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Widening wealth-related inequality in childhood stunting in Nigeria, 1990–2024: repeated cross-sectional analysis and descriptive decomposition

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Research Article

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Abstract

Background

Child stunting is a persistent health concern in Nigeria. We assessed how wealth-related inequalities in stunting changed across six nationally representative demographic surveys from 1990 to 2024.

Methods

We analysed 73,947 children aged 0–59 months with valid height-for-age measurements from the 1990, 2003, 2008, 2013, 2018 and 2024 Nigeria Demographic and Health Surveys. We compared stunting prevalence across household wealth quintiles and estimated the design-weighted slope index of inequality (SII), relative index of inequality (RII) and a descriptive two-fold Oaxaca–Blinder decomposition for the 1990–2024 difference.

Results

Stunting prevalence among the poorest quintile was 53.7% in 1990 and 55.6% in 2024; among the richest quintile, it fell from 36.7% to 14.8%. The poorest–richest absolute gap widened from 17.0 to 40.8 percentage points. The SII rose from 18.7 (95% confidence interval [CI] 11.9–25.5) to 51.3 (46.2–56.3) percentage points; the reported change was 32.5 (24.1–41.0) percentage points. The RII increased from 1.47 to 3.58. Zone-specific SII trajectories varied across survey rounds. The descriptive decomposition apportioned the − 9.5-percentage-point overall prevalence change into a − 3.6-point covariate-composition component and a − 5.9-point residual component.

Conclusions

Wealth-related inequalities in childhood stunting widened substantially despite a reduction in overall prevalence. Monitoring distributional change alongside national averages is central to equitable nutrition and child-health policy.

Background

Childhood stunting, defined as height-for-age below − 2 standard deviations of the World Health Organization Child Growth Standards median, reflects sustained limitations in linear growth associated with nutritional, infectious and social exposures [1, 2, 4]. Its distribution within a population is an equity concern because household socioeconomic conditions affect food security, maternal care, infection exposure and access to preventive services. National changes in average prevalence alone do not describe whether these differences narrow or widen over time [1, 2].

Nigeria has undertaken repeated household surveys over several decades, permitting design-based comparisons of stunting across households occupying different positions in the survey-specific wealth distribution [3]. The DHS wealth index represents a relative household asset ranking rather than an

income measure, and quintiles must be interpreted within their survey round [5]. Consequently, wealth-related inequality analysis complements rather than duplicates analyses of national prevalence.

Relative and absolute measures describe different dimensions of inequality. The slope index of inequality (SII) summarises the modelled absolute gradient between ends of the wealth distribution, whereas the relative index of inequality (RII) expresses the ratio of predicted prevalences [6, 7]. Concentration-based measures describe distribution across the full wealth ranking [8, 9]. Published work from Nigeria and other low- and middle-income settings has documented socioeconomic gradients in child undernutrition [10–15].

We analysed trends across six Nigeria Demographic and Health Surveys (NDHS) spanning 1990 to 2024. The objectives were to describe stunting prevalence by wealth quintile, quantify absolute and relative wealth-related inequality nationally and across the six geopolitical zones, assess the influence of missing anthropometry through a multiple-imputation sensitivity analysis, and statistically decompose the national prevalence difference between the first and last surveys. The decomposition is descriptive and does not estimate causal effects of wealth, schooling or place of residence.

Methods

Study design and survey sources

This repeated cross-sectional study used six NDHS rounds conducted in 1990, 2003, 2008, 2013, 2018 and 2024. The surveys used stratified, multistage household sampling with sampling weights, primary sampling units and strata [3]. The analysis was restricted to living children aged 0–59 months with valid height-for-age z-scores (HAZ) and wealth-rank information. Each round contributed survey-specific observations rather than a longitudinal follow-up of the same children.

The analytic sample contained 73,947 valid HAZ observations among 122,000 living children aged 0–59 months represented in the source-flow counts. The valid-measurement denominator was 5,496 in 1990, 4,282 in 2003, 19,010 in 2008, 24,505 in 2013, 11,309 in 2018 and 9,345 in 2024. Figure 1 and Additional file 1 report the full survey-specific flow. Missing or invalid HAZ records were excluded from the primary complete-case analysis. Thus the analytic sample represents measured children within each survey design, not automatically every eligible child.

Outcome and wealth ranking

Outcome and wealth ranking
Stunting was defined as a HAZ less than − 2, relative to WHO Child Growth Standards [4]. HAZ outside − 6 to + 6 or designated invalid by the DHS measurement procedures did not contribute to the valid-HAZ analytic sample. Household socioeconomic ranking was based on the DHS asset-based wealth index [5].

Wealth quintiles were ordered poorest, poorer, middle, richer and richest within each survey. Weighted fractional wealth ranks were used to construct summary inequality indices.

Statistical methods

Stunting prevalence and uncertainty intervals were estimated within survey rounds using the survey design and sample weights. The unadjusted absolute prevalence gap was the difference in percentage points between the poorest and richest wealth quintiles. The SII was estimated using an identity-link binomial-family regression of the binary stunting indicator on the fractional wealth rank; its orientation was expressed as the predicted prevalence at the disadvantaged end minus the predicted prevalence at the advantaged end, in percentage points. The RII was the corresponding ratio of predicted stunting prevalences, estimated using a log-link model [6, 7].

The Erreygers-corrected concentration index was also calculated as a supplementary wealth-ranking summary for the bounded binary stunting outcome [8, 9]. The supplementary table reports the absolute magnitudes of the index, while the direction of inequality is established independently by the quintile gradients, SII and RII. Under the conventional poor-to-rich ranking, a negative concentration index indicates a greater concentration of an adverse outcome among poorer households. For geographical description, survey-specific SII trajectories were plotted for all six geopolitical zones. The 2024 zonal SII values were also displayed on the corresponding DHS boundaries. These displays present zone-level summary patterns, not state-level estimates.

For 1990 and 2024, a two-fold Oaxaca–Blinder decomposition using a weighted linear-probability model partitioned the change in national stunting prevalence into a component associated with differences in the mean covariate distribution and a residual component based on pooled reference coefficients. The supplementary specification included wealth rank, maternal education, urban residence, geopolitical zone, child-age category and child sex. The components sum algebraically to the observed prevalence difference, but are not interpreted as mechanisms or intervention effects [10, 17, 20, 21].

Multiple imputation by chained equations (20 imputations) was reported as a sensitivity analysis for the change in the SII [19]. The results are displayed alongside complete-case results. The source analysis reported 1,000 cluster-within-stratum bootstrap replications for the change and decomposition summaries. The study follows the reporting principles of STROBE for observational research [22].

Use of artificial intelligence in manuscript preparation

ChatGPT (OpenAI) was used in November 2026 to assist with editorial restructuring, language refinement and bibliographic cross-checking using PubMed records. The author retains responsibility for the analysis, factual claims, citations and final manuscript.

Results

Analytic sample and measurement availability

Of 122,000 living children aged 0–59 months in the survey-specific source flow, 73,947 had valid HAZ. Valid HAZ proportions ranged from 36.8% in 2024 and 37.0% in 2018 to 85.7% in 2013. The early survey rounds had substantially higher valid-measurement proportions than the last two rounds. Table 1 reports the complete source-flow counts, and Fig. 1 summarises the pooled flow. Consequently, differences in anthropometry availability must be considered when interpreting between-survey trends.

Table 1
Availability of valid height-for-age measurements by NDHS round.

Survey	Living children	Valid HAZ	Missing/invalid HAZ	Valid HAZ (%)
1990	6,860	5,496	1,364	80.1%
2003	5,186	4,282	904	82.6%
2008	25,446	19,010	6,436	74.7%
2013	28,596	24,505	4,091	85.7%
2018	30,547	11,309	19,238	37.0%
2024	25,365	9,345	16,020	36.8%
Total	122,000	73,947	48,053	60.6%

Wealth-quintile trajectories

Overall national stunting prevalence was 43.5% in 1990 and 34.0% in 2024, a decline of 9.5 percentage points. This overall change masked divergent trajectories. In the poorest quintile, prevalence was 53.7% in 1990 and 55.6% in 2024; in the richest quintile it declined from 36.7% to 14.8%. The observed poorest–richest gap widened from 17.0 to 40.8 percentage points, an increase of 23.8 points (Table 2 and Fig. 2).

Table 2
Design-weighted stunting prevalence by household wealth quintile, 1990–2024.

Survey	Poorest (%)	Poorer (%)	Middle (%)	Richer (%)	Richest (%)	Gap (pp)
1990	53.7	47.2	42.1	38.5	36.7	17.0
2003	52.1	46.8	41.0	32.4	24.1	28.0
2008	48.3	44.1	38.7	29.2	22.0	26.3
2013	50.4	43.2	35.8	25.1	18.3	32.1
2018	54.4	44.6	34.1	23.8	17.5	36.9
2024	55.6	43.1	32.0	21.5	14.8	40.8
2024 − 1990	+ 1.9	−4.1	−10.1	−17.0	−21.9	+ 23.8

Summary indices of wealth-related inequality

The SII increased from 18.7 percentage points (95% CI 11.9–25.5) in 1990 to 51.3 points (46.2–56.3) in 2024. The reported 2024-minus-1990 SII change was 32.5 percentage points (95% CI 24.1–41.0). The RII increased from 1.47 (1.25–1.72) to 3.58 (3.12–4.11), indicating a larger relative prevalence contrast between the disadvantaged and advantaged ends of the wealth ranking. These national indices appear in Table 3 and Fig. 3; the RII trajectory is also shown in Supplementary Figure S1 (Additional file 1).

Table 3
Slope and relative indices of inequality, with reported 95% confidence intervals.

Survey	SII (pp)	SII 95% CI	RII	RII 95% CI
1990	18.7	11.9–25.5	1.47	1.25–1.72
2003	32.1	26.4–37.8	2.16	1.88–2.48
2008	33.4	30.1–36.7	2.19	2.01–2.39
2013	38.6	35.2–42.0	2.75	2.48–3.05
2018	44.8	41.0–48.6	3.11	2.82–3.43
2024	51.3	46.2–56.3	3.58	3.12–4.11

Geographical variation in the SII

Figure 4 displays six-zone SII trajectories for 1990–2024. The zone-specific trends were heterogeneous and several changed non-monotonically between successive surveys. The national increase in the SII therefore did not represent an identical pattern in every geopolitical zone.

Sensitivity analyses and descriptive decomposition

The complete-case SII change was 32.5 percentage points (95% CI 24.1–41.0), compared with 31.4 points (22.8–40.0) under multiple imputation. The covariate-adjusted sensitivity result reported in the supplementary analysis was 17.7 points (10.0–25.4). These estimates differ by specification, but both the imputation and adjusted comparisons remained positive.

Table 4
Supported sensitivity comparisons for the 2024-minus-1990 SII difference.

Analysis	Change in SII (pp)	95% CI
Primary complete case	32.5	24.1–41.0
Multiple imputation (20 datasets)	31.4	22.8–40.0
Covariate-adjusted model	17.7	10.0–25.4

The Oaxaca–Blinder decomposition partitioned the 9.5-percentage-point reduction in national prevalence into an explained covariate-composition contribution of − 3.6 points and a residual component of − 5.9 points (Fig. 5). Reported individual contributions included − 5.2 points for maternal education and − 1.5 points for urban residence; the remaining covariate terms offset part of these contributions. These are algebraic contributions from the selected model, not evidence that changes in education or residence caused these numbers of percentage points of decline.

Geographical distribution of inequality in 2024

The 2024 zone-specific SII display (Fig. 6) illustrates spatial variation in the absolute wealth gradient. The South South and South East zones have larger displayed gradients than the South West zone. The choropleth presents geopolitical-zone summaries; the shaded areas do not represent state-specific estimates.

Discussion

Across six repeated cross-sectional surveys, the poorest–richest gap in childhood stunting widened substantially, despite a fall in national average prevalence. Stunting prevalence was almost unchanged in the poorest wealth quintile, whereas the richest quintile experienced a marked decline. Both the SII and RII showed widening differences across the wealth ranking, which gives the findings a stronger distributional basis than a comparison of only the extreme quintiles [6, 7].

The pattern is consistent with the broader literature documenting wealth-related inequalities in child nutrition in Nigeria and across sub-Saharan Africa [10–15]. Nwosu and Ataguba examined changes in stunting and wasting inequalities in Nigeria and identified socioeconomic and geographic correlates [10]. The multi-country work of Baye and colleagues showed that progress in stunting prevalence may

coexist with persistent inequalities in diet quality and health-service coverage [12]. These external observations provide comparative context, not independent validation of the present survey-specific estimates. Spatial studies across low- and middle-income countries likewise demonstrate geographic heterogeneity in child growth failure [18].

The recovered geographical analyses further show variation in wealth-related stunting gradients within Nigeria (Figs. 4 and 6). The six-zone time series and the 2024 map complement the national indices by showing that zonal patterns were not uniform. They describe geographical variation in the fitted wealth gradient, without identifying geographical causes or implying state-level precision.

The difference between absolute and relative indices matters for policy interpretation. When average prevalence changes, a relative prevalence contrast can widen alongside an absolute gradient; the SII and RII quantify separate dimensions. In 2024, the modelled prevalence ratio between opposite ends of the wealth ranking was 3.58, while the corresponding SII was 51.3 percentage points. Neither statistic describes a causal effect of increasing household wealth, and the DHS wealth index is not a direct estimate of income [5–7].

The Oaxaca–Blinder partition describes how the modelled average difference was distributed between changes in observed covariate composition and a residual term. The residual includes differences in coefficients, baseline prevalence and other variation not allocated to covariate means. It cannot identify worsening health systems, food insecurity, conflict or other named mechanisms without separate exposure measurements and analyses [17, 20, 21]. Similarly, the education and urban-residence contributions are descriptive regression decompositions rather than intervention effect estimates.

Several limitations influence interpretation. The study compares repeated cross-sections rather than following children through time. The wealth index reflects relative assets within each survey and its constituent items are not identical to an income scale. The markedly lower availability of valid HAZ in 2018 and 2024 raises selection concerns that design weighting alone does not resolve. Multiple imputation produced a similar SII contrast, but neither imputation nor covariate adjustment establishes the missing-at-random assumption or makes the sample equivalent to all eligible children. Analyses based on different reference coefficients in an Oaxaca–Blinder decomposition can yield different explained and residual allocations [19–21].

Equity-oriented policy responses should therefore monitor both national stunting prevalence and inequalities across wealth strata. Existing reviews support nutrition-specific interventions and multisectoral strategies that address maternal and child nutrition [2, 16]. The observed Nigerian gradients help identify priority population groups for monitoring and programme evaluation; they do not, by themselves, establish which intervention would close the gap. Programmes should measure changes in stunting across wealth groups rather than infer an equity effect solely from aggregate improvement.

Conclusions

Between 1990 and 2024, the observed socioeconomic distribution of childhood stunting in Nigeria became more unequal. The poorest–richest gap increased from 17.0 to 40.8 percentage points, while the modelled SII rose from 18.7 to 51.3 points. National nutrition monitoring and policies should evaluate equity explicitly alongside changes in mean prevalence.

Abbreviations

CI
confidence interval
DHS
Demographic and Health Surveys
HAZ
height-for-age z-score
MICE
multiple imputation by chained equations
NDHS
Nigeria Demographic and Health Survey
RII
relative index of inequality
SII
slope index of inequality
WHO
World Health Organization.

Declarations

Ethics approval and consent to participate

The study used anonymised, secondary DHS data. The original surveys obtained relevant ethical approval and participant informed consent under DHS protocols. No participants were contacted as part of this secondary analysis.

Consent for publication

Not applicable. The manuscript contains no identifiable participant information.

Competing interests

The author declares no competing interests.

Additional file

Additional file 1. Supplementary methods, Tables S1–S3 and Figure S1 (DOCX). Survey-specific sample flow, concentration-measure reporting, analytical definitions, sensitivity comparisons, descriptive decomposition and the RII trends figure.

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Author Contribution

KRF conceived and designed the study, conducted the analysis, interpreted the findings, and prepared and approved the manuscript.

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Data Availability

The study used anonymised, secondary DHS data. The original surveys obtained relevant ethical approval and participant informed consent under DHS protocols. No participants were contacted as part of this secondary analysis.

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Figures

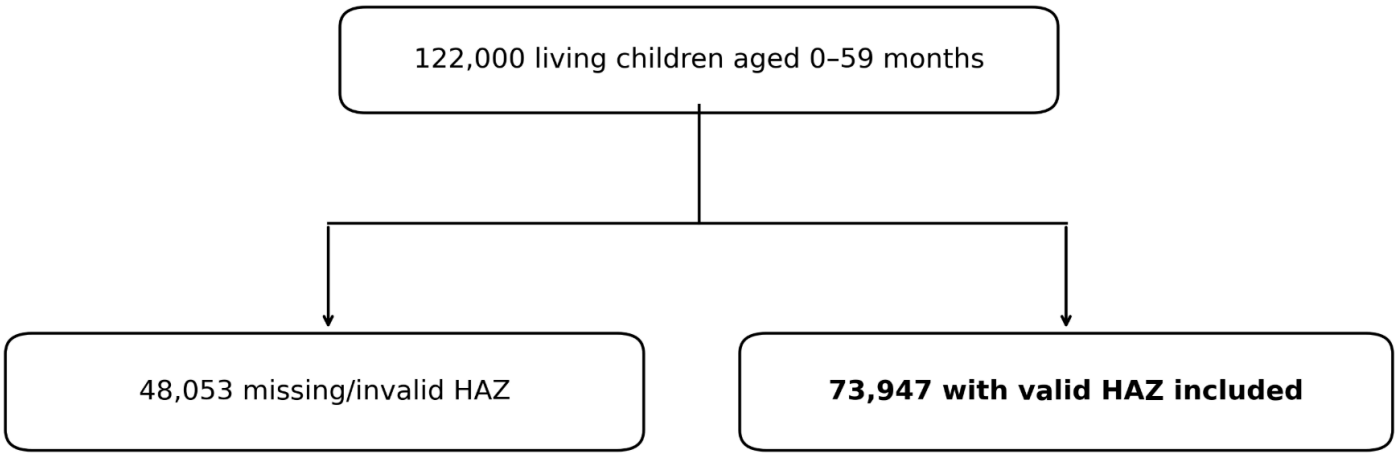


Figure 1

Aggregate eligibility flow for the six Nigeria Demographic and Health Surveys. The diagram distinguishes living children aged 0–59 months from valid-height-for-age observations retained in the analysis.

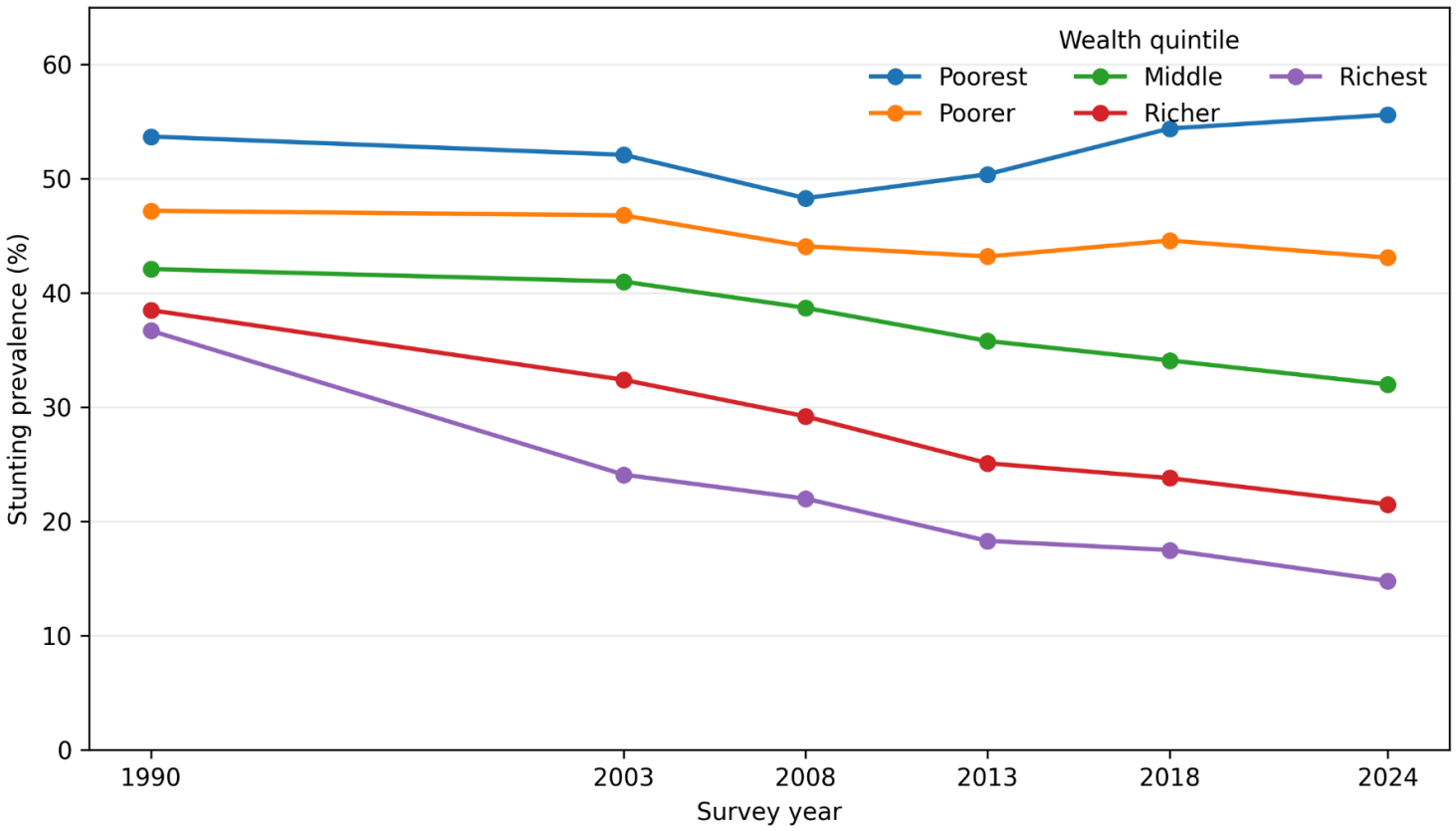


Figure 2

Weighted stunting prevalence by survey and within-survey wealth quintile. Values are percentages and represent children with valid height-for-age measurements.

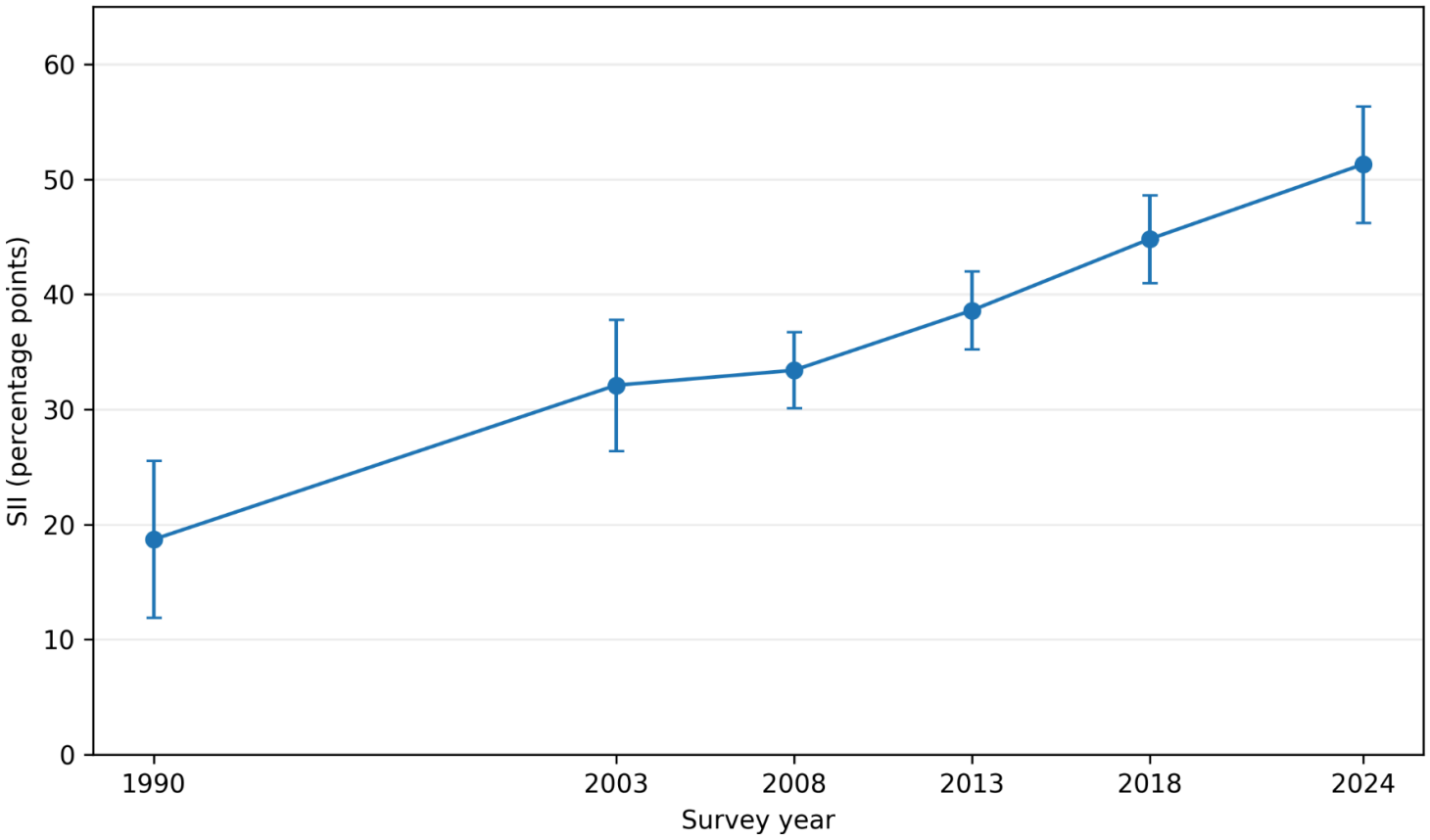


Figure 3

Slope index of inequality (SII) in stunting prevalence by survey with reported 95% confidence intervals. Positive values represent a greater prevalence at the disadvantaged end of the wealth ranking.

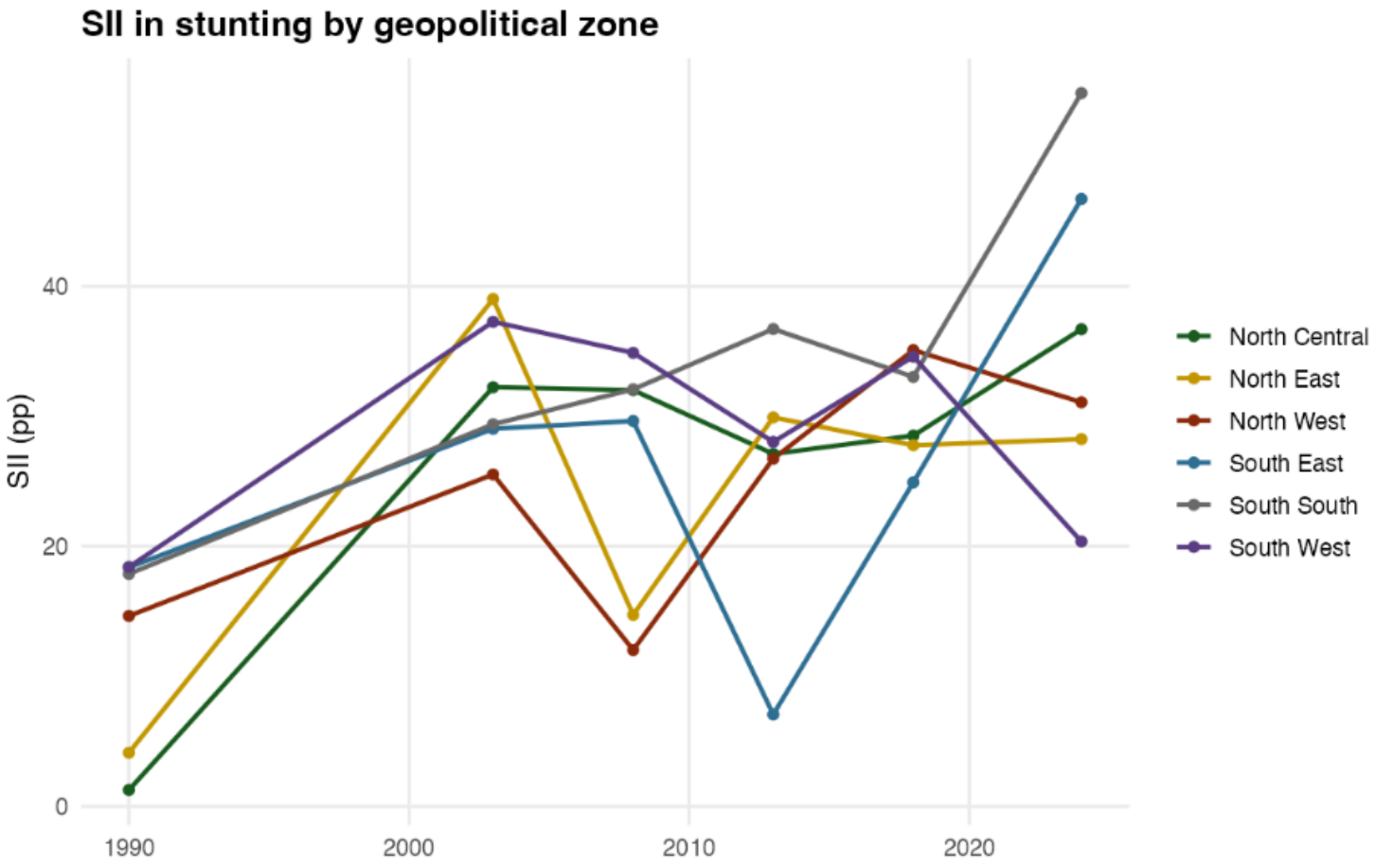


Figure 4

Zone-specific slope index of inequality (SII) in childhood stunting across the six Nigeria Demographic and Health Surveys, 1990–2024. Values are percentage-point differences between opposite ends of the wealth-ranking distribution within each geopolitical zone.

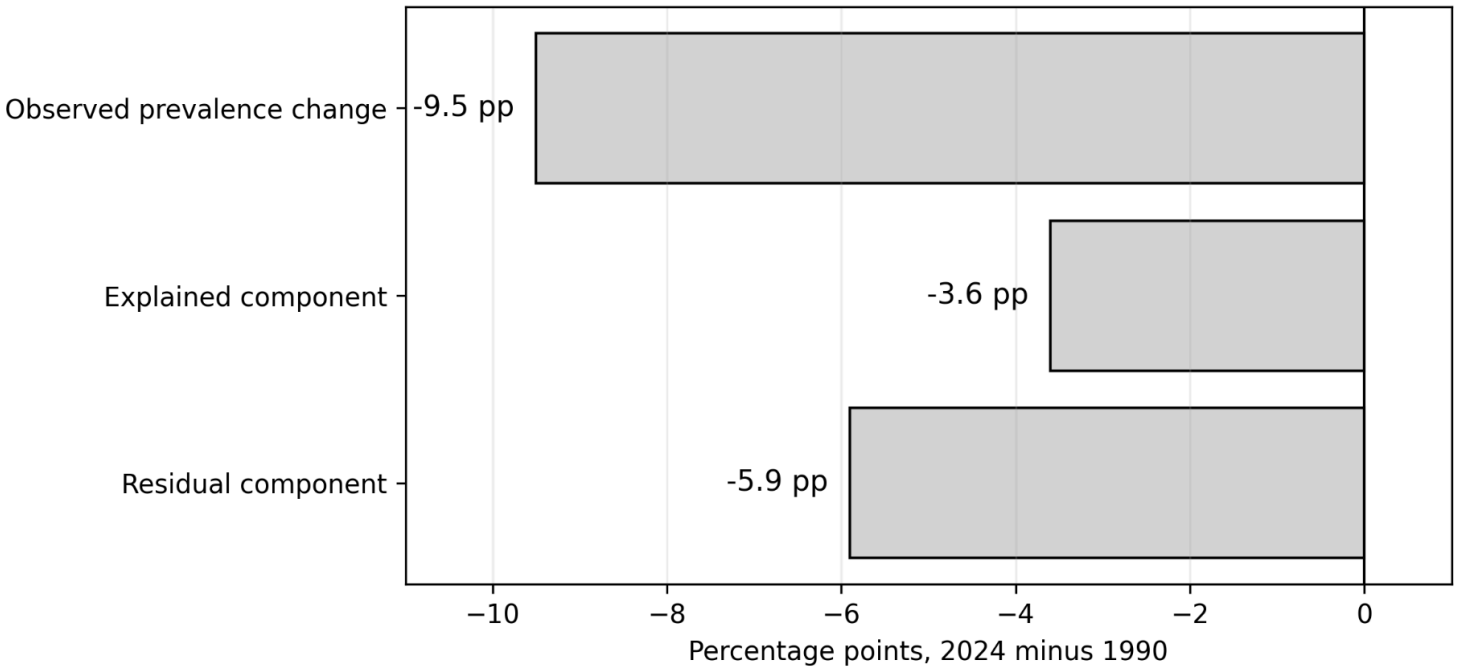


Figure 5

Descriptive two-fold Oaxaca–Blinder partition of the national 1990–2024 change in stunting prevalence. Components are algebraic model summaries, not causal effects.

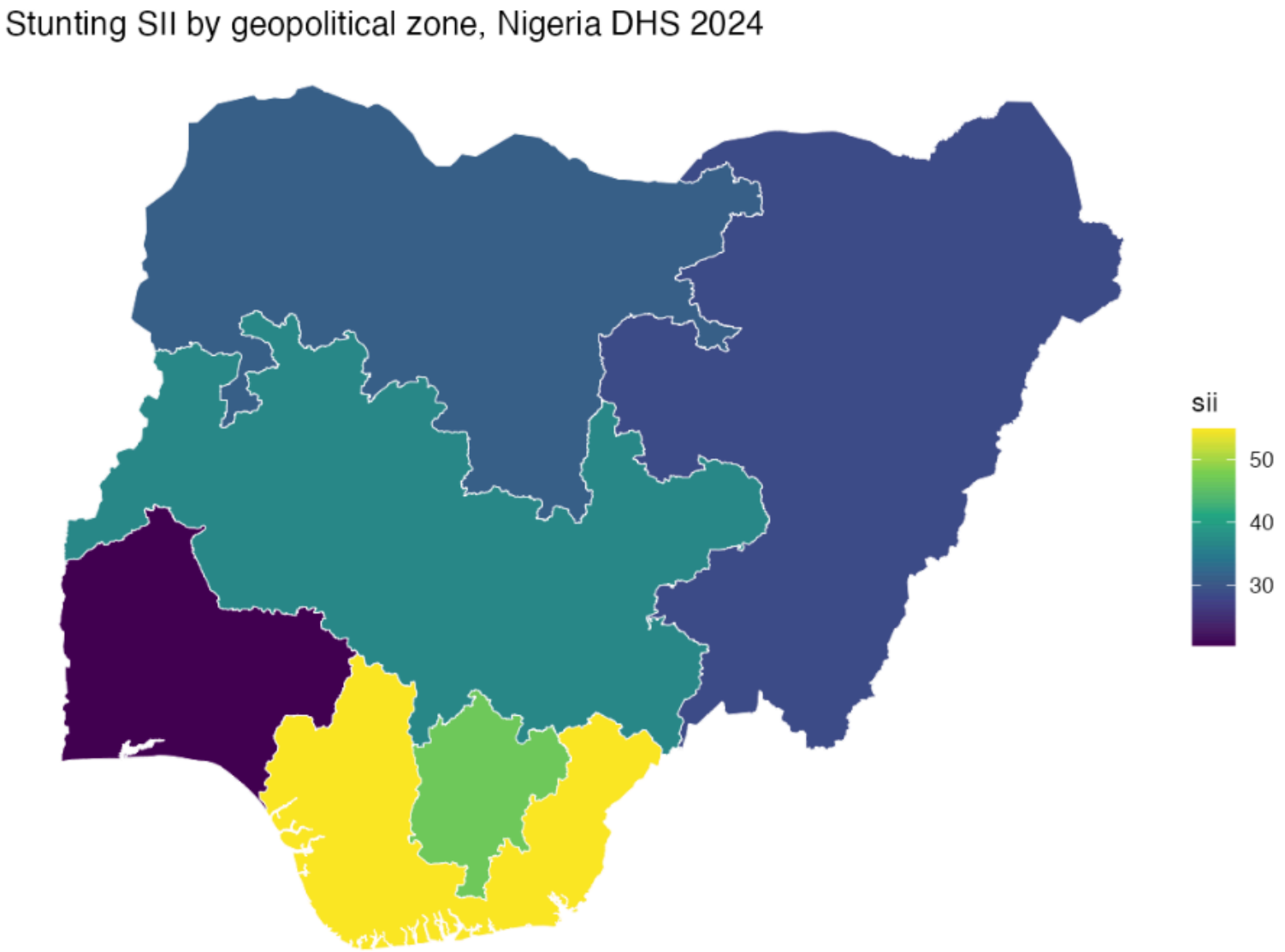


Figure 6

Zone-specific slope index of inequality (SII) in childhood stunting, Nigeria, 2024. Zonal estimates are shown using survey-matched DHS geopolitical-zone boundaries; the legend gives SII in percentage points.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- 02AdditionalFile1SupplementaryAppendix.docx