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IFPRI Discussion Paper 2442

September 2026

Double Burden of Malnutrition in Nigeria:

Trends, Drivers, and Regional Disparities among Children

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Abstract

Malnutrition remains a central public health and development challenge in Nigeria, with profound implications for human capital formation, labor productivity, and inclusive growth. Using four rounds of the Nigeria Demographic and Health Survey (NDHS, 2008 to 2023-24), this study documents national and regional trends in the double burden of malnutrition and rigorously identifies the socioeconomic, demographic, and contextual determinants driving persistent North–South inequalities. We estimate pooled binary and multinomial logistic regression models to assess the effects of household characteristics on child nutrition and apply the Blinder-Oaxaca decomposition to separate disparities arising from differences in household endowments from those arising from differences in the structural returns to those endowments. Results show deteriorating nutritional outcomes, with rising stunting and wasting and persistent regional inequalities. Stunting and wasting are disproportionately concentrated in northern zones, even among households with comparable assets. Decomposition analysis indicates that regional gaps stem more from systematically lower returns to income, maternal education, and access to basic services than from differences in endowments. Low-returns equilibria reflect deep structural constraints, including inefficient food systems, limited service quality, restrictive gender norms, exposure to conflict, and weak complementarities between household investments and local service environments. Policy interventions targeting households alone are insufficient. Closing regional gaps requires raising the returns to public and private investments via nutrition-sensitive agricultural programs, strengthened service delivery, gender-responsive policies, and conflict-adaptive governance. Without addressing these structural penalties, additional spending risks reinforcing inequality rather than accelerating progress toward Nigeria's Sustainable Development Goals.

Keywords: Malnutrition, child nutrition, double burden, regional disparities, Nigeria

Acknowledgments

The authors gratefully acknowledge the International Food Policy Research Institute (IFPRI) for the institutional support that made this research possible. We also acknowledge the DHS Program and the institutions responsible for implementing the Nigeria Demographic and Health Surveys (NDHS) for making the 2008, 2013, 2018, and 2023–24 survey data available for research. The analysis presented in this paper draws on these four nationally representative survey rounds. We are grateful to colleagues and reviewers who provided comments and suggestions on earlier versions of the manuscript.

1. Introduction

Malnutrition remains one of the world's most persistent development challenges, imposing substantial human and economic costs and disproportionately affecting the most vulnerable, particularly women and children (Basu et al., 2025). In 2022, an estimated 149 million children under five were stunted, 45 million were wasted, and 37 million were overweight or obese (WHO, 2024). Undernutrition contributes to nearly half of global under-five mortality (UNICEF, WHO & World Bank, 2023) and undermines long-term learning, productivity, and human capital accumulation. Across much of sub-Saharan Africa, poverty, widening inequalities, limited healthcare access, evolving dietary patterns, demographic transition, and climate shocks interact to sustain this persistent burden of child malnutrition (Omokpariola et al., 2026; Afoakwah et al., 2024). Significant shares of the region's population face food insecurity rooted in limited household resources, seasonal food shortages, and the high cost of nutritious foods (Obada et al., 2024). These pressures are compounded by weak food systems and fragile health infrastructure, so that stunting, wasting, and, increasingly, overweight persist side by side across the region. Nigeria ranks among the top 10 countries with the highest burden of child malnutrition globally (Obasohan et al., 2020)

Acute and chronic forms of malnutrition remain widespread in Nigeria, reflecting both immediate nutritional deficits and deeper structural constraints. Nationally, stunting affects roughly one-third of children under five, and malnutrition contributes to more than one-third of under-five mortality (UNICEF, 2023). These averages, however, mask stark regional disparities: while the national stunting rate stood at 32 percent in 2018, prevalence exceeded 40 percent in many northern states (UNICEF, 2018). Nearly half of all stunted children reside in the Northwest and about one-fifth in the Northeast (Amare et al., 2018; Akombi et al., 2017; Ezeh et al., 2021), highlighting the spatial concentration of nutritional deprivation. The developmental consequences of early-life undernutrition are severe and long-lasting. Growth faltering occurs primarily in utero and during the first two years of life, with largely irreversible effects (Benson & Shekar, 2006). Children’s nutritional outcomes reflect interactions between proximate factors, such as diet quality, infant and young child feeding practices, and access to health care, and broader structural determinants such as maternal empowerment, education, and household resources (Benson et al., 2017).

Despite Nigeria’s adoption of multiple national nutrition strategies, including the National Nutrition Policy and the National Strategic Plan of Action for Nutrition, progress in reducing malnutrition has stalled. Since 2018, a confluence of economic, environmental, and security shocks has substantially reshaped the country’s nutrition landscape. Sharp depreciation of the naira and sustained food price inflation have eroded households’ real purchasing power and reduced access to diverse, nutrient-dense diets (Amare et al., 2025; Omamo et al., 2025). At the same time, escalating conflict and insecurity, particularly in the Northwest and North Central, have displaced millions of households, disrupted agricultural livelihoods, and constrained access to health services and nutritious foods (Olanrewaju & Balana, 2023; UNHCR, 2023; Balana et al., 2025; Diallo et al., 2026). These pressures were further compounded by the lingering socioeconomic effects of the COVID-19 pandemic (Amare et al., 2021; Amare et al., 2025). Already characterized by higher poverty incidence and lower agricultural productivity, northern regions have borne a disproportionate share of these overlapping shocks.

This study examines trends and determinants of malnutrition among children in Nigeria using binary and multinomial regression models complemented by Blinder-Oaxaca decomposition techniques. The analysis draws on four rounds of the Nigeria Demographic and Health Survey (NDHS): 2008, 2013, 2018, and 2023-24. The study addresses three interrelated questions: how child malnutrition outcomes have evolved; which socioeconomic, demographic, and environmental factors shape these outcomes; and the extent to which observed North–South disparities reflect differences in household endowments versus differences in the structural returns to those endowments. Identifying these mechanisms is critical for informing regionally targeted nutrition, social protection, and agri-food system policies.

This paper provides new evidence on the evolution and structural drivers of malnutrition in Nigeria. Using the 2023–24 NDHS alongside earlier rounds, it documents a reversal in nutritional progress among children since 2018, with rising stunting and wasting amid worsening food insecurity and instability. Blinder-Oaxaca decompositions quantify regional (North-South) and temporal (2008–2023/24) disparities, distinguishing gaps due to household endowments from those driven by lower returns to income and maternal education. Undernutrition remains concentrated in northern regions, even among households with similar assets, reflecting structural constraints in food systems, service quality, gender norms, conflict exposure, and nutrition knowledge. By analyzing multiple forms of malnutrition within the UNICEF (2021) Conceptual Framework, the study shows that household-targeted interventions alone are insufficient. Closing regional gaps requires policies that raise the returns to public and private investments through nutrition-sensitive agriculture, strengthened service delivery, gender-responsive programming, and conflict-adaptive governance, ensuring that additional spending reduces inequality and advances Nigeria's Sustainable Development Goals.

2. Conceptual Framework

This study is guided by the UNICEF (2021) Framework on the Determinants of Maternal and Child Nutrition, which provides a multisectoral lens linking child nutrition outcomes to immediate, underlying, and enabling determinants. The framework is particularly relevant to Nigeria, where structural inequalities, household constraints, and service-delivery challenges jointly shape malnutrition patterns (Adeyemi et al., 2023a; 2023b). At the immediate level, nutritional outcomes depend on diets and care. Diets reflect the adequacy and nutrient quality of food consumed, while care encompasses practices essential for growth, including breastfeeding, complementary feeding, hygiene, and health-seeking behaviors. These factors are the direct pathways through which household resources influence children's well-being.

The underlying determinants operate through three domains: food, practices, and services. The food domain covers access to safe, nutrient-rich foods, clean water, and household food security. The practices domain includes feeding, preparation, hygiene, and caregiving behaviors shaped by maternal knowledge, time, and social norms. The services domain captures the broader environment: health, education, sanitation, social protection, and food systems, which support or constrain nutritional outcomes. Empirical evidence from Nigeria highlights limited dietary diversity, early marriage, suboptimal feeding, poor sanitation, and constrained access to health services as key drivers of malnutrition (Hoddinott et al., 2013; Fang et al., 2024; Adeyemi et al., 2023a). Enabling determinants are structural conditions that affect nutrition, including economic, social, and human resources, cultural norms, and governance; in northern Nigeria, restricted female autonomy, early marriage, and gendered barriers to accessing services limit child nutrition. Weak governance and inconsistent implementation of national strategies further reinforce regional and socio-economic disparities.

By linking immediate, underlying, and enabling determinants to observed outcomes, the framework provides a structured lens for interpreting nutrition patterns, identifying structural bottlenecks, and informing policy interventions that address both household-level constraints and broader systemic challenges.

3. Data Sources and Descriptive Results

3.1. Data sources

The data sources for this study are the 2008, 2013, 2018, and 2023-24 Nigerian Demographic and Health Surveys (NDHS). The NDHS employs a cross-sectional, two-stage stratified cluster sampling design. The full NDHS report included a detailed description of the sampling technique (NPC & ICF Macro, 2009; NPC & ICF International, 2014; NPC & ICF, 2019; FMoHSW, NPC & ICF, 2024). The NDHS collects extensive information on women aged 15-49, their households, and children, including socio-demographic and economic characteristics, anthropometry, infant and young child feeding (IYCF) practices, dietary diversity, maternal diet, health service use, and WASH (water, sanitation, and hygiene) access. Although the NDHS datasets are publicly available on the DHS website, the authors obtained explicit permission from Measure-DHS to download and use them for this study. This study examines the double burden of malnutrition – undernutrition (stunting and wasting) and overweight of the under-5 children. Weighting was done using the complex sample design, and the 'svyset' Stata command was applied. The analysis included a total weighted sample of 64,022 children under 5 across all four waves. The four survey rounds were conducted during different calendar periods: the 2008 NDHS ran from June to October 2008; the 2013 NDHS from February to June 2013; the 2018 NDHS from August to December 2018; and the 2023–24 NDHS from December 2023 to May 2024. Although the analysis does not adjust for season of measurement, this variation should be borne in mind when interpreting patterns across rounds.

3.2. Definition of variables

- **Outcome variables:** The double burden of malnutrition - Undernutrition (stunting and wasting) and overweight was the outcome variable for under-5 children in this study.
- **Stunting (low height-for-age)**: This is impaired growth and development in children, defined as a height-for-age value that falls more than two standard deviations below the World Health Organization (WHO) child growth standards median (FMoHSW, NPC & ICF, 2024; Said-Mohammed et al., 2015). Stunting was dichotomized and coded as: 0 = not stunted (HAZ> −2 SD) and 1 = stunted (HAZ < -2 SD).
- **Wasting (low weight-for-height):** This is defined as when a child is too thin for their height, resulting from recent rapid weight loss or failure to gain weight. This is the percentage of children under five years old whose weight-for-height falls below minus 2 standard deviations (-2SD) from the median of the WHO child growth standards. Wasting was dichotomized as 0 = not wasted (WHZ> -2 SD) and 1 = wasted (WHZ< -2 SD).
- **Overweight (weight-for-height):** This indicator assesses excessive weight relative to height, signaling an accumulation of excess body fat. Children whose weight-for-height z-score (WHZ) is more than two standard deviations (+2 SD) above the WHO Child Growth Standards median are considered overweight (FMoHSW, NPC & ICF, 2024). Overweight was dichotomized as 0 = not overweight (WHZ < +2 SD) and 1 = overweight (WHZ> +2 SD).
- **Explanatory variables:** The study harmonized core socioeconomic, demographic, and environmental variables, including mother's age group; mother's years of education; mother's occupation; wealth status; place of residence; household size; improved source of drinking water; improved toilet facility; and geopolitical zones. We describe each variable below. Maternal age, household size, and maternal education were included as continuous measures. Place of residence was dichotomized as urban versus rural. The DHS household wealth index, a nationally standardized asset-based composite constructed via principal component analysis of household assets and housing characteristics, was recoded into three categories: poor, middle, and rich. For the Blinder–Oaxaca decompositions, we generated two binary dummies (middle and rich classes). While the DHS wealth index is constructed at the national level and is therefore comparable across regions within a given round, it is not directly comparable across

survey rounds because asset lists and factor loadings are re-estimated independently for each round. Maternal occupation was harmonized across rounds into four categories: not working (reference), white collar, agricultural worker, and service/manual worker. Improved drinking water sources were coded as 1 (piped water, protected wells, boreholes, rainwater, and tanker trucks) and 0 for unimproved sources. Improved toilet facilities were coded as 1 (flush or pour-flush toilets, ventilated improved pit latrines, and composting toilets) and 0 for unimproved sources. The North–South indicator was coded 1 for geopolitical zones 1–3 (North Central, Northeast, Northwest) and 0 for zones 4–6 (Southeast, South-South, Southwest).

3.3. Descriptive results

Table 1 presents the socioeconomic and demographic profile of Nigerian children under five who were stunted, wasted, or overweight across four survey waves (2008, 2013, 2018, and 2023-24).

Among stunted children, average maternal age remained stable (29.2-29.9 years) across waves, while maternal years of education rose steadily, from 3.4 years in 2008 to 4.5 years in 2023-24. Poverty remained strongly associated with stunting: the share of stunted children from the poorest wealth tercile increased from 51% in 2008 to 54% in 2023-24, while the share from the richest tercile declined from 29% to 23% over the same period. Rural residence was consistently overrepresented among stunted children (43- 47% across waves) relative to urban residence (26–31%). Regionally, the North West accounted for the largest share of stunted children in earlier waves (53–57% in 2008 -2018) but fell sharply to 37% by 2023-24, coinciding with a rise in the North Central and North East shares to 52% each, suggesting a geographic redistribution of the stunting burden toward north-central and north-eastern Nigeria in the most recent period.

The demographic profile of wasted children shows more instability across waves. Household size among wasted children declined from around 7.3 in 2008-2013 to 6.7 in 2023-24, and maternal education rose markedly, from 2.8 years in 2008 to 6.6 years in 2023-24. Unlike stunting, the poorest-wealth-tercile share among wasted children fell over time (19% in 2008 to 8% in 2023-24), as did rural residence, lack of improved water, and lack of improved sanitation, all roughly halving between 2013 and 2018. The North East consistently accounted for the largest regional share of wasted children, though this share also declined over time (22% in 2008 to 8% in 2023-24).

The profile of overweight children differs sharply from the other two indicators. Across nearly every categorical variable (urban/rural residence, wealth tercile, occupation, water and sanitation access, and region), the proportions among overweight children fell steeply after 2008, often to 1 - 2% by 2023-24, while maternal education among this group rose from 4.8 to 7.1 years.

Table 1. Socioeconomic and demographic characteristics of stunted, wasted, and overweight children under five

Variables	Stunting				Wasting				Overweight			
	2008	**2013**	**2018**	**2023-24**	**2008**	**2013**	**2018**	**2023-24**	**2008**	**2013**	**2018**	**2023-24**
Mother's age (years)	29.22 (7.10)	29.28 (7.09)	29.49 (6.98)	29.94 (6.86)	28.93 (7.17)	28.92 (6.91)	29.19 (6.56)	29.92 (6.78)	28.87 (6.83)	29.09 (7.17)	29.69 (7.13)	28.88 (6.29)
Household size	7.33 (3.73)	7.53 (3.67)	7.71 (3.96)	7.42 (3.72)	7.31 (3.58)	7.37 (3.79)	7.21 (3.70)	6.72 (3.48)	6.84 (3.38)	7.07 (3.40)	6.52 (3.08)	6.53 (4.06)
Residence: Urban	0.31 (0.46)	0.26 (0.44)	0.26 (0.44)	0.28 (0.45)	0.11 (0.31)	0.18 (0.38)	0.05 (0.23)	0.09 (0.29)	0.09 ().28)	0.03 (0.17)	0.02 (0.14)	0.01 (0.12)
Residence: Rural	0.45 (0.50)	0.43 (0.49)	0.44 (0.50)	0.47 (0.50)	0.15 (0.36)	0.19 (0.39)	0.08 (0.27)	0.08 (0.26)	0.09 (0.28)	0.04 (0.20)	0.02 (0.14)	0.01 (0.12)
Wealth: Poor	0.51 (0.50)	0.50 (0.50)	0.52 (0.50)	0.54 (0.50)	0.19 (0.39)	0.21 (0.41)	0.09 (0.29)	0.08 (0.28)	0.09 (0.28)	0.05 (0.21)	0.02 (0.14)	0.02 (0.13)
Wealth: Middle	0.42 (0.49)	0.35 (0.48)	0.37 (0.48)	0.41 (0.49)	0.12 (0.32)	0.17 (0.38)	0.07 (0.25)	0.07 (0.25)	0.09 (0.29)	0.04 (0.19)	0.02 (0.13)	0.01 (0.10)
Wealth: Rich	0.29 (0.45)	0.22 (0.41)	0.22 (0.41)	0.23 (0.42)	0.09 (0.29)	0.16 (0.36)	0.05 (0.21)	0.09 (0.29)	0.09 (0.28)	0.03 (0.17)	0.02 (0.14)	0.01 (0.11)
Years of education	3.37 (4.47)	3.17 (4.83)	3.91 (5.00)	4.54 (5.45)	2.75 (4.34)	3.99 (5.01)	4.46 (5.44)	6.62 (5.89)	4.84 (5.06)	4.12 (5.27)	6.87 (5.64)	7.12 (6.29)
White-collar occupation	0.37 (0.48)	0.35 (0.48)	0.34 (0.47)	0.35 (0.48)	0.13 (0.34)	0.18 (0.39)	0.07 (0.25)	0.08 (0.28)	0.09 (0.28)	0.03 (0.18)	0.02 (0.12)	0.02 (0.13)
Agricultural occupation	0.43 (0.50)	0.31 (0.46)	0.36 (0.48)	0.38 (0.48)	0.10 (0.30)	0.12 (0.32)	0.06 (0.24)	0.06 (0.23)	0.09 (0.28)	0.04 (0.19)	0.03 (0.16)	0.002 (0.05)
Manual/service occupation	0.39 (0.49)	0.37 (0.48)	0.31 (0.46)	0.34 (0.47)	0.16 (0.36)	0.19 (0.39)	0.06 (0.23)	0.08 (0.28)	0.07 (0.26)	0.03 (0.18)	0.03 (0.16)	0.01 (0.09)
Not employed	0.45 (0.50)	0.41 (0.49)	0.42 (0.49)	0.46 (0.50)	0.16 (0.37)	0.20 (0.40)	0.07 (0.27)	0.09 (0.28)	0.09 (0.29)	0.05 (0.22)	0.02 (0.15)	0.02 (0.12)
Currently employed	0.38 (0.49)	0.35 (0.48)	0.34 (0.47)	0.35 (0.48)	0.13 (0.33)	0.17 (0.38)	0.06 (0.25)	0.08 (0.27)	0.08 (0.28)	0.03 (0.18)	0.02 (0.13)	0.01 (0.11)
Improved water source	0.36 (0.48)	0.42 (0.49)	0.33 (0.47)	0.39 (0.49)	0.12 (0.33)	0.18 (0.39)	0.06 (0.25)	0.08 (0.28)	0.09 (0.28)	0.04 (0.19)	0.02 (0.13)	0.01 (0.11)
Improved toilet facility	0.37 (0.48)	0.33 (0.47)	0.30 (0.46)	0.35 (0.48)	0.13 (0.34)	0.19 (0.40)	0.06 (0.24)	0.08 (0.28)	0.09 (0.28)	0.04 (0.20)	0.02 (0.14)	0.01 (0.11)
Region: North Central	0.43 (0.50)	0.29 (0.45)	0.28 (0.45)	0.52 (0.50)	0.09 (0.29)	0.12 (0.33)	0.06 (0.23)	0.08 (0.27)	0.10 (0.31)	0.03 (0.18)	0.02 (0.14)	0.02 (0.14)
Region: North East	0.49 (0.50)	0.42 (0.49)	0.48 (0.50)	0.52 (0.50)	0.22 (0.42)	0.20 (0.40)	0.09 (0.30)	0.08 (0.27)	0.08 (0.28)	0.04 (0.20)	0.02 (0.16)	0.02 (0.12)
Region: North West	0.53	0.55	0.57	0.37	0.20	0.27	0.09	0.06	0.09	0.05	0.02	0.01

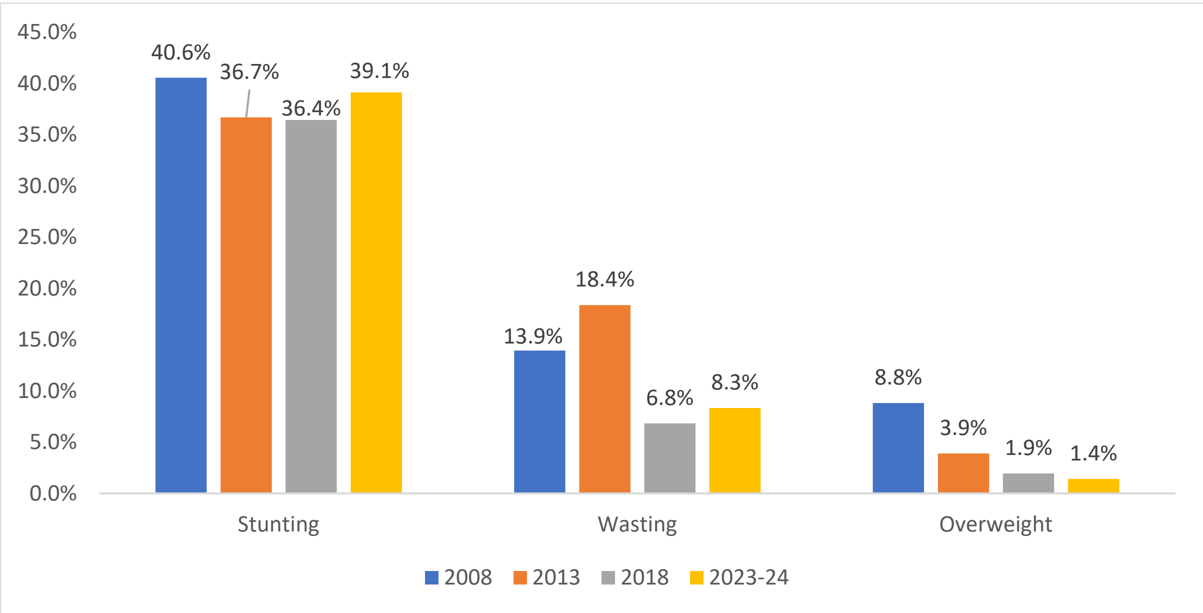
	(0.50)	(0.50)	(0.49)	(0.48)	(0.40)	(0.44)	(0.28)	(0.25)	(0.29)	(0.22)	(0.13)	(0.11)
Region: South East	0.21 (0.41)	0.15 (0.36)	0.18 (0.38)	0.20 (0.40)	0.08 (0.27)	0.12 (0.33)	0.05 (0.21)	0.07 ().26)	0.07 (0.26)	0.02 (0.15)	0.03 (0.16)	0.01 (0.11)
Region: South South	0.31 (0.46)	0.18 (0.38)	0.20 (0.40)	0.18 (0.38)	0.07 (0.25)	0.11 (0.32)	0.04 (0.20)	0.12 (0.32)	0.10 (0.29)	0.04 (0.20)	0.02 (0.13)	0.01 (0.11)
Region: South West	0.31 (0.46)	0.22 (0.41)	0.23 (0.42)	0.21 (0.41)	0.09 (0.29)	0.10 (0.30)	0.05 (0.22)	0.10 (0.30)	0.08 (0.27)	0.02 (0.13)	0.01 (0.11)	0.01 (0.07)

Source: Nigeria Demographic and Health Survey (NDHS), 2008, 2013, 2018, 2023-24.
Note: Values are means (standard deviations) for children with the nutritional condition (yes = 1).

Figure 1 presents the trends in the prevalence of stunting, wasting, and overweight among Nigerian children under five across four DHS survey rounds (2008, 2013, 2018, and 2023-24). Stunting remained the most prevalent form of malnutrition throughout the period, fluctuating between 36% and 41%. Prevalence declined from 40.6% in 2008 to 36.7% in 2013 and remained stable at 36.4% in 2018, before rising again to 39.1% in 2023-24. The prevalence of wasting rose from 13.9% in 2008 to 18.4 in 2013, before falling to 6.8% in 2018, and jumping to 8.3% in 2023-24. Overweight prevalence, by contrast, has declined steadily and substantially, from 8.8% in 2008 to 3.9% in 2013, 1.9% in 2018, and 1.4% in 2023-24. This downward trend contrasts with the patterns observed for stunting and wasting and may reflect changing dietary/feeding patterns.

These shifts indicate a widening burden of undernutrition in recent years, reversing earlier progress and highlighting the fragility of previous gains amid severe macroeconomic instability, unprecedented food price inflation, intensified conflict in northern regions, and the lingering effects of the COVID-19 pandemic. The current stunting rate of 39.1% underscores the significant challenge Nigeria faces in achieving the internationally agreed-upon target of a 40% reduction in stunted children by 2025 (UNICEF, WHO, and World Bank Group, 2023).

Figure 1. National trends in child stunting, wasting, and overweight (%)



Source: Authors' calculations based on NDHS (2008 – 2023/24).

4. Econometric Framework and Results

Let i index individuals (children), h households, and $r \in \{N, S\}$ regions (North, South). Nutritional outcomes are modeled as functions of demographic, socioeconomic, and contextual characteristics. All analyses exploit the DHS complex survey design to ensure population-representative inference.

4.1. Survey-weighted regression models for binary child outcomes

For child i in household h and region r, the probability of experiencing a nutritional outcome (e.g., stunting, wasting, or overweight) is estimated using a survey-weighted logistic regression:

$$\Pr(y_{ihr} = 1) = \Lambda(\alpha^m + X'_{ihr}\beta^m + H'_{hr}\gamma^m + C'_r\delta), \quad (1)$$

where $\Lambda(\cdot)$denotes the logistic cumulative distribution function. The vector X_{ihr}includes child-specific and maternal characteristics (e.g., age, sex, education, fertility history), H_{hr}captures household socioeconomic conditions (e.g., wealth, household size, sanitation), and $C_r$represents regional contextual factors.

Survey-weighted estimation, implemented using DHS sampling weights and Stata's *svy* procedure, ensures that coefficient estimates and marginal effects represent the population while accounting for stratification, clustering, and unequal selection probabilities. Logistic specifications are preferred over linear probability models because they respect the bounded nature of nutritional indicators and provide a consistent functional form for subsequent nonlinear decomposition analysis. These models also generate the structural inputs for the Blinder–Oaxaca decompositions, ensuring coherence between estimation and disparity attribution. Because the analysis draws on data pooled across four DHS rounds (2008, 2013, 2018, and 2023–24), all pooled regression models include survey-round fixed effects (coded as indicator variables for each wave) to absorb period-level variation in nutritional outcomes that is unrelated to household characteristics. This accounts for macroeconomic, climatic, and policy shifts between rounds that could otherwise confound coefficient estimates. Survey round indicators were generated from the DHS country code identifier (v000): NG5 = 2008, NG6 = 2013, NG7 = 2018, NG8 = 2023–24. The temporal Blinder–Oaxaca decompositions directly address change over time by comparing only the 2008 and 2023–24 rounds, using a binary survey-year indicator (0 = 2008; 1 = 2023–24).

4.3. Decomposition of regional and temporal nutritional gaps

To quantify the sources of regional disparities in nutritional outcomes, we apply the Blinder–Oaxaca decomposition. For a binary nutritional outcome and two groups A and B, the mean gap is decomposed as:

$$E(Y_A) - E(Y_B) = (\bar{X}_A - \bar{X}_B)'\beta_B + \bar{X}_B'(\beta_A - \beta_B) + (\bar{X}_A - \bar{X}_B)'(\beta_A - \beta_B) \quad (3)$$

The first term (*levels*) is the share of the gap attributable to differences in the distribution of observed characteristics, evaluated at group *B*'s returns. The second (*effects*) is the share attributable to differences in the returns to those characteristics, evaluated at group *B*'s characteristics. The third (*interaction*) captures their joint contribution. Decompositions are estimated as linear probability models using the implementation of Jann (2008), applying DHS sampling weights with standard errors clustered on the survey primary sampling unit. Component-level contributions are reported for each covariate, following

Fortin, Lemieux and Firpo (2011), so that maternal education, household wealth and service access can be linked directly to the observed gaps.

Applied across regions, A and B index northern and southern Nigeria, and the decomposition separates the North–South gap arising from the North's lower average endowments from the gap arising from lower returns to those endowments. To examine change over time, we apply the same decomposition to the 2008 and 2023–24 rounds, so that A and B index survey years rather than regions. Here, the levels component measures how much of the change in prevalence is attributable to changes in the distribution of covariates between the two rounds, and the effects component measures how much is attributable to changes in the estimated returns to those covariates over the same interval. Demographic characteristics are retained in the covariate vector because their distributions are not time-invariant: both the maternal age distribution and the child age structure of the under-five sample shift across rounds (Table 1), and excluding them would load that compositional change onto the socioeconomic terms. For a covariate whose distribution is effectively stable across rounds, with child sex being the clearest case, the levels contribution is close to zero by construction, and the covariate's entire contribution appears in the effects term. Such a contribution should be read as a change in the strength of an association over time, not as a source of the change in prevalence itself.

Two limitations bear on interpretation. First, the decomposition is descriptive: it apportions an observed gap between composition and returns, and does not identify causal effects. Second, because the DHS wealth index is re-estimated independently in each round (Section 3.2), the levels contribution of wealth in the temporal decomposition reflects changes in relative asset ranking rather than a directly comparable change in household wealth, and is interpreted accordingly.

5. Empirical Results

Table 2 presents logistic regression estimates of the correlates of child stunting, wasting, and overweight, pooled across all survey waves and disaggregated by northern and southern Nigeria.

Household wealth was the strongest correlate of stunting in the pooled model: children from middle-wealth (β = -0.305, $p<0.01$) and rich households (β = -0.666, $p<0.01$) had substantially lower odds of stunting relative to poor households, with the wealth gradient more pronounced in the North than the South (Rich: β = -0.586 vs. -0.331). Rural residence was associated with significantly higher odds of stunting in the pooled (β = 0.147, $p<0.01$) and southern (β = 0.158, $p<0.05$) samples, though the northern coefficient, while positive, was only marginally significant. Maternal education was protective against stunting across all specifications (pooled β = -0.067, $p<0.01$), as was maternal age (pooled β = -0.016, $p<0.01$). Household size was positively associated with stunting in the pooled and northern samples (β = 0.028 and 0.018, respectively; both $p < 0.01$) but was not significant in the South. Female children had significantly lower odds of stunting than male children across pooled, northern, and southern samples (pooled β = -0.224, $p<0.01$). Child age was positively associated with stunting (pooled β =

0.015, $p<0.01$), reflecting the cumulative nature of chronic undernutrition. Notably, maternal employment was associated with lower odds of stunting in the pooled and northern samples ($\beta = -0.155$ and -0.155, respectively, both $p<0.05/0.10$). At the same time, agricultural occupation was also protective relative to the reference occupation category (pooled $\beta = -0.164$, $p<0.05$).

The wealth gradient was also evident for wasting, though somewhat weaker than for stunting (Rich: pooled $\beta = -0.254$, $p<0.01$), and was not significant in the South. Rural residence was associated with significantly lower odds of wasting in the pooled ($\beta = -0.142$, $p<0.05$) and northern ($\beta = -0.194$, $p<0.10$) samples. Maternal employment showed a striking reversal relative to stunting: employed mothers' children had significantly higher odds of wasting (pooled $\beta = 0.199$, $p<0.05$; North $\beta = 0.230$, $p<0.05$), potentially reflecting reduced childcare time or feeding practices among working mothers. Agricultural occupation was strongly protective against wasting (pooled $\beta = -0.658$, $p<0.01$; North $\beta = -0.719$, $p<0.01$). As with stunting, maternal education remained protective (pooled $\beta = -0.061$, $p<0.01$) and child age was inversely associated with wasting odds (pooled $\beta = -0.019$, $p<0.01$.

Overweight. In contrast to stunting and wasting, few covariates were significantly associated with overweight, and the pooled model showed comparatively small and mostly non-significant coefficients. Rural residence was associated with significantly higher odds of overweight in the pooled sample ($\beta = 0.166$, $p<0.05$) and even more strongly in the South ($\beta = 0.329$, $p<0.01$), reversing the pattern typically expected, as overweight is conventionally an urban-linked phenomenon. Household size was inversely associated with overweight (pooled $\beta = -0.020$, $p<0.05$; North $\beta = -0.028$, $p<0.05$). Maternal age was negatively associated with overweight in the South only ($\beta = -0.015$, $p<0.10$). Child age showed a consistent negative association with overweight across all specifications (pooled $\beta = -0.015$, $p<0.01$), suggesting overweight risk declines as children get older within the under-five window.

To aid interpretation of the magnitude of these associations, we report average marginal effects (AMEs) as percentage-point changes in predicted probability in Appendix Table A1. These estimates are directionally consistent with the logit coefficients in Table 2 and confirm the substantive importance of the key correlates identified above. Household wealth showed the largest estimated effects on stunting: relative to children in poor households, those in the wealthiest households had a 14.5 percentage-point lower predicted probability of stunting in the pooled sample (North: 13.6 pp; South: 5.7 pp), reinforcing the sharper wealth gradient in stunting observed in the North. Maternal education was associated with a 1.4 percentage-point reduction in stunting probability per additional year of schooling (pooled), and a comparable 0.6 percentage-point reduction in wasting probability, though its association with overweight was negligible in magnitude. Rural residence was associated with a 3.0 percentage-point higher probability of stunting but a 2.0 percentage-point lower probability of wasting (pooled), underscoring the divergent geographic patterning of chronic versus acute undernutrition. Consistent with the declining overweight prevalence documented in Table 1, the survey-wave indicators showed a cumulative reduction of roughly 7 percentage points in the predicted probability of overweight by 2023-24 relative to 2008, corroborating the descriptive trend.

As a robustness check, we re-estimated the pooled models above separately for each survey year (2008, 2013, 2018, 2023-24); logit coefficients and corresponding average marginal effects are reported in Appendix Tables A2 and A3, respectively. Two notable patterns emerge from this disaggregation. First, the wealth gradient in stunting widened over the study period: children in the wealthiest households had a 10.0 percentage-point lower predicted probability of stunting than children in poor households in 2008, widening to 16.9, 16.1, and 16.3 percentage points in 2013, 2018, and 2023-24, respectively. Second, the wealth gradient in wasting moved in the opposite direction, narrowing from a 5.0 percentage-point gap in 2008 to a statistically insignificant 1.2 percentage points by 2023-24, suggesting that while wealth has become a stronger predictor of chronic undernutrition, it no longer meaningfully predicts acute undernutrition in the most recent survey round. By contrast, the protective association between maternal education and stunting remained remarkably stable across all four waves (AME range: -0.013 to -0.016 percentage points), indicating that, unlike the wealth gradient, this relationship has not shifted materially over the 15 years.

Table 2. Determinants of child stunting, wasting, and overweight

	Stunting			Wasting			Overweight		
	Pooled	**North**	**South**	**Pooled**	**North**	**South**	**Pooled**	**North**	**South**
Age of mother	-0.016***	-0.010***	-0.018***	-0.005*	-0.003	-0.002	-0.004	0.002	-0.015*
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.005)	(0.003)	(0.004)	(0.007)
Household size	0.028***	0.018***	0.008	0.005	-0.004	-0.003	-0.020**	-0.028**	-0.015
	(0.003)	(0.004)	(0.007)	(0.005)	(0.005)	(0.014)	(0.008)	(0.009)	(0.014)
Rural residence	0.147***	0.106*	0.158**	-0.142*	-0.194*	-0.095	0.166*	-0.002	0.329***
	(0.037)	(0.049)	(0.051)	(0.057)	(0.080)	(0.066)	(0.075)	(0.110)	(0.095)
Wealth Middle	-0.305***	-0.276***	-0.146*	-0.257***	-0.248***	-0.101	-0.025	-0.041	-0.017
	(0.034)	(0.041)	(0.066)	(0.053)	(0.060)	(0.102)	(0.075)	(0.092)	(0.137)
Wealth Rich	-0.666***	-0.586***	-0.331***	-0.254***	-0.161*	-0.008	0.021	-0.051	0.168
	(0.042)	(0.054)	(0.074)	(0.058)	(0.074)	(0.106)	(0.085)	(0.120)	(0.127)
Mother employed (yes)	-0.155**	-0.155*	0.051	0.199**	0.230**	0.264	-0.082	-0.045	-0.148
	(0.055)	(0.062)	(0.121)	(0.076)	(0.083)	(0.192)	(0.116)	(0.137)	(0.215)
Female child	-0.224***	-0.212***	-0.263***	-0.125***	-0.154***	-0.049	0.066	0.089	0.018
	(0.019)	(0.023)	(0.037)	(0.027)	(0.031)	(0.050)	(0.041)	(0.050)	(0.074)
Child age (months)	0.015***	0.019***	0.007***	-0.019***	-0.017***	-0.027***	-0.015***	-0.013***	-0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)
Improved source of drinking water	0.041	0.014	0.055	-0.008	-0.005	-0.073	-0.104	-0.188*	0.045
	(0.028)	(0.034)	(0.051)	(0.040)	(0.047)	(0.070)	(0.061)	(0.076)	(0.108)
Improved toilet facilities	0.073*	0.038	-0.076	0.111**	0.087	-0.025	0.105	0.148*	-0.036
	(0.029)	(0.033)	(0.056)	(0.042)	(0.049)	(0.075)	(0.061)	(0.074)	(0.102)
Mother’s years of education	-0.067***	-0.042***	-0.061***	-0.061***	-0.048***	-0.041***	-0.011*	-0.007	-0.008
	(0.003)	(0.004)	(0.005)	(0.005)	(0.006)	(0.008)	(0.006)	(0.007)	(0.011)
Mother's occupation: White-collar	0.080	0.117	0.024	-0.181*	-0.167	-0.218	-0.147	-0.141	-0.119
	(0.059)	(0.065)	(0.127)	(0.080)	(0.087)	(0.203)	(0.122)	(0.141)	(0.229)
Mother's occupation: Agric worker	-0.164*	-0.211**	0.057	-0.658***	-0.719***	-0.398	0.036	0.039	0.101
	(0.065)	(0.075)	(0.132)	(0.088)	(0.098)	(0.218)	(0.132)	(0.153)	(0.246)
Mother's occupation: Service manual	0.096	0.144	-0.018	-0.064	-0.019	-0.189	-0.124	-0.151	-0.067
	(0.065)	(0.074)	(0.135)	(0.084)	(0.092)	(0.216)	(0.133)	(0.157)	(0.245)
N	63,982	40,607	23,375	63,982	40,607	23,375	63,982	40,607	23,375

Source: Authors’ calculations based on NDHS (2008 – 2023/24). **Note**: Significance levels: *p <0.10, **p <0.05, and ***p <0.01

5.2. Regional disparities in child malnutrition

Table 3 presents the Blinder–Oaxaca decomposition of regional (North-South) gaps in child stunting, wasting, and overweight prevalence. The 25-percentage point (pp) stunting gap between Northern and Southern Nigeria was explained evenly by differences in household and maternal characteristics (levels: 10.6 pp, 42.4% of the gap) and by differences in the returns to those characteristics (effects: 11.0 pp, 44.0%), with a smaller interaction contribution (3.4 pp, 13.6%). Wealth (rich tercile) and years of maternal education were the largest contributors to the levels component (0.031 and 0.063, respectively, both $p<0.01$), indicating that the North's lower average wealth and education levels account for a substantial share of its excess stunting burden. At the same time, child's age was the dominant driver of the effects component (0.093, $p<0.01$), indicating a stronger age-stunting association in the North independent of compositional differences.

The regional wasting gap (7.8 pp) was more heavily attributable to the effects component (4.3 pp, 55.1%) than to levels (1.7 pp, 21.8%) or interaction (1.7 pp, 21.8%), with years of education again the largest single contributor to both the levels (0.019, $p<0.01$) and effects (-0.022, $p<0.01$) components, indicating education's protective association with wasting is meaningfully stronger in the South than the North.

The regional overweight gap, though small in absolute terms (0.8 pp), was driven primarily by the effects component (0.6 pp, 75.0%), with a partially offsetting negative interaction term (-37.5%), while the levels component contributed 62.5%. Mother's age was a significant contributor across all three components, and improved water source and toilet facilities contributed significantly to the effects component, suggesting regional overweight differences are shaped more by how these characteristics translate into risk than by their distribution across regions.

Table 3. Blinder-Oaxaca decomposition of regional differences in the prevalence of child malnutrition

Dependent Variable	**Child Stunting**			**Child Wasting**			**Child Overweight**		
Northern Nigeria	0.475***			0.164***			0.049***		
Southern Nigeria	0.225***			0.087***			0.041***		
Difference	0.250***			0.078***			0.008***		
	Levels (X) of determinants	**Effects (β) of determinants**	**Interaction**	**Levels (X) of determinants**	**Effects (β) of determinants**	**Interaction**	**Levels (X) of determinants**	**Effects (β) of determinants**	**Interaction**
Difference attributed to component	0.106***	0.110***	0.034***	0.017***	0.043***	0.017***	0.005*	0.006**	-0.003
Percent of component	42.4%	44.0%	13.6%	21.8%	55.1%	21.8%	62.5%	75.0%	-37.5%
Contribution of each variable to the component of the difference									
Mother's age	0.004***	0.015	-0.001	0.000	-0.005	0.000	0.001**	0.021**	-0.001**
Household size	0.003	0.015*	0.005*	-0.000	-0.002	-0.001	-0.001	-0.004	-0.001
Child's age	0.000	0.093***	0.000	-0.000	-0.008	-0.000	-0.000	0.002	0.000
Rural residence	0.008***	-0.001	-0.001	-0.002	-0.008**	-0.006**	0.004***	-0.006***	-0.004
Wealth tercile – Rich	0.031***	-0.048***	0.033***	0.000	-0.016**	0.011**	-0.003	-0.006	-0.000
Wealth tercile – Middle	-0.000	-0.006**	-0.000	-0.000	-0.005***	-0.000	-0.000	-0.000	0.000
Mother currently employed	-0.003	-0.041**	0.010**	-0.003	0.012	-0.003	0.000	-0.0001	0.000
Child's sex (female)	-0.000**	-0.008	-0.000	-0.000	-0.026***	-0.000*	0.000	0.005	0.000
Improved source of drinking water	-0.001	-0.004	0.001	0.001	0.003	-0.001	-0.000	-0.007**	0.001**
Improved type of toilet facilities	0.001	0.012**	-0.002**	0.000	0.008*	-0.001*	0.000	0.005*	-0.001*
Years of Education	0.063***	0.011	-0.008	0.019***	-0.022***	0.015***	0.003	0.001	-0.001
White-collar occupation	0.001	0.015	-0.004	0.001	-0.005	0.001	0.002	0.003	-0.001
Agric-related occupation	-0.000	-0.009**	0.002**	0.001*	-0.009***	0.002***	0.000	0.001	-0.000
Mother's occupation: service	0.000	0.007*	-0.001*	0.000	0.001	-0.000	0.000	0.001	-0.000

Source: Authors' calculations based on NDHS (2008 – 2023/24)
Note: Significance levels: *p < 0.10, **p < 0.05 and***p < 0.01

5.3. Temporal trends in child malnutrition: 2008 vs 2023/24

Table 4 presents the Blinder–Oaxaca decomposition of temporal (2008 vs 2023/24) gaps in child stunting, wasting, and overweight prevalence. Stunting prevalence declined significantly between 2008 and 2023-24 (-1.5 pp, $p<0.05$. This modest net decline masked a considerably larger negative levels contribution (-2.0 pp, 133.3% of the total change), driven primarily by improvements in maternal education (-0.019, $p<0.01$) and household wealth (-0.001 to -0.024, $p<0.05$), which was substantially offset by a positive interaction term (0.5 pp, -33.3%). In comparison, the effects component contributed negligibly (0.0 pp). This indicates that improvements in socioeconomic conditions were the main force reducing stunting over the period, but the joint levels-effects interaction partly counteracted their impact.

The decline in wasting prevalence (-5.6 pp, $p<0.01$) was overwhelmingly attributable to the effects component (-5.7 pp, 101.8%), with years of education (0.030, $p<0.01$) and agricultural occupation (0.011, $p<0.01$) the largest contributors, indicating a strengthening of protective associations over time rather than compositional change (levels: -0.7 pp, 12.5%). The decline in overweight prevalence was the largest of the three outcomes in relative terms (-7.4 pp, $p<0.01$). The effects component explained almost all of it (-7.5 pp, 101.4%), while the levels component contributed negligibly (0.1 pp, -1.4%) and the interaction term contributed nothing. Child's age (0.031, $p<0.01$) was the largest single contributor to the effects component.

Table 4. Temporal trends in child malnutrition: 2008 vs. 2023/24

Dependent Variable	**Child Stunting**			**Child Wasting**			**Child Overweight**		
2023-24	0.391***			0.083***			0.014***		
2008	0.406***			0.139***			0.088***		
Difference	-0.015**			-0.056***			-0.074***		
	Levels (X) of determinants	**Effects (β) of determinants**	**Interaction**	**Levels (X) of determinants**	**Effects (β) of determinants**	**Interaction**	**Levels (X) of determinants**	**Effects (β) of determinants**	**Interaction**
Difference attributed to component	-0.020***	-0.000	0.005	-0.007***	-0.057***	0.008***	0.001	-0.075***	0.000
Percent of component	133.3%	0.0%	-33.3%	12.5%	101.8%	-14.3%	-1.4%	101.4%	0.0%
Contribution of each variable to the component of the difference									
Mother's age	-0.00***	-0.064**	-0.002*	-0.000	0.004	0..000	-0.000	-0.007	-0.000
Household size	0.000	0.038**	0.001	0.000	-0.011	-0.000	-0.000	0.008	0.000
Child's age	0.001*	0.045***	0.001	-0.001	-0.006	-0.000	-0.001*	0.031***	0.000
Rural residence	-0.004***	0.010	-0.001	0.000	-0.016**	0.002**	-0.000	-0.003	0.000
Wealth tercile – Rich	-0.001**	-0.024**	-0.001*	0.001**	0.026***	0.001**	-0.000	-0.003	-0.000
Wealth tercile – Middle	-0.000	-0.006	-0.000	-0.000	0.009***	0.000	0.000	-0.002	-0.000
Mother currently employed	0.002**	0.034	-0.003	-0.000	-0.006	0.001	-0.001	-0.007	0.001
Child's sex (female)	0.001**	-0.018	0.000	0.000	0.003	-0.000	-0.000	-0.012	0.000
Improved source of drinking water	0.001	0.009	0.001	0.001	-0.000	-0.000	-0.000	-0.002	-0.000
Improved type of toilet facilities	0.001	0.020**	0.004	-0.000	-0.004	-0.001	-0.000	0.002	0.000
Years of Education	-0.019***	-0.001	-0.000	-0.011***	0.030***	0.008***	0.002**	-0.004	-0.001
White-collar occupation	0.001	-0.019	-0.004	-0.001	0.006	0.001	-0.001*	0.009	0.002*
Agric-related occupation	0.000	-0.016**	0.007	0.006***	0.011***	-0.005***	0.002*	0.001	-0.001
Mother's occupation: service	-0.000	-0.009	0.003	-0.000	-0.000	0.000	0.002***	0.004	-0.001

Source: Authors' calculations based on NDHS (2008 – 2023/24)
Note: Significance levels: *p < 0.10, **p < 0.05 and***p < 0.01

6. Discussion

The findings reveal a concerning reversal in Nigeria’s nutritional progress. After improvements observed up to 2018, recent data (2023–24) show deterioration in child nutrition. The rebound in stunting from 36.4% in 2018 to 39.1% in 2023- 24, alongside a rise in wasting from 6.8% to 8.3% over the same interval, indicates that earlier gains in child nutrition were not consolidated. This reversal coincides with macroeconomic instability, sharp food price inflation, intensifying conflict in northern Nigeria, and lingering COVID-19 disruptions to health and food systems (UNICEF, WHO & World Bank, 2023; Global Nutrition Report, 2021). The pattern suggests that Nigeria's nutritional progress remains highly sensitive to shocks, and that gains achieved during more stable periods can erode quickly once household purchasing power and service delivery are disrupted.

The widening wealth gradient in stunting, from a 10.0 percentage-point gap between rich and poor households in 2008 to roughly 16 percentage points by 2023-24, contrasts with the wasting gradient, which narrowed from 5.0 percentage points in 2008 to a statistically insignificant 1.2 percentage points in 2023-24. This divergence implies that household wealth has become a stronger buffer against chronic, long-term deprivation but no longer reliably protects children from acute, short-term nutritional shocks. Acute malnutrition appears to be increasingly shock-driven and distributed across the wealth spectrum, while chronic malnutrition is becoming more concentrated among poorer households, a distinction with direct implications for how safety-net and health programming should be targeted.

Third, the Blinder-Oaxaca decomposition shows that the effects component, differences in the returns to household and maternal characteristics, explains the large majority of the regional gap in wasting (101.8%) and overweight (101.4%), and a substantial share of the stunting gap (44.0%), with the remainder attributable to differences in endowments (levels) and their interaction. In practical terms, this means that raising northern households to southern levels of wealth, maternal education, or service access would close only part of the gap. The same year of maternal education or the same wealth tercile yields a smaller nutritional benefit in the North than in the South, most plausibly because of weaker health and sanitation service quality, conflict-related disruption to markets and health services, gender norms that constrain how maternal education translates into child feeding and care practices, and less efficient local food systems. This is consistent with the study's conceptual framework linking child nutrition outcomes to both the level of household inputs and the local environment that determines how effectively those inputs are converted into better outcomes.

The steady decline in overweight prevalence, from 8.8% in 2008 to 1.4% in 2023-24, and its association with rural residence rather than the more conventional urban pattern, is notable. This may reflect changing dietary and feeding environments among Nigerian children under five, or a genuine narrowing of urban-rural differences in early-childhood diets. Because overweight prevalence is now very low in absolute terms, further declines may carry diminishing policy relevance relative to the rising burden of stunting and wasting.

7. Conclusion and Policy Implications

This study has traced the trajectory of the double burden of child malnutrition in Nigeria between 2008 and 2023-24 using four rounds of the Nigeria Demographic and Health Survey. Three findings stand out. First, nutritional progress has been partially reversed since 2018: stunting rose from 36.4% to 39.1% and wasting rose from 6.8% to 8.3% by 2023-24, even as overweight continued a steady decline from 8.8% in 2008 to 1.4% in 2023-24. Second, the socioeconomic patterning of chronic and acute malnutrition is diverging: the wealth gradient in stunting widened from 10.0 to roughly 16 percentage points between 2008 and 2023-24, while the wealth gradient in wasting narrowed to a statistically insignificant 1.2 percentage points over the same period. Third, persistent North-South disparities are driven by a mix of unequal endowments and unequal returns to those endowments, with the balance differing markedly by outcome: stunting's 25-percentage-point regional gap is split almost evenly between differences in household and maternal characteristics (42.4%) and differences in the returns to those characteristics (44.0%), whereas the wasting gap (55.1%) and overweight gap (75.0%) are disproportionately driven by unequal returns rather than unequal endowments. Taken together, these results show that Nigeria's regional nutrition gap cannot be closed by a single policy lever.

Maternal education protects against both stunting and wasting nationally, but its protective association with wasting is meaningfully stronger in the South than in the North. This points to a returns gap rather than an education-level gap: educated mothers in the North are not converting their schooling into equivalent nutritional benefits for their children, plausibly because restrictive gender norms limit decision-making authority over child feeding, antenatal and nutrition counseling infrastructure is weaker, or market access to diverse foods is poorer. Programming should therefore pair girls' education and adult literacy investments with gender-responsive nutrition counseling and demand-generation activities specifically in northern zones, rather than assuming that education gains alone will close the gap.

Agricultural occupation is strongly protective against wasting nationally and especially in the North, suggesting that households connected to functioning agricultural livelihoods are better buffered against acute malnutrition. Nutrition-sensitive agricultural programs, including biofortified crops, homestead food production, and extension services linked to child feeding practices, should be scaled in northern states where this protective association is strongest, alongside investments in food-system resilience (storage, market access, price stabilization) to guard against food-price shocks.

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Appendix Table A1. Average marginal effects of sociodemographic and regional correlates on child stunting, wasting, and overweight, Nigeria (2008-2023/24)

	Stunting			Wasting			Overweight		
	Pooled	**North**	**South**	**Pooled**	**North**	**South**	**Pooled**	**North**	**South**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Mother's age	-0.003***	-0.003***	-0.003***	-0.000	-0.000	-0.000	-0.000	0.000	-0.000*
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Household size	0.006***	0.004***	0.002	0.001	-0.000	-0.000	-0.001**	-0.001***	-0.001
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
Rural residence	0.030***	0.026**	0.015*	-0.020***	-0.033***	-0.007	0.002	-0.001	0.003
	(0.008)	(0.012)	(0.008)	(0.007)	(0.011)	(0.005)	(0.003)	(0.005)	(0.004)
Wealth status: middle	-0.069***	-0.066***	-0.022*	-0.032***	-0.034***	-0.009	-0.004	-0.003	0.002
	(0.008)	(0.010)	(0.012)	(0.006)	(0.007)	(0.008)	(0.003)	(0.004)	(0.005)
Wealth status: rich	-0.145***	-0.136***	-0.057***	-0.038***	-0.033***	-0.004	-0.008**	-0.007	0.003
	(0.009)	(0.012)	(0.013)	(0.006)	(0.009)	(0.009)	(0.004)	(0.005)	(0.005)
Currently employed	-0.024**	-0.027*	0.012	0.009	0.015	0.015	-0.001	0.003	-0.009
	(0.012)	(0.014)	(0.019)	(0.008)	(0.011)	(0.013)	(0.005)	(0.006)	(0.009)
Female child	-0.047***	-0.049***	-0.044***	-0.015***	-0.022***	-0.005	0.002	0.003	0.000
	(0.004)	(0.005)	(0.006)	(0.003)	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)
Child age	0.003***	0.004***	0.001***	-0.002***	-0.002***	-0.002***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Improved source of water	0.009	0.003	0.007	0.003	0.009	-0.005	-0.001	-0.001	-0.003
	(0.006)	(0.008)	(0.008)	(0.004)	(0.006)	(0.006)	(0.003)	(0.004)	(0.005)
Improved source of toilet	0.013**	0.007	-0.017*	0.015***	0.012*	0.002	0.005*	0.005	-0.001
	(0.006)	(0.008)	(0.009)	(0.005)	(0.006)	(0.006)	(0.003)	(0.003)	(0.004)
Years of education	-0.014***	-0.010***	-0.010***	-0.006***	-0.005***	-0.003***	0.000	0.000	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Mother's occupation: white collar	0.011	0.021	0.002	-0.010	-0.013	-0.011	-0.009	-0.011	-0.000
	(0.012)	(0.015)	(0.021)	(0.009)	(0.012)	(0.017)	(0.006)	(0.007)	(0.009)
Mother's occupation: agriculture	-0.045***	-0.059***	0.004	-0.055***	-0.072***	-0.023	-0.008	-0.009	0.006
	(0.014)	(0.018)	(0.022)	(0.009)	(0.012)	(0.018)	(0.006)	(0.008)	(0.010)
Mother's occupation: service/manual	0.016	0.030*	-0.004	-0.007	-0.009	-0.011	-0.012**	-0.018**	0.001
	(0.014)	(0.018)	(0.022)	(0.010)	(0.013)	(0.018)	(0.006)	(0.007)	(0.010)
Year 2013	-0.047***	-0.038***	-0.081***	0.038***	0.035***	0.029***	-0.048***	-0.046***	-0.056***
	(0.008)	(0.010)	(0.009)	(0.007)	(0.010)	(0.006)	(0.004)	(0.005)	(0.005)
Year 2018	-0.017**	-0.002	-0.050***	-0.070***	-0.098***	-0.033***	-0.068***	-0.072***	-0.064***
	(0.008)	(0.011)	(0.011)	(0.005)	(0.008)	(0.006)	(0.003)	(0.005)	(0.005)
Year 2023-24	0.002	0.009	-0.051***	-0.056***	-0.105***	0.019**	-0.074***	-0.076***	-0.072***
	(0.009)	(0.012)	(0.011)	(0.006)	(0.008)	(0.008)	(0.003)	(0.005)	(0.005)
N	63982	40607	23375	63982	40607	23375	63982	40607	23375

Source: Authors' calculations based on NDHS (2008-2023/24). Note: Marginal effects (dy/dx) reported. Significance levels: *p<0.10, **p<0.05, ***p<0.01

Appendix Table A2. Determinants of child stunting, wasting, and overweight by survey year

	Stunting				Wasting				Overweight			
	2008	**2013**	**2018**	**2023-24**	**2008**	**2013**	**2018**	**2023-24**	**2008**	**2013**	**2018**	**2023-24**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Mothers' age	-0.014***	-0.014***	-0.018***	-0.026***	-0.003	-0.006*	0.002	-0.002	-0.003	-0.000	0.010	-0.040**
	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.003)	(0.007)	(0.008)	(0.004)	(0.006)	(0.014)	(0.019)
Household Size	0.014***	0.022***	0.045***	0.042***	0.007	0.014**	-0.010	-0.013	-0.014	-0.021*	-0.031	0.008
	(0.005)	(0.006)	(0.007)	(0.010)	(0.008)	(0.006)	(0.012)	(0.014)	(0.011)	(0.012)	(0.025)	(0.045)
Rural Residence	0.158***	0.098	0.065	0.240***	-0.024	-0.249***	0.046	-0.331***	0.007	0.073	0.201	-0.354
	(0.060)	(0.061)	(0.063)	(0.088)	(0.098)	(0.082)	(0.113)	(0.111)	(0.096)	(0.141)	(0.193)	(0.284)
Wealth status: middle	-0.189***	-0.388***	-0.332***	-0.319***	-0.427***	-0.207**	-0.187	-0.186	0.013	-0.139	-0.240	-0.853**
	(0.054)	(0.062)	(0.073)	(0.085)	(0.078)	(0.081)	(0.133)	(0.150)	(0.098)	(0.120)	(0.245)	(0.391)
Wealth status: rich	-0.438***	-0.790***	-0.770***	-0.764***	-0.434***	-0.319***	-0.429**	0.157	-0.074	-0.339**	-0.055	-0.974**
	(0.066)	(0.074)	(0.090)	(0.116)	(0.095)	(0.090)	(0.187)	(0.165)	(0.111)	(0.153)	(0.289)	(0.435)
Currently employed	-0.205**	-0.297***	0.092	0.062	0.075	0.188	0.086	-0.032	0.173	-0.306	-0.571*	0.087
	(0.086)	(0.098)	(0.127)	(0.151)	(0.115)	(0.116)	(0.227)	(0.229)	(0.147)	(0.273)	(0.305)	(0.585)
Female child	-0.202***	-0.195***	-0.280***	-0.280***	-0.075*	-0.139***	-0.363***	-0.092	0.080	0.112	-0.270	-0.126
	(0.033)	(0.033)	(0.050)	(0.054)	(0.045)	(0.040)	(0.094)	(0.087)	(0.055)	(0.077)	(0.174)	(0.197)
Child's age	0.012***	0.017***	0.015***	0.020***	-0.014***	-0.021***	-0.028***	-0.024***	-0.019***	-0.005**	-0.025***	-0.029***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(0.003)	(0.002)	(0.003)	(0.006)	(0.008)
Improved source of water	0.035	-0.001	-0.035	0.147**	0.055	0.040	0.025	0.090	-0.032	0.009	-0.166	-0.460*
	(0.043)	(0.052)	(0.064)	(0.074)	(0.071)	(0.056)	(0.120)	(0.106)	(0.079)	(0.129)	(0.200)	(0.256)
Improved source of toilet	0.019	0.083	0.075	0.189**	-0.057	0.290***	0.000	-0.146	-0.037	0.320***	0.349*	0.041
	(0.044)	(0.051)	(0.059)	(0.081)	(0.065)	(0.064)	(0.126)	(0.127)	(0.081)	(0.096)	(0.198)	(0.240)
Years of education	-0.062***	-0.065***	-0.082***	-0.066***	-0.078***	-0.054***	-0.038***	-0.026***	0.016**	-0.028***	0.017	0.033
	(0.005)	(0.005)	(0.006)	(0.007)	(0.007)	(0.007)	(0.012)	(0.010)	(0.008)	(0.011)	(0.020)	(0.032)
Mother's occupation: white collar	0.093	0.275***	-0.130	-0.178	-0.130	-0.187	-0.002	0.027	-0.283*	-0.125	0.197	0.230
	(0.096)	(0.101)	(0.136)	(0.160)	(0.124)	(0.120)	(0.237)	(0.236)	(0.149)	(0.288)	(0.330)	(0.575)
Mother's occupation: agriculture	0.035	-0.184	-0.457***	-0.400**	-0.695***	-0.671***	-0.358	-0.327	-0.305*	0.030	0.806**	-1.968**
	(0.102)	(0.116)	(0.147)	(0.172)	(0.141)	(0.134)	(0.260)	(0.263)	(0.165)	(0.295)	(0.362)	(0.890)
Mother's occupation: service/manual	0.079	0.348***	-0.057	-0.238	0.008	-0.197	-0.149	-0.006	-0.446***	-0.120	0.663*	-0.628
	(0.103)	(0.110)	(0.149)	(0.197)	(0.128)	(0.125)	(0.277)	(0.263)	(0.171)	(0.299)	(0.367)	(0.637)
N	18788	24505	11315	9374	18788	24505	11315	9374	18788	24505	11315	9374

Source: Authors' calculations based on NDHS (2008, 2013, 2018, 2023-24). Note: Logit coefficients reported; standard errors in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01

Appendix Table A3. Average marginal effects of determinants of child stunting, wasting, and overweight by survey year

	Stunting				Wasting				Overweight			
	2008	**2013**	**2018**	**2023-24**	**2008**	**2013**	**2018**	**2023-24**	**2008**	**2013**	**2018**	**2023-24**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Mothers' age	-0.003***	-0.003***	-0.004***	-0.005***	-0.000	-0.001*	0.000	-0.000	-0.000	-0.000	0.000	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Household Size	0.003***	0.005***	0.009***	0.009***	0.001	0.002**	-0.001	-0.001	-0.001	-0.001*	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
Rural Residence	0.036***	0.020	0.013	0.050***	-0.003	-0.037***	0.003	-0.025***	0.001	0.003	0.004	-0.005
	(0.013)	(0.013)	(0.013)	(0.018)	(0.011)	(0.012)	(0.007)	(0.009)	(0.008)	(0.005)	(0.004)	(0.004)
Wealth status: middle	-0.044***	-0.087***	-0.073***	-0.071***	-0.050***	-0.031***	-0.013	-0.013	0.001	-0.005	-0.004	-0.014*
	(0.013)	(0.014)	(0.016)	(0.019)	(0.009)	(0.012)	(0.009)	(0.010)	(0.008)	(0.005)	(0.005)	(0.007)
Wealth status: rich	-0.100***	-0.169***	-0.161***	-0.163***	-0.050***	-0.046***	-0.026**	0.012	-0.006	-0.012**	-0.001	-0.015*
	(0.015)	(0.016)	(0.019)	(0.025)	(0.011)	(0.013)	(0.011)	(0.013)	(0.009)	(0.005)	(0.006)	(0.008)
Currently employed	-0.047**	-0.062***	0.018	0.013	0.009	0.027*	0.005	-0.002	0.013	-0.012	-0.012	0.001
	(0.020)	(0.021)	(0.025)	(0.031)	(0.013)	(0.016)	(0.014)	(0.017)	(0.011)	(0.011)	(0.007)	(0.008)
Female child	-0.045***	-0.040***	-0.056***	-0.057***	-0.009*	-0.020***	-0.022***	-0.007	0.006	0.004	-0.005	-0.002
	(0.007)	(0.007)	(0.010)	(0.011)	(0.005)	(0.006)	(0.006)	(0.007)	(0.004)	(0.003)	(0.003)	(0.003)
Child's age	0.003***	0.003***	0.003***	0.004***	-0.002***	-0.003***	-0.002***	-0.002***	-0.001***	-0.000**	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Improved source of water	0.008	-0.000	-0.007	0.030**	0.006	0.006	0.002	0.007	-0.003	0.000	-0.003	-0.007
	(0.010)	(0.011)	(0.013)	(0.015)	(0.008)	(0.008)	(0.007)	(0.008)	(0.006)	(0.005)	(0.004)	(0.004)
Improved source of toilet	0.004	0.017*	0.015	0.038**	-0.007	0.042***	0.000	-0.011	-0.003	0.012***	0.007*	0.001
	(0.010)	(0.010)	(0.012)	(0.016)	(0.008)	(0.009)	(0.008)	(0.010)	(0.006)	(0.004)	(0.004)	(0.003)
Years of education	-0.014***	-0.013***	-0.016***	-0.013***	-0.009***	-0.008***	-0.002***	-0.002**	0.001**	-0.001***	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Mother's occupation: white collar	0.021	0.057***	-0.026	-0.037	-0.016	-0.028	-0.000	0.002	-0.024*	-0.005	0.003	0.004
	(0.021)	(0.020)	(0.028)	(0.034)	(0.016)	(0.019)	(0.016)	(0.018)	(0.013)	(0.011)	(0.005)	(0.009)
Mother's occupation: agriculture	0.008	-0.036	-0.089***	-0.081**	-0.071***	-0.088***	-0.020	-0.022	-0.026*	0.001	0.018**	-0.013**
	(0.023)	(0.023)	(0.029)	(0.035)	(0.015)	(0.019)	(0.015)	(0.018)	(0.014)	(0.012)	(0.008)	(0.006)
Mother's occupation: service/manual	0.018	0.072***	-0.012	-0.049	0.001	-0.030	-0.009	-0.000	-0.036**	-0.004	0.013*	-0.007
	(0.023)	(0.022)	(0.030)	(0.041)	(0.017)	(0.019)	(0.017)	(0.020)	(0.014)	(0.011)	(0.008)	(0.007)
N	18788	24505	11315	9374	18788	24505	11315	9374	18788	24505	11315	9374

Source: Authors' calculations based on NDHS (2008, 2013, 2018, 2023-24). Note: Marginal effects (dy/dx) reported, expressed as percentage-point changes in predicted probability; standard errors in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01

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