54.41)	49.36 (46.18, 52.55)	38.49 (35.85, 41.14)	37.62 (33.81, 41.43)	46.13 (44.71, 47.55)	-6.597	< 0.001
Types of Toilet Facility								
Improved	47.11 (44.92, 49.29)	46.34 (44.73, 47.95)	44.21 (42.74, 45.68)	35.92 (34.51, 37.33)	32.56 (30.87, 34.24)	40.91 (40.18, 41.64)	-11.138	< 0.001
Unimproved	59.66 (57.73, 61.59)	59.97 (58.19, 61.75)	56.98 (54.70, 59.27)	46.42 (44.43, 48.40)	43.17 (39.48, 46.85)	55.05 (54.09, 56.01)	-8.367	< 0.001
Maternal Characteristics								
Maternal Education								
No education	64.48 (61.99, 66.97)	64.68 (62.22, 67.15)	60.32 (57.39, 63.24)	54.46 (50.34, 58.59)	55.16 (49.02, 61.30)	61.92 (60.54, 63.30)	-3.276	< 0.001

Note. Values are prevalence (%) with 95% confidence intervals. Z-scores and p-values are from the Cochran–Armitage test for trend.

Variables	2007	2011	2014	2017-18	2022	Pooled Undernutrition (95% CI)	Z-score	p-value
Child Characteristics								
Age of Child								
Primary	60.85 (58.49, 63.20)	59.35 (57.35, 61.35)	57.91 (55.70, 60.11)	47.20 (45.14, 49.26)	41.68 (38.51, 44.84)	54.48 (53.46, 55.50)	-8.878	< 0.001
Secondary	46.36 (44.05, 48.66)	46.41 (44.69, 48.12)	42.52 (40.81, 44.23)	38.20 (36.64, 39.77)	33.26 (31.25, 35.26)	41.37 (40.56, 42.18)	-8.387	< 0.001
Higher	28.71 (24.37, 33.05)	29.28 (25.66, 32.89)	30.57 (27.24, 33.90)	22.11 (19.85, 24.37)	24.55 (21.51, 27.59)	26.08 (24.69, 27.47)	-2.682	0.0104
Respondent's Working Status								
No	53.24 (51.70, 54.78)	52.51 (51.33, 53.69)	46.86 (45.51, 48.22)	37.70 (36.30, 39.09)	34.86 (33.18, 36.54)	46.22 (45.60, 46.86)	-12.948	< 0.001
Yes	58.07 (55.35, 60.80)	51.87 (48.22, 55.51)	52.52 (50.18, 54.87)	41.66 (39.95, 43.38)	34.95 (31.98, 37.93)	46.77 (45.67, 47.86)	-9.543	< 0.001
Body Mass Index								
Underweight	64.07 (61.76, 66.37)	64.45 (62.41, 66.50)	60.19 (57.76, 62.63)	52.50 (49.62, 55.37)	45.45 (41.21, 49.70)	60.00 (58.86, 61.15)	-6.655	< 0.001
Normal weight	53.00 (51.24, 54.74)	50.98 (49.52, 52.44)	48.65 (47.11, 50.18)	40.36 (38.95, 41.77)	36.59 (34.62, 38.57)	46.39 (45.68, 47.11)	-11.569	< 0.001
Overweight	30.05 (25.64, 34.45)	32.87 (29.67, 36.10)	33.58 (30.78, 36.37)	30.48 (28.24, 32.72)	29.10 (26.30, 31.88)	31.24 (29.95, 32.52)	-1.201	0.2742
Obesity	28.57 (17.99, 39.15)	34.09 (26.00, 42.18)	29.65 (23.69, 35.60)	24.03 (19.77, 28.29)	19.92 (14.87, 24.96)	25.85 (23.21, 28.49)	-2.473	0.0293
Media Access								
No	61.83 (59.71, 63.96)	63.03 (61.22, 64.84)	57.73 (55.85, 59.61)	46.15 (44.32, 47.99)	38.77 (36.51, 41.02)	54.05 (53.16, 54.94)	-14.177	< 0.001

Note. Values are prevalence (%) with 95% confidence intervals. Z-scores and p-values are from the Cochran–Armitage test for trend.

Variables	2007	2011	2014	2017-18	2022	Pooled Undernutrition (95% CI)	Z-score	p-value
Child Characteristics								
Age of Child								
Yes	49.82 (48.11, 51.53)	46.46 (45.06, 47.86)	42.47 (41.00, 43.95)	35.42 (34.10, 36.75)	31.83 (29.82, 33.74)	41.66 (40.97, 42.35)	-12.948	< 0.001
Delivery by Caesarean Section								
No	56.70 (55.30, 58.10)	55.19 (53.98, 56.40)	49.43 (47.66, 51.20)	43.26 (41.56, 44.97)	38.76 (36.16, 41.35)	51.43 (50.72, 52.15)	-11.62	< 0.001
Yes	30.80 (26.65, 34.96)	36.86 (34.04, 39.67)	32.42 (29.49, 35.34)	30.07 (27.83, 32.32)	27.95 (25.33, 30.57)	31.56 (30.31, 32.81)	-2.961	0.007
No. of ANC Visits								
0	62.74 (60.40, 65.07)	61.62 (59.57, 63.67)	59.34 (56.03, 62.65)	50.40 (45.35, 55.44)	51.41 (44.05, 58.78)	60.44 (59.11, 61.77)	-3.227	< 0.001
1	56.13 (52.39, 59.87)	52.50 (49.27, 55.73)	51.61 (47.77, 55.44)	43.52 (39.48, 47.56)	42.09 (36.95, 47.23)	50.30 (48.56, 52.04)	-4.027	< 0.001
2	53.79 (49.64, 57.94)	45.19 (41.90, 48.47)	42.92 (39.19, 46.65)	43.21 (39.63, 46.79)	31.78 (27.36, 36.19)	43.98 (42.28, 45.68)	-4.741	< 0.001
3	49.10 (44.71, 53.48)	51.44 (48.05, 54.84)	41.45 (37.39, 45.50)	38.05 (34.47, 41.63)	31.24 (26.93, 35.54)	43.15 (41.39, 44.91)	-5.8	< 0.001
4 or more	37.08 (34.13, 40.02)	40.77 (38.46, 43.07)	35.97 (33.36, 38.58)	33.82 (31.87, 35.78)	28.87 (26.01, 31.72)	35.67 (34.57, 36.77)	-4.229	< 0.001
Place of Delivery								
Home	58.60 (57.13, 60.06)	57.32 (56.01, 58.62)	51.32 (49.38, 53.26)	44.64 (42.66, 46.62)	42.12 (38.87, 45.36)	53.90 (52.12, 54.68)	-9.843	< 0.001

Note. Values are prevalence (%) with 95% confidence intervals. Z-scores and p-values are from the Cochran–Armitage test for trend.

Variables	2007	2011	2014	2017-18	2022	Pooled Undernutrition (95% CI)	Z-score	p-value
Child Characteristics								
Age of Child								
Hospital	34.57 (31.49, 37.64)	38.02 (35.63, 40.40)	35.20 (32.77, 37.64)	35.29 (31.45, 39.13)	30.97 (25.43, 36.51)	35.78 (34.44, 37.13)	-0.785	0.376
Birth Interval (In Years)								
Less than 2 Years	64.00 (59.89, 68.11)	62.16 (58.22, 66.09)	58.61 (54.19, 63.04)	45.77 (41.49, 50.05)	46.06 (39.93, 52.19)	56.51 (54.51, 58.51)	-5.152	< 0.001
2 Years and more	55.59 (53.83, 57.36)	53.20 (51.71, 54.68)	49.46 (47.86, 51.05)	40.43 (38.96, 41.89)	36.86 (33.90, 37.83)	47.49 (46.76, 48.23)	-13.782	< 0.001
Birth Order								
First	49.18 (46.81, 51.55)	49.19 (47.30, 51.09)	44.90 (43.02, 46.78)	36.48 (34.76, 38.21)	31.43 (29.11, 33.75)	42.56 (41.66, 43.46)	-10.381	< 0.001
Second	51.64 (49.03, 54.26)	50.18 (48.10, 52.26)	46.96 (44.82, 49.10)	37.30 (35.42, 39.17)	34.11 (31.64, 36.57)	43.94 (42.95, 44.93)	-9.8	< 0.001
Third	55.49 (52.27, 58.72)	52.90 (50.18, 55.61)	49.77 (46.82, 52.72)	41.70 (39.04, 44.36)	35.96 (36.43, 39.48)	47.67 (46.33, 49.01)	-7.258	< 0.001
Fourth & more	63.53 (60.89, 66.17)	61.67 (59.15, 64.19)	57.81 (54.85, 60.77)	50.00 (46.86, 53.14)	48.89 (44.02, 53.76)	58.12 (56.77, 59.47)	-5.491	< 0.001
Type of Birth								
Single	54.17 (34.23, 74.10)	62.75 (49.48, 76.01)	65.22 (51.45, 78.98)	50.00 (37.35, 62.65)	32.14 (14.84, 49.44)	54.55 (47.79, 61.30)	-1.658	0.1015
Multiple	59.38 (42.36, 76.39)	60.32 (48.23, 72.40)	52.94 (36.16, 69.72)	61.43 (50.03, 72.83)	53.57 (35.10, 72.04)	58.59 (52.18, 65.00)	-0.193	0.8438
Breastfeeding Status								

Note. Values are prevalence (%) with 95% confidence intervals. Z-scores and p-values are from the Cochran–Armitage test for trend.

Variables	2007	2011	2014	2017-18	2022	Pooled Undernutrition (95% CI)	Z-score	p-value
Child Characteristics								
Age of Child								
No	53.35 (50.88, 55.83)	51.42 (49.47, 53.37)	49.37 (47.53, 51.21)	39.58 (37.87, 41.30)	35.85 (33.60, 38.10)	45.75 (44.85, 46.65)	-10.3	< 0.001
Yes	54.80 (53.21, 56.40)	52.96 (51.59, 54.33)	47.52 (46.00, 49.05)	39.12 (37.73, 40.51)	34.16 (32.24, 36.09)	46.72 (46.03, 47.41)	-15.241	< 0.001
Paternal Characteristics								
Paternal Education								
No education	64.52 (62.30, 66.74)	62.75 (60.70, 64.80)	60.70 (58.40, 63.00)	51.66 (48.77, 54.56)	44.43 (40.51, 48.34)	59.46 (58.34, 60.57)	-7.183	< 0.001
Primary	58.11 (55.59, 60.63)	57.94 (55.88, 59.10)	52.65 (50.51, 54.78)	45.49 (43.59, 47.39)	39.07 (36.33, 41.80)	51.01 (50.01, 52.01)	-9.631	< 0.001
Secondary	47.87 (45.22, 50.52)	46.67 (44.60, 48.75)	41.28 (39.18, 43.37)	35.69 (33.81, 37.58)	31.27 (28.84, 33.71)	40.57 (39.58, 41.55)	-8.885	< 0.001
Higher	32.43 (28.88, 35.92)	32.18 (29.34, 35.02)	32.61 (29.71, 35.50)	23.88 (21.66, 26.11)	26.36 (23.29, 29.42)	28.98 (27.72, 30.25)	-3.63	< 0.001

Note. Values are prevalence (%) with 95% confidence intervals. Z-scores and p-values are from the Cochran–Armitage test for trend.

3.3 Determinants of Child Undernutrition

After adjusting for potential confounders, several factors remained significantly associated with child undernutrition in the pooled multivariable logistic regression model (Table 3). Compared with children aged 48–59 months, younger children (< 6 months: AOR = 0.405; 95% CI: 0.340–0.483; 6–8 months: AOR = 0.368; 95% CI: 0.302–0.448; and 9–11 months: AOR = 0.549; 95% CI: 0.450–0.669) had significantly lower odds of undernutrition ($p < 0.001$).

Maternal nutritional status was strongly associated with child undernutrition: children of underweight mothers (AOR = 2.480; 95% CI: 1.854–3.318) and normal-weight mothers (AOR = 1.601; 95% CI: 1.210–2.118) had higher odds of anthropometric failure compared with children of obese mothers. Birth order was also a significant predictor; first-born (AOR = 0.528; 95% CI: 0.494–0.565), second-born (AOR = 0.577; 95% CI: 0.539–0.618), and third-born children (AOR = 0.636; 95% CI: 0.589–0.687) had lower odds than children of fourth or

higher birth order ($p < 0.001$). Maternal education remained independently associated with undernutrition. Compared with children of mothers with higher education, odds were higher among children whose mothers had no education (AOR = 1.530; 95% CI: 1.195–1.959), primary education (AOR = 1.482; 95% CI: 1.176–1.868), or secondary education (AOR = 1.303; 95% CI: 1.051–1.614). Short birth interval (< 2 years) was associated with higher odds of undernutrition (AOR = 1.196; 95% CI: 1.051–1.360).

Household sanitation and socioeconomic status were also critical determinants: improved toilet facilities were associated with lower odds (AOR = 0.864; 95% CI: 0.791–0.943), whereas poor households had higher odds (AOR = 1.158; 95% CI: 1.024–1.309) compared with rich households. Paternal education showed an independent association, with higher odds among children whose fathers had no education (AOR = 1.233; 95% CI: 1.023–1.487). Regarding health service utilization, home delivery was associated with higher odds (AOR = 1.189; 95% CI: 1.009–1.409). Fewer antenatal care visits were associated with higher odds of undernutrition compared with four or more visits (0 visits: AOR = 1.400; 95% CI: 1.236–1.586; 1 visit: AOR = 1.216; 95% CI: 1.063–1.391; 2 visits: AOR = 1.182; 95% CI: 1.031–1.356; 3 visits: AOR = 1.199; 95% CI: 1.039–1.384). Finally, the absence of recent fever was a protective factor, associated with lower odds of undernutrition (AOR = 0.804; 95% CI: 0.740–0.872).

Figure 2. Forest plot of adjusted odds ratios (AORs) and 95% confidence intervals (CIs) for significant determinants from pooled multivariable model

Table 3
Multivariable analysis of child undernutrition and associated factors in Bangladesh

Variable	2007	2011	2014	2017-18	2022	Overall AOR (95% CI)
Age of Child						
< 6	0.388 (0.273, 0.552)***	0.420 (0.315, 0.559)***	0.646 (0.529, 0.788)***	0.762 (0.639, 0.908)**	0.711 (0.551, 0.918)**	0.405 (0.340, 0.483)***
6–8	0.403 (0.276, 0.589)***	0.384 (0.277, 0.533)***	0.473 (0.372, 0.601)***	0.632 (0.494, 0.809)***	0.497 (0.348, 0.709)***	0.368 (0.302, 0.448)***
9–11	0.595 (0.393, 0.901)*	0.500 (0.351, 0.712)***	0.677 (0.543, 0.844)**	0.640 (0.500, 0.818)***	0.687 (0.501, 0.944)*	0.549 (0.450, 0.669)***
12–23	0.815 (0.615, 1.081)	1.138 (0.910, 1.423)	0.995 (0.860, 1.151)	1.161 (1.005, 1.342)*	1.043 (0.848, 1.282)	0.881 (0.759, 1.022)
24–35	1.120 (0.847, 1.482)	1.146 (0.912, 1.440)	1.107 (0.954, 1.285)	1.476 (1.275, 1.707)***	1.143 (0.930, 1.405)	1.094 (0.942, 1.271)
36–47	1.034 (0.776, 1.378)	1.082 (0.873, 1.341)	1.163 (1.001, 1.350)*	1.255 (1.082, 1.455)**	1.080 (0.877, 1.330)	1.080 (0.912, 1.280)
48–59	1.00	1.00	1.00	1.00	1.00	1.00
Division						
Barisal	0.918 (0.601, 1.401)	1.152 (0.780, 1.700)	1.334 (0.834, 2.136)	0.653 (0.394, 1.083)	0.594 (0.258, 1.368)	1.056 (0.774, 1.440)
Chittagong	0.972 (0.693, 1.364)	1.041 (0.783, 1.383)	1.268 (0.893, 1.802)	0.797 (0.542, 1.173)	0.773 (0.401, 1.492)	1.059 (0.799, 1.403)
Dhaka	0.930 (0.674, 1.290)	1.132 (0.858, 1.494)	0.900 (0.644, 1.257)	0.706 (0.477, 1.045)	0.687 (0.346, 1.368)	0.998 (0.754, 1.319)
Khulna	0.694 (0.469, 1.028)	0.786 (0.560, 1.105)	0.933 (0.592, 1.470)	0.480 (0.289, 0.797)**	1.027 (0.443, 2.384)	0.807 (0.596, 1.091)
Mymensingh	-	-	-	0.971 (0.615, 1.534)	1.085 (0.517, 2.276)	0.923 (0.691, 1.233)
Rajshahi	0.891 (0.630,	0.830 (0.608,	0.673 (0.444,	0.573 (0.358,	0.560 (0.237,	0.985 (0.731,

1.00 = Reference Category, *= <0.05, **= <0.01, ***= <0.001, - =Variable not included in the model

Variable	2007	2011	2014	2017-18	2022	Overall AOR (95% CI)
Age of Child						
	1.260)	1.132)	1.020)	0.918)*	1.322)	1.327)
Rangpur	-	0.836 (0.599, 1.167)	1.356 (0.882, 2.085)	0.681 (0.431, 1.077)	0.403 (0.180, 0.903)*	0.874 (0.644, 1.186)
Sylhet	1.00	1.00	1.00	1.00	1.00	1.00
Residence						
Urban	1.023 (0.814, 1.286)	1.033 (0.849, 1.258)	1.141 (0.899, 1.448)	0.938 (0.710, 1.238)	0.978 (0.823, 1.100)	1.052 (0.943, 1.174)
Rural	1.00	1.00	1.00	1.00	1.00	1.00
BMI						
Underweight	4.788 (1.846, 12.423)**	2.600 (1.460, 4.629)**	1.564 (0.854, 2.864)	2.071 (1.114, 3.851)*	1.469 (0.573, 3.766)	2.480 (1.854, 3.318)***
Normal weight	3.778 (1.473, 9.691)**	1.392 (0.759, 2.437)	1.129 (0.635, 2.008)	1.189 (0.676, 2.091)	1.912 (0.824, 4.440)	1.601 (1.210, 2.118)**
Overweight	1.977 (0.745, 5.245)	0.953 (0.533, 1.705)	0.644 (0.353, 1.175)	1.086 (0.596, 1.979)	1.079 (0.449, 2.596)	1.020 (0.760, 1.369)
Obesity	1.00	1.00	1.00	1.00	1.00	1.00
Birth Order						
First	0.567 (0.488, 0.660)***	0.574 (0.503, 0.654)***	0.570 (0.494, 0.658)***	0.591 (0.510, 0.685)***	0.506 (0.404, 0.634)***	0.528 (0.494, 0.565)***
Second	0.691 (0.590, 0.810)***	0.591 (0.516, 0.677)***	0.681 (0.587, 0.791)***	0.620 (0.533, 0.721)***	0.565 (0.450, 0.709)***	0.577 (0.539, 0.618)***
Third	0.740 (0.620, 0.883)**	0.635 (0.546, 0.739)***	0.689 (0.582, 0.815)***	0.709 (0.599, 0.839)***	0.603 (0.469, 0.774)***	0.636 (0.589, 0.687)***
Fourth & more	1.00	1.00	1.00	1.00	1.00	1.00
Maternal Education						
No education	1.038 (0.614,	1.780 (1.132,	2.280 (1.314,	1.007 (0.527,	1.414 (0.544,	1.530 (1.195,

1.00 = Reference Category, *= <0.05, **= <0.01, ***= <0.001, - =Variable not included in the model

Variable	2007	2011	2014	2017-18	2022	Overall AOR (95% CI)
Age of Child						
	1.755)	2.799)*	3.958)**	1.925)	3.679)	1.959)**
Primary	1.189 (0.721, 1.962)	1.789 (1.167, 2.741)**	2.104 (1.253, 3.532)**	0.955 (0.538, 1.696)	0.942 (0.404, 2.194)	1.482 (1.176, 1.868)**
Secondary	1.026 (0.643, 1.636)	1.527 (1.029, 2.265)*	1.464 (0.916, 2.341)	1.249 (0.726, 2.148)	0.839 (0.378, 1.862)	1.303 (1.051, 1.614)*
Higher	1.00	1.00	1.00	1.00	1.00	1.00
Birth Interval (Years)						
< 2 Years	1.294 (0.998, 1.677)	1.172 (0.931, 1.474)	0.967 (0.718, 1.302)	1.186 (0.842, 1.671)	1.600 (0.960, 2.669)	1.196 (1.051, 1.360)*
2 Years & More	1.00	1.00	1.00	1.00	1.00	1.00
Type of Toilet Facility						
Improved	0.866 (0.720, 1.042)	0.908 (0.777, 1.060)	0.883 (0.711, 1.096)	0.965 (0.769, 1.211)	0.884 (0.585, 1.336)	0.864 (0.791, 0.943)**
Unimproved	1.00	1.00	1.00	1.00	1.00	1.00
Wealth Index						
Poor	1.251 (0.969, 1.614)	1.207 (0.966, 1.508)	1.338 (0.992, 1.805)	0.972 (0.703, 1.344)	1.832 (1.071, 3.136)*	1.158 (1.024, 1.309)*
Middle	1.029 (0.792, 1.335)	1.108 (0.892, 1.377)	1.120 (0.841, 1.492)	0.982 (0.705, 1.368)	1.315 (0.733, 2.359)	1.059 (0.935, 1.200)
Rich	1.00	1.00	1.00	1.00	1.00	1.00
Paternal Education						
No education	1.616 (1.086, 2.407)*	1.120 (0.815, 1.538)	0.860 (0.576, 1.284)	2.978 (1.683, 5.271)***	0.958 (0.387, 2.375)	1.233 (1.023, 1.487)*
Primary	1.198 (0.817, 1.759)	1.263 (0.935, 1.707)	0.755 (0.521, 1.093)	2.926 (1.726, 4.960)***	1.162 (0.493, 2.739)	1.167 (0.979, 1.392)

1.00 = Reference Category, *= <0.05, **= <0.01, ***= <0.001, - =Variable not included in the model

Variable	2007	2011	2014	2017-18	2022	Overall AOR (95% CI)
Age of Child						
Secondary	1.257 (0.868, 1.821)	1.060 (0.796, 1.411)	0.843 (0.598, 1.189)	1.841 (1.098, 3.087)*	1.166 (0.508, 2.675)	1.066 (0.900, 1.262)
Higher	1.00	1.00	1.00	1.00	1.00	1.00
Place of Delivery						
Home	1.035 (0.703, 1.524)	1.278 (0.934, 1.749)	1.005 (0.735, 1.373)	1.108 (0.723, 1.699)	2.544 (1.296, 4.994)**	1.189 (1.009, 1.409)*
Hospital	1.00	1.00	1.00	1.00	1.00	1.00
No. of ANC Visits						
0	1.258 (0.952, 1.663)	1.020 (0.809, 1.285)	1.671 (1.259, 2.220)***	1.287 (0.915, 1.812)	2.141 (1.205, 3.805)**	1.400 (1.236, 1.586)***
1	1.362 (0.995, 1.864)	0.812 (0.627, 1.052)	1.772 (1.328, 2.364)***	1.193 (0.875, 1.626)	1.252 (0.727, 2.158)	1.216 (1.063, 1.391)**
2	1.534 (1.098, 2.141)*	0.765 (0.588, 0.995)*	1.417 (1.060, 1.894)*	1.365 (1.004, 1.856)*	1.056 (0.622, 1.794)	1.182 (1.031, 1.356)*
3	1.383 (0.990, 1.933)	0.994 (0.755, 1.308)	1.193 (0.878, 1.620)	1.094 (0.794, 1.509)	1.655 (0.944, 2.903)	1.199 (1.039, 1.384)*
4 & more	1.00	1.00	1.00	1.00	1.00	1.00
Delivery by Caesarean Section						
No	1.240 (0.752, 2.042)	0.966 (0.665, 1.402)	0.843 (0.592, 1.200)	0.790 (0.454, 1.373)	0.235 (0.101, 0.544)**	0.837 (0.687, 1.021)
Yes	1.00	1.00	1.00	1.00	1.00	1.00
Had Fever						
No	0.839 (0.707, 0.996)*	0.787 (0.681, 0.910)**	0.663 (0.551, 0.798)***	0.821 (0.666, 1.011)	-	0.804 (0.740, 0.872)***

1.00 = Reference Category, *= <0.05, **= <0.01, ***= <0.001, - =Variable not included in the model

Variable	2007	2011	2014	2017-18	2022	Overall AOR (95% CI)
Age of Child						
Yes	1.00	1.00	1.00	1.00	-	1.00
Media Access						
No	0.995 (0.815, 1.213)	1.271 (1.075, 1.504)**	1.052 (0.833, 1.328)	1.074 (0.849, 1.359)	0.763 (0.522, 1.117)	1.081 (0.983, 1.188)
Yes	1.00	1.00	1.00	1.00	1.00	1.00
Respondent's Working Status						
No	1.061 (0.877, 1.285)	-	0.788 (0.642, 0.967)*	0.965 (0.777, 1.198)	-	-
Yes	1.00	-	1.00	1.00	-	-
1.00 = Reference Category, *= <0.05, **= <0.01, ***= <0.001, - =Variable not included in the model						

4. Discussion

This study assessed the long-term trends and determinants of child undernutrition in Bangladesh using pooled, nationally representative data spanning 15 years (2007–2022). The overarching finding demonstrates a substantial and statistically significant decline in the overall prevalence of child undernutrition, dropping from approximately 54% in 2007 to 35% in 2022. This progress underscores the success of sustained macroeconomic growth, poverty reduction initiatives, and targeted maternal and child health interventions in Bangladesh over the last decade and a half [23, 24]. However, despite this aggregate progress, profound socioeconomic, environmental, and maternal disparities persist, and the reduction across different forms of malnutrition has not been uniform.

A critical observation from the trend analysis is the diverging trajectory of acute versus chronic malnutrition. While stunting and underweight have shown consistent and steep declines, the reduction in wasting has been markedly more modest, with data suggesting a slight stagnation or increase leading up to 2022. Stunting reflects chronic, long-term nutritional deficits, which are responsive to gradual improvements in living standards and education. Conversely, wasting is an indicator of acute nutritional shocks. The stall in wasting reduction likely reflects recent macroeconomic volatility, including the immediate and lingering socioeconomic impacts of the COVID-19 pandemic, rising global inflation, and localized climate shocks, which precipitously exacerbate acute household food insecurity[25].

Consistent with a robust body of global health literature, socioeconomic status remains a primary driver of nutritional outcomes. Children from poorer households and those with uneducated mothers faced significantly higher odds of undernutrition [26]. Maternal education acts as a critical catalyst for child health;

educated mothers are more likely to exhibit health-promoting behaviors, ensure optimal infant and young child feeding (IYCF) practices, and effectively navigate the healthcare system [27, 28]. Furthermore, the analysis highlights the persistent threat of poor environmental hygiene. Children residing in households with unimproved sanitation facilities or those who recently experienced febrile illnesses were highly susceptible to undernutrition. This reinforces the established pathway wherein poor water, sanitation, and hygiene (WASH) conditions lead to repeated enteric infections and environmental enteric dysfunction, severely impairing a child's ability to absorb nutrients regardless of caloric intake [29].

Maternal and reproductive health characteristics were also intrinsically linked to child nutritional status. Maternal undernutrition (underweight BMI), home deliveries, and inadequate utilization of antenatal care (ANC) significantly elevated the risk of child undernutrition. These findings highlight the intergenerational cycle of malnutrition, where malnourished mothers with limited access to formalized healthcare are at a substantially higher risk of delivering low-birth-weight infants predisposed to early growth faltering [30–32]. Additionally, reproductive dynamics such as short birth intervals and higher birth orders compounded this risk, likely due to maternal nutritional depletion syndrome and the intensified sibling competition for limited household resources and maternal care [33].

The primary strength of this study lies in the utilization of a large, pooled dataset from five BDHS rounds, yielding high statistical power and allowing for a comprehensive evaluation of long-term temporal trends rather than cross-sectional snapshots. Furthermore, employing a composite index for undernutrition provides a holistic measure of the true, overarching burden of anthropometric failure, capturing children who suffer from multiple deficits simultaneously [34]. However, several limitations must be acknowledged. First, the cross-sectional nature of the BDHS data precludes the establishment of causal relationships between the identified determinants and child undernutrition. Second, while the composite indicator is valuable for overall burden estimation, it inherently masks the distinct etiologies of acute (wasting) versus chronic (stunting) malnutrition. Consequently, some determinants may have differential impacts on specific anthropometric failures that are not fully disaggregated in a composite model.

5. Conclusion

While Bangladesh has made commendable strides in reducing the overall prevalence of child undernutrition between 2007 and 2022, the persistence of acute malnutrition and glaring socioeconomic inequities demand immediate policy recalibration. Progress is threatened by recent macroeconomic shocks that disproportionately affect the most vulnerable populations. Moving forward, public health interventions must adopt an integrated approach that goes beyond food supplementation. Strategies must prioritize the expansion of maternal education, integrate robust WASH interventions into community nutrition programs, and enhance the coverage and quality of maternal healthcare services. Specifically, social safety net programs must be dynamically scaled during economic crises to buffer vulnerable households against the acute nutritional shocks that drive childhood wasting.

Declarations

Ethics approval and consent to participate

This study was based on secondary analysis of publicly available data from the Bangladesh Demographic and Health Survey (BDHS). Ethical approval for the BDHS surveys was obtained by the National Institute of Population Research and Training (NIPORT), Bangladesh, and the Institutional Review Board of ICF International. Informed consent was obtained from all respondents at the time of data collection. As this study used anonymized secondary data, no additional ethical approval was required.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

EA conceived and designed the study, and conducted the data analysis. EA and SA interpreted the results and drafted the manuscript. All authors reviewed, edited, and approved the final manuscript.

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Author Contribution

EA conceived and designed the study, conducted the data analysis. EA, SA interpreted the results and drafted the manuscript. All authors reviewed, edited, and approved the final manuscript.

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Data Availability

The datasets analyzed during the current study are publicly available from the DHS Program website (https://dhsprogram.com) upon reasonable request and approval.

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35. Supplementary Table S. Trends in Nutritional Status among Under-Five Children in Bangladesh (BDHS 2007–2022).

Figures

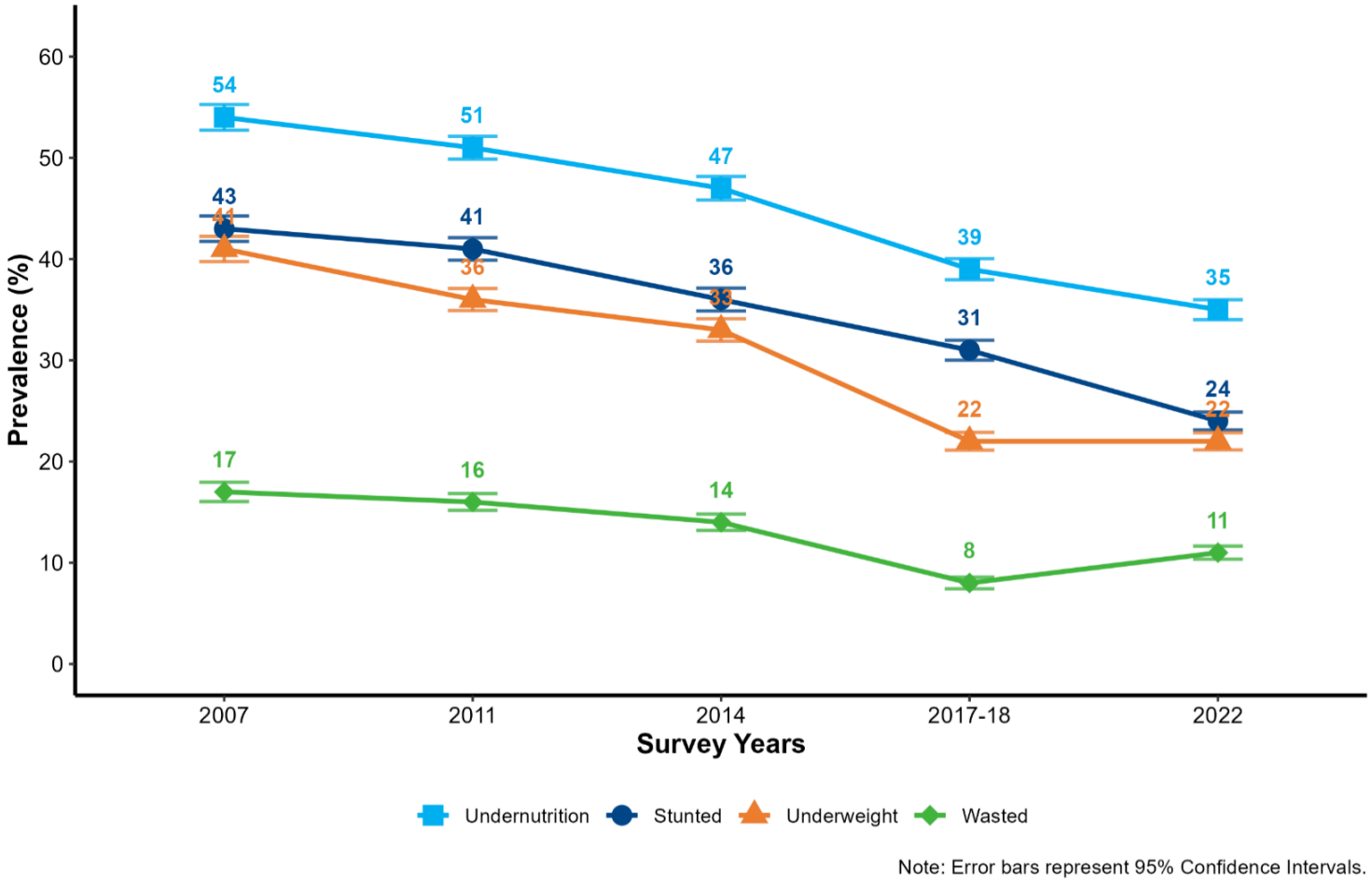


Figure 1

Trends in child nutritional outcomes in Bangladesh, 2007–2022.

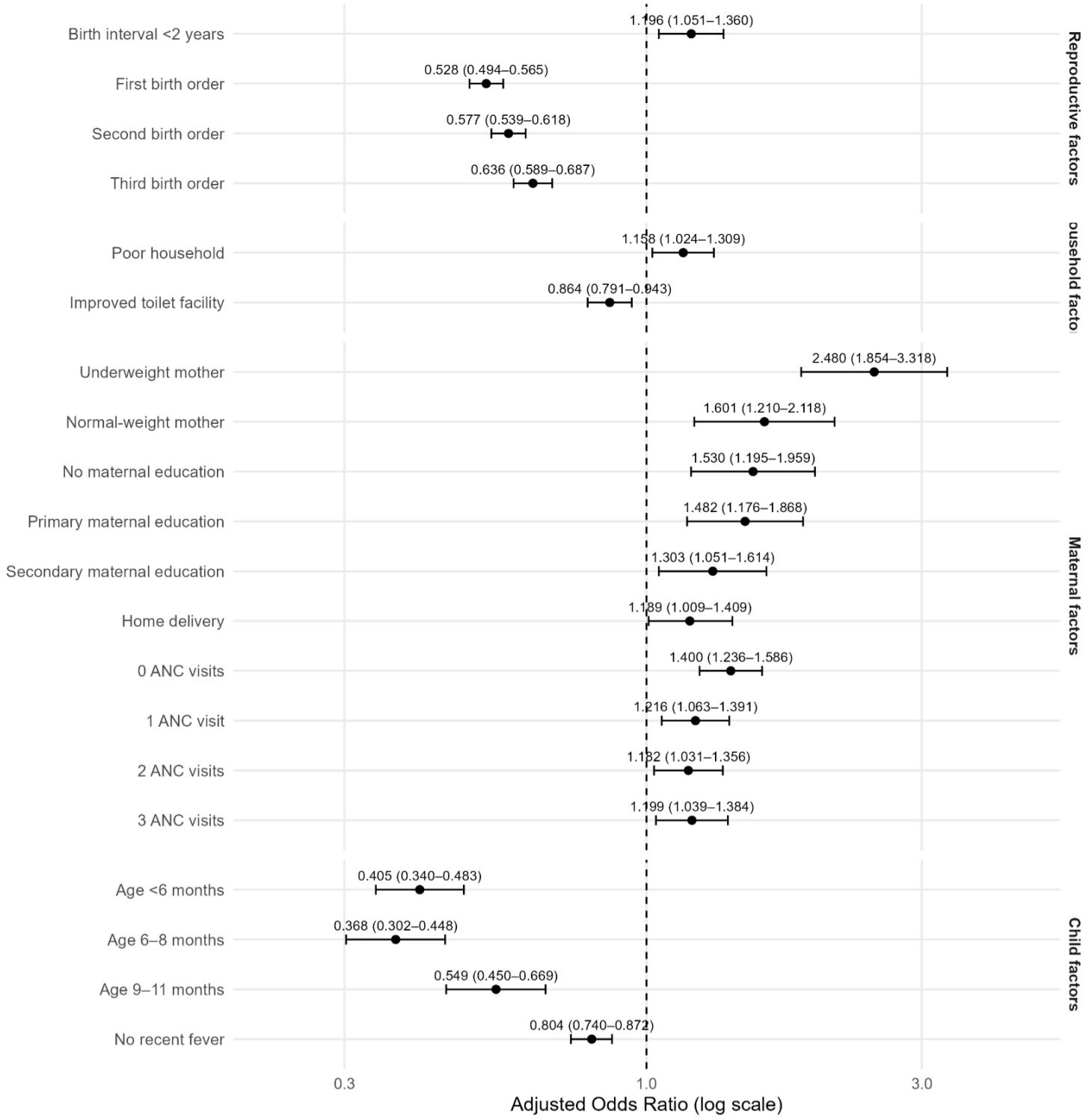


Figure 2

Forest plot of adjusted odds ratios (AORs) and 95% confidence intervals (CIs) for significant determinants from pooled multivariable model

Supplementary Files

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- Supplementaryfile.docx