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HEALTH INEQUALITY AND NUTRITIONAL STATUS OF CHILDREN AND WOMEN IN PAKISTAN: CONCENTRATION INDEX EVIDENCE FROM THE PAKISTAN DEMOGRAPHIC AND HEALTH SURVEY 2017-18

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KEYWORDS	ABSTRACT
Health inequality, concentration index, decomposition, stunting, double burden of malnutrition, women's nutrition, Pakistan.	Pakistan carries one of the heaviest burdens of child undernutrition in the world while overweight and obesity are rising rapidly among adult women. This study measures socioeconomic inequality in the nutritional status of children and women in Pakistan and identifies its principal sources. We analyzed unit-record data from the Pakistan Demographic and Health Survey 2017-18 for children under five with valid anthropometry, non-pregnant ever-married women of reproductive age, children in the complementary feeding age range and women with a recent live birth. Inequality was measured with concentration curves and concentration indices ranked on the continuous household wealth score with cluster-bootstrap standard errors and Ereygers-corrected indices. The concentration index for stunting was decomposed into its determinants and survey-weighted probit and ordinary least squares models identified the correlates of child stunting and women's body mass index. More than a third of children were stunted and stunting, underweight and wasting were all concentrated among the poor. Among women, underweight was concentrated among the poor whereas overweight or obesity which affected about half of women was concentrated among the better-off. Minimum dietary diversity, minimum acceptable diet and antenatal iron supplementation were all pro-rich. Household wealth, maternal education and region explained most of the inequality in stunting. Children in the richest quintile were substantially less likely to be stunted than those in the poorest and small size at birth and short birth intervals independently raised the risk. Nutritional inequality in Pakistan is steep and runs in opposite directions for undernutrition and overnutrition. Because household wealth and maternal education jointly account for the bulk of the inequality in child stunting, equity-oriented social protection, investment in girl's education, birth-spacing services and region-specific health investment should be pursued together.
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Introduction

Malnutrition in all its forms remains one of the most pervasive threats to human health and economic development. The latest estimates of UNICEF, World Health Organization and World Bank indicate that about 148 million children under five years of age were stunted in 2022, 45 million were wasted and 37 million were overweight (UNICEF et al., 2023). Chronic undernutrition in early life is associated with higher child mortality, impaired cognitive development, lower school attainment, reduced adult height and lower earnings (Black et al., 2013; Grantham-McGregor et al., 2007; Victora et al., 2008). Much of this damage is irreversible after the first two years of life (Dewey & Begum, 2011; Victora et al., 2010), stunting represents a substantial and lasting loss of human capital and investment in its reduction yields high economic returns (Hoddinott et al., 2013).

At the same time, many low and middle income countries are passing through a rapid nutrition transition in which diets shift towards energy-dense processed foods and physical activity declines (Popkin et al., 2012). The result is a double burden of malnutrition in which undernutrition and overweight coexist within the same populations, households and even individuals across the life course (Popkin et al., 2020; Wells et al., 2020; World Health Organization, 2017). Global pooled analyses show that obesity among adults has risen sharply since 1990 while underweight has declined only slowly in South Asia (NCD Risk Factor Collaboration, 2024) and cross-country evidence suggests that the double burden intensifies as national income rises from low to middle levels (Seenivasan et al., 2023).

Pakistan illustrates both sides of this burden with particular clarity. With a population of about 241 million (Pakistan Bureau of Statistics, 2023), it has one of the largest numbers of stunted children in the world. The Pakistan Demographic and Health Survey (PDHS) 2017-18 reported that 38% of children under five were stunted and 23% were underweight while more than half of ever-married women aged 15-49 were overweight or obese (National Institute of Population Studies & ICF, 2019). Progress has been slow and uneven: national stunting declined only from 42.3% to 40.2% between 2011 and 2018 with marked differences across provinces and districts (Ataullahjan et al., 2025). Earlier nationally representative data revealed pronounced geographical and socioeconomic gradients in the nutritional status of both women and children (Di Cesare et al., 2015) and the prevalence of coexisting forms of malnutrition remains persistently higher in Sindh and Balochistan than elsewhere (Khalig et al., 2021). These patterns unfold within a health system characterised by large gaps in the coverage of reproductive, maternal and child health services (Bhutta, Hafeez, et al., 2013) and against a global backdrop of highly variable progress on maternal and child undernutrition (Victora et al., 2021).

From a public health perspective, differences in nutrition that are systematic, avoidable and linked to social position are not merely variations but inequities (Braveman, 2006; Whitehead, 1992). Reducing them is central to the social-determinants agenda (Marmot et al., 2008). Across developing countries, child malnutrition is disproportionately concentrated among poorer households (Van de Poel et al., 2008) and in South Asia wealth-related inequalities in stunting

have narrowed only modestly over time (Krishna et al., 2018). Measuring such inequalities requires methods that use the whole socioeconomic distribution rather than comparing extreme groups. The concentration curve and concentration index developed by Wagstaff et al. (1989, 1991) and formalised by Kakwani et al. (1997) serve this purpose and the decomposition method of Wagstaff et al. (2003) links measured inequality to its underlying determinants thereby indicating where policy can have the greatest equalising effect (O'Donnell et al., 2008).

Existing research on Pakistan has identified many determinants of child undernutrition. Regression analyses of successive PDHS rounds point to household wealth, maternal education, child age, birth size and region (Khan et al., 2019; Siddiqi et al., 2023) and similar risk factors emerge from provincial surveys (Burki, 2025). Other studies have decomposed changes in nutrition over time (Ataullahjan et al., 2025; Rehman et al., 2023) measured inequality of opportunity (Sriram & Naz, 2025) mapped the spatial distribution of women's malnutrition (Naz et al., 2025) or described the joint nutritional status of women and children (Waghmare et al., 2022). A narrative synthesis of this literature concludes that poverty, low maternal education and poor access to services are the recurring drivers of child malnutrition in the country (Asim & Nawaz, 2018). However, few studies have applied the full concentration curve-concentration index-decomposition framework to the PDHS microdata and none, to our knowledge, has examined within a single framework the socioeconomic distribution of child undernutrition, women's under and overnutrition and the nutrition inputs (child diets, breastfeeding practices and antenatal iron) that link household resources to nutritional outcomes.

This study addresses that gap. Using the unit-record data of the PDHS 2017-18, it pursues three objectives (a) to quantify socioeconomic inequality in 13 indicators of child and maternal nutrition and nutrition inputs (b) to decompose inequality in child stunting into the contributions of household wealth, maternal education, region, child characteristics and maternal factors and (c) to estimate the independent associations between these factors and child stunting and women's BMI. The study contributes to the literature in two ways. First, the analysis places the double burden among women and the distribution of nutrition inputs alongside child undernutrition. Second, the decomposition translates measured inequality into policy relevant priorities. The remainder of the paper reviews the relevant literature, describes the data and methods, presents the results and discusses their implications for policy.

Literature Review

Socioeconomic Inequality and Child Undernutrition

The conceptual framework that underpins most research on child nutrition distinguishes immediate causes (inadequate dietary intake and disease), underlying causes (household food insecurity, inadequate care and feeding practices and unhealthy environments) and basic causes (poverty, education and institutional context) (Black et al., 2013). Socioeconomic position operates through each level. Household wealth determines access to diverse foods, safe water, sanitation and health services (Smith & Haddad, 2015; Van de Poel et al., 2008). Maternal education

improves health knowledge, decision-making autonomy and the use of services (Frost et al., 2005; Glewwe, 1999; Thomas et al., 1991) and its association with child growth becomes stronger at higher levels of schooling (Alderman & Headey, 2017). Cross-country analyses for South Asia identify maternal height, maternal education and household wealth as among the most important correlates of stunting (Kim et al., 2017) while additive quantile models for India show that these socioeconomic factors matter across the whole height for age distribution (Fenske et al., 2013).

Pakistan specific evidence broadly confirms these patterns. Using the PDHS 2012-13, Khan et al. (2019) found that household wealth, maternal education and maternal nutritional status (height and BMI) were common correlates of stunting, underweight and wasting and that stunting was additionally associated with child age, male sex and small size at birth. Siddiga et al. (2023) reported similar determinants in the PDHS 2017-18, including child age, sex, birth size, maternal education, iron supplementation during pregnancy, economic status, improved drinking water and residence in Sindh or Balochistan. Analysing the Punjab Multiple Indicator Cluster Survey 2018, Burki (2025) ranked household poverty, low maternal education, short birth intervals, adolescent motherhood and low birth weight as the leading risk factors for stunting and underweight. Khalig et al. (2021) showed that the prevalence of coexisting forms of malnutrition fell from 30.6% to 21.5% between 2012-13 and 2017-18 with persistently higher levels in Sindh and Balochistan.

A smaller literature addresses inequality and change directly. Rehman et al. (2023) decomposed nutritional change between the two most recent PDHS rounds and attributed the largest shares of improvement to maternal nutritional status and household wealth. Ataullahjan et al. (2025) found that socioeconomic improvement and female-targeted social safety nets accounted for a large part of the subnational variation in stunting reduction between 2011 and 2018. Sriram and Naz (2025) used the dissimilarity index and Shapley decomposition to show that maternal education, the wealth index and water and sanitation were the largest contributors to inequality of opportunity in stunting. Internationally, Wagstaff et al. (2003) pioneered the decomposition of concentration indices for malnutrition in Vietnam, Van de Poel et al. (2008) documented pro-poor concentration of stunting across 47 developing countries and Ijaiya et al. (2024) applied non-linear decomposition to 27 countries and identified maternal education, maternal health behaviour and place of residence as key contributors to income-related gaps.

Women's Nutrition, the Double Burden and Nutrition Inputs

The socioeconomic patterning of adult nutrition differs fundamentally from that of child undernutrition. In lower income countries, overweight and obesity among women are concentrated among wealthier and more educated groups whereas underweight remains concentrated among the poor (Monteiro et al., 2004; Subramanian et al., 2011). As national income rises, the burden of overweight tends to shift towards poorer groups (Jones-Smith et al., 2012), urban-rural differences are largely explained by socioeconomic status (Neuman et al., 2013) and education can modify the wealth-obesity relationship (Aitsi-Selmi et al., 2012). In Pakistan, Di Cesare et al. (2015) documented large provincial and socioeconomic inequalities in women's

underweight and overweight in 2011, Waghmare et al. (2022) found that obesity rose with age and wealth in the PDHS 2012-13 and Naz et al. (2025) identified spatial clustering of thinness in southern regions and of overweight in northern districts of Khyber Pakhtunkhwa using the PDHS 2017-18.

Nutrition inputs are themselves unequally distributed. Optimal breastfeeding and complementary feeding confer large benefits for child survival and development (Rollins et al., 2016; Victora et al., 2016) yet complementary feeding practices in South Asia remain poor (Senarath & Dibley, 2012). Tariqujjaman et al. (2022) reported that Pakistan had the lowest prevalence of early initiation of breastfeeding (20.8%) and of minimum dietary diversity (18.5%) in the region with a wide wealth gap in minimum acceptable diet. Coverage of antenatal and child health interventions (including micronutrient supplementation) is systematically higher among wealthier women in low and middle income countries (Barros et al., 2012) despite evidence that such nutrition-specific interventions are effective and affordable at scale (Bhutta, Das, et al., 2013; Ruel & Alderman, 2013).

Table 1 summarises the principal empirical studies reviewed. Taken together, they show that socioeconomic and regional disparities in nutrition in Pakistan are large and persistent but they measure inequality with different tools, often focus on a single population group and rarely quantify how much each determinant contributes to overall inequality. The present study complements this literature by applying a common concentration-index framework to children, women and nutrition inputs and by decomposing the inequality in stunting.

Table 1: Summary of Key Empirical Studies on Nutritional Status and Inequality

Study	Setting and data	Method	Main findings
Khan et al. (2019)	Pakistan; PDHS 2012-13	Multivariable logistic regression	Wealth, maternal education and maternal nutrition predict all three outcomes; age, sex and birth size predict stunting
Siddiqi et al. (2023)	Pakistan; PDHS 2017-18 (n = 4,226)	Multivariable logistic regression	Age, sex, birth size, maternal education, iron use, wealth, water source and region predict stunting
Burki (2025)	Punjab; MICS 2018 (n = 38,495)	Logistic regression	Poverty, low maternal education, short birth intervals, adolescent motherhood and low birth weight are leading risks
Khaliq et al. (2021)	Pakistan; PDHS 2012-13 and 2017-18	Trend and regression analysis	Coexisting malnutrition fell from 30.6% to 21.5%; higher in Sindh and Balochistan
Rehman et al.	Pakistan; PDHS	Regression-based	Maternal BMI and household

Study	Setting and data	Method	Main findings
(2023)	2012-13 and 2017-18	decomposition	wealth explain the largest share of nutritional improvement
Ataullahjan et al. (2025)	Pakistan; 2011-2018 surveys	Oaxaca–Blinder decomposition; mixed methods	Socioeconomic improvement and safety nets drive subnational stunting reduction
Sriram and Naz (2025)	Pakistan; PDHS 2017-18	Dissimilarity index; Shapley decomposition	Maternal education, wealth and WASH are the largest sources of inequality of opportunity
Di Cesare et al. (2015)	Pakistan; National Nutrition Survey 2011	Spatial and socioeconomic analysis	Large provincial and wealth inequalities in women's and children's nutrition
Waghmare et al. (2022)	Pakistan; PDHS 2012-13	Multinomial and binary logistic regression	Obesity among women rises with age and wealth; child undernutrition concentrated among the poor
Naz et al. (2025)	Pakistan; PDHS 2017-18	Bayesian additive quantile regression	Thinness clusters in southern regions; overweight in northern Khyber Pakhtunkhwa
Tariqujjaman et al. (2022)	Six South Asian countries; DHS	Comparative IYCF analysis	Pakistan has the region's lowest early breastfeeding (20.8%) and dietary diversity (18.5%)
Van de Poel et al. (2008)	47 developing countries; DHS	Concentration indices	Stunting and underweight are concentrated among the poor in almost all countries
Ijaiya et al. (2024)	27 countries; DHS 2015-2020	Fairlie decomposition	Maternal education, health behaviour and residence explain income-related gaps

Note. BMI = body mass index; DHS = Demographic and Health Survey; IYCF = infant and young child feeding; MICS = Multiple Indicator Cluster Survey; PDHS = Pakistan Demographic and Health Survey; WASH = water, sanitation and hygiene.

Data and Methods

Data and Study Samples

The study uses the PDHS 2017-18, a nationally representative household survey implemented by the National Institute of Population Studies with technical assistance from ICF under the Demographic and Health Surveys (DHS) Program (NIPS & ICF, 2019). The survey followed a stratified two-stage cluster design in which enumeration areas were selected with probability proportional to size in the first stage and households were selected systematically in the second. Two recode files were analysed. The individual women's file contains 15,068 interviewed ever-

married women aged 15–49 years and the children's file contains one record for every birth in the five years preceding the survey. The study population covers Punjab, Sindh, Khyber Pakhtunkhwa, Balochistan, Islamabad Capital Territory (ICT) and the former Federally Administered Tribal Areas (FATA), comprising 12,364 women and 10,473 births.

Height and weight were measured in a subsample of households. Five analytic samples were constructed (a) 3,431 living children aged 0–59 months with a valid height-for-age z-score (b) 3,660 ever-married women with a measured BMI, excluding women who were pregnant or had given birth in the preceding two months (c) 2,708 youngest children aged 6–23 months living with their mothers for feeding indicators (d) 3,872 last-born children born in the 24 months before the survey for early initiation of breastfeeding and (e) 6,803 women with a live birth in the preceding five years for iron supplementation during the most recent pregnancy. All estimates are weighted with the women's sample weight and standard errors account for the 16 sampling strata and the clustering of observations within primary sampling units. The weighted prevalences reproduce the published national estimates closely (NIPS & ICF, 2019) which confirms the construction of the variables.

Variables

Child anthropometric indices were computed against the WHO Child Growth Standards (WHO Multicentre Growth Reference Study Group, 2006). Stunting, severe stunting, wasting and underweight were defined as height for age below -2 SD, height-for-age below -3 SD, weight for height below -2 SD and weight for age below -2 SD, respectively and overweight as weight for height above $+2$ SD. Implausible z-scores flagged by the DHS Program were excluded. Women's BMI (kg/m^2) was classified as underweight (< 18.5), normal (18.5 – 24.9), overweight (25.0 – 29.9) and obese (≥ 30.0).

Feeding indicators followed the World Health Organization (2008) definitions as implemented in the Guide to DHS Statistics (Croft et al., 2018). Minimum dietary diversity denotes consumption of at least four of seven food groups on the previous day; minimum meal frequency depends on the child's age and breastfeeding status and minimum acceptable diet combines both criteria, with non-breastfed children additionally required to receive at least two milk feeds. Iron-rich food consumption denotes any meat, organ meat, fish or eggs on the previous day and early initiation of breastfeeding denotes putting the child to the breast within one hour of birth. Adequate antenatal iron supplementation denotes taking iron tablets or syrup for at least 90 days during the most recent pregnancy.

Socioeconomic position was measured with the DHS wealth index, a principal-components score of household assets and dwelling characteristics (Filmer & Pritchett, 2001; Rutstein & Johnson, 2004). The continuous score was used to rank individuals for the concentration indices and its quintiles were used in the regressions. Explanatory variables comprised maternal education (none, primary, middle, secondary, higher), urban residence, region, child age in months, child sex, a preceding birth interval of less than 24 months, small or very small size at birth as reported by the

mother, maternal underweight and delivery in a health facility. Women's models included wealth, education, residence, region, age and parity.

Analytical Strategy

The analysis proceeded in three steps. First, weighted prevalences were estimated by background characteristics. Second, socioeconomic inequality was measured with the concentration curve (CC) and concentration index (CI) (Wagstaff et al., 1989, 1991). The CC plots the cumulative share of the population, ranked from poorest to richest, against the cumulative share of the outcome. A curve above the 45-degree line of equality indicates concentration among the poor and a curve below it concentration among the better-off. The CI equals twice the area between the CC and the line of equality and was computed with the covariance formula (Kakwani et al., 1997):

$$C = (2 / \mu) \text{cov}(h_i, r_i)$$

where h_i is the outcome for individual i , μ its weighted mean and r_i the weighted fractional rank in the wealth distribution. The index ranges from -1 to +1 with negative values indicating pro-poor concentration and positive values pro-rich concentration. Because all outcomes are binary, the attainable range of C depends on the mean (Wagstaff, 2005), the Erreygers (2009) corrected index, $E = 4\mu C$, is therefore also reported. Standard errors and 95% confidence intervals were obtained from a stratified cluster bootstrap with 500 replications.

Third, the CI for stunting was decomposed following Wagstaff et al. (2003) and O'Donnell et al. (2008):

$$C = \sum_k (\beta_k \bar{x}_k / \mu) C_k + GC\varepsilon / \mu$$

where β_k is the average marginal effect of determinant k from the stunting probit model, $\bar{x}_k$ its weighted mean, $\beta_k \bar{x}_k / \mu$ the elasticity of stunting with respect to x_k , and C_k the concentration index of x_k . The product of the elasticity and C_k gives the contribution of each determinant and the residual captures unexplained inequality together with the error of the linear approximation. Bootstrap standard errors (200 replications) were computed for grouped contributions.

The correlates of stunting were estimated with a survey-weighted probit model, $P(\text{stunted}_i = 1) = \Phi(\alpha + \beta_1 \text{WEALTH}_i + \beta_2 \text{EDUC}_i + \beta_3 \text{URBAN}_i + \beta_4 \text{REGION}_i + \beta_5 \text{CHILD}_i + \beta_6 \text{MATERNAL}_i)$, in which child age entered with a quadratic term. Mother's BMI was unavailable for 20.9% of children, mainly because the mother was pregnant or recently delivered; these children were retained with a missing-value indicator. For women, BMI was modelled with ordinary least squares (OLS) and underweight and overweight/obesity with parallel probit models. Results are reported as average marginal effects (AMEs) with discrete changes for binary variables. Standard errors were Taylor-linearised to account for stratification and clustering and delta-method standard errors were used for the AMEs.

Results

Nutritional Status and Its Socioeconomic Distribution

Table 2 presents the nutritional status of children under five by background characteristics. Overall, 37.3% of children were stunted, 17.1% severely stunted, 7.0% wasted, 22.7% underweight and 2.5% overweight. These estimates are close to those in the official survey report (NIPS & ICF, 2019) and confirm that Pakistan's stunting prevalence remains far above the global average of 22.3% (UNICEF et al., 2023). Stunting fell steeply with household wealth, from 56.0% in the poorest quintile to 22.5% in the richest, a gap of 33.5 percentage points. The gradient was steepest in the lower half of the distribution and almost flat between the middle (31.1%) and fourth (30.5%) quintiles. Severe stunting showed an even sharper gradient (34.7% versus 7.7%). Children of mothers without schooling were three times as likely to be stunted as children of mothers with higher education (47.5% versus 15.8%). These gradients agree with earlier PDHS analyses (Khan et al., 2019; Siddiqi et al., 2023) and with the South Asian evidence of Kim et al. (2017).

Regional differences were equally striking. Stunting was highest in FATA (52.4%), Sindh (49.3%) and Balochistan (47.2%) and lowest in ICT (23.5%) and Punjab (29.6%). Acute undernutrition was concentrated in Balochistan where 18.4% of children were wasted and in Sindh, where 11.5% were wasted and 39.0% underweight. The disadvantage of Sindh and Balochistan mirrors the regional pattern reported by Di Cesare et al. (2015) and Khalig et al. (2021). Rural children were more often stunted than urban children (40.3% versus 31.2%), consistent with the urban advantage observed across developing countries (Smith et al., 2005; Van de Poel et al., 2007).

Table 2: Nutritional Status of Children Aged 0–59 Months by Background Characteristics (%)

Characteristic	Stunted	Severely stunted	Wasted	Underweight	Overweight	N
Pakistan (total)	37.3	17.1	7.0	22.7	2.5	3,431
<i>Residence</i>						
Urban	31.2	12.2	6.6	19.1	3.0	1,601
Rural	40.3	19.5	7.2	24.5	2.3	1,830
<i>Wealth quintile</i>						
Lowest	56.0	34.7	9.4	41.0	1.9	736
Second	44.4	19.2	9.3	27.1	2.0	795
Middle	31.1	10.9	4.8	14.7	1.2	622
Fourth	30.5	11.7	7.2	17.5	2.5	653
Highest	22.5	7.7	3.5	11.1	5.4	625
<i>Mother's education</i>						
No education	47.5	24.9	8.7	31.6	1.9	1,884
Primary	38.7	13.4	5.3	19.3	1.5	456
Middle	26.3	9.6	4.4	15.5	2.2	238

Characteristic	Stunted	Severely stunted	Wasted	Underweight	Overweight	N
Secondary	29.1	8.9	6.4	14.1	2.1	390
Higher	15.8	6.8	5.1	8.3	6.2	463
<i>Region</i>						
Punjab	29.6	10.2	3.8	13.8	2.1	902
Sindh	49.3	28.4	11.5	39.0	2.3	779
Khyber Pakhtunkhwa	40.2	18.8	7.5	21.8	3.0	691
Balochistan	47.2	26.3	18.4	38.6	5.3	485
ICT	23.5	6.9	2.8	8.7	2.1	233
FATA	52.4	27.8	5.3	23.1	5.9	341

Note. Weighted percentages; N is the unweighted number of children with a valid height-for-age z-score. Stunted, wasted and underweight: z-score below -2 SD; severely stunted: height-for-age below -3 SD; overweight: weight-for-height above $+2$ SD. Pakistan excludes Azad Jammu and Kashmir and Gilgit-Baltistan. ICT = Islamabad Capital Territory; FATA = former Federally Administered Tribal Areas. Source: Authors' calculations from PDHS 2017-18.

Table 3 reports the distribution of women's BMI. Of ever-married women, 8.5% were underweight, 39.3% had a normal BMI, 30.4% were overweight and 21.8% were obese, giving a mean BMI of 25.7 kg/m². The distribution was sharply polarised by wealth. In the poorest quintile, 21.1% of women were underweight and 23.0% overweight or obese. In the richest quintile, only 3.1% were underweight whereas 72.8% were overweight or obese. This opposing gradient is the signature of the nutrition transition in lower-middle-income settings (Monteiro et al., 2004; Subramanian et al., 2011) and agrees with the rise in obesity with wealth reported for the PDHS 2012-13 (Waghmare et al., 2022). Regionally, Sindh combined the highest underweight (14.9%) with the lowest overweight or obesity (39.5%) whereas ICT (67.6%), FATA (58.3%) and Khyber Pakhtunkhwa (57.4%) had the highest overweight or obesity, a spatial pattern consistent with Naz et al. (2025).

Table 3: Nutritional Status (BMI) of Ever-Married Women Aged 15–49 Years by Background Characteristics (%)

Characteristic	Under-weight	Normal	Over-weight	Obese	Overweight or obese	N
Pakistan (total)	8.5	39.3	30.4	21.8	52.2	3,660
<i>Residence</i>						
Urban	5.5	31.5	37.7	25.3	63.0	1,855
Rural	10.5	44.3	25.7	19.5	45.3	1,805
<i>Wealth quintile</i>						
Lowest	21.1	55.9	15.9	7.1	23.0	652
Second	9.2	50.1	24.8	15.9	40.7	760
Middle	7.3	36.2	33.8	22.7	56.5	680
Fourth	5.0	35.4	33.9	25.8	59.6	709
Highest	3.1	24.2	39.6	33.2	72.8	859
<i>Education</i>						

Characteristic	Under-weight	Normal	Over-weight	Obese	Overweight or obese	N
No education	11.8	45.3	26.5	16.4	42.9	1,967
Primary	6.7	37.9	29.1	26.3	55.4	505
Middle	7.0	30.2	31.2	31.5	62.7	271
Secondary	3.7	33.0	36.6	26.7	63.3	392
Higher	4.3	30.7	39.8	25.2	65.0	525
<i>Region</i>						
Punjab	6.6	37.2	30.7	25.4	56.1	1,010
Sindh	14.9	45.6	26.4	13.1	39.5	861
Khyber Pakhtunkhwa	6.7	35.9	35.1	22.3	57.4	722
Balochistan	5.8	43.2	29.3	21.7	51.0	490
ICT	2.7	29.7	38.5	29.1	67.6	306
FATA	2.9	38.8	33.5	24.8	58.3	271

Note. Weighted percentages. Underweight: BMI < 18.5; normal: 18.5–24.9; overweight: 25.0–29.9; obese: ≥ 30.0 kg/m². Excludes women who were pregnant or had given birth in the preceding two months. Source: Authors' calculations from PDHS 2017–18.

Table 4 describes the nutrition inputs. Only 19.7% of children aged 6–23 months achieved minimum dietary diversity, 57.8% minimum meal frequency and 12.0% a minimum acceptable diet. These levels are close to the regional lows reported by Tariqujjaman et al. (2022) and confirm the poor state of complementary feeding in South Asia (Senarath & Dibley, 2012). The minimum acceptable diet rose from 5.9% in the poorest quintile to 20.6% in the richest and dietary diversity from 8.6% to 33.4%. Early initiation of breastfeeding reached only 19.6% of recent births and ran against the wealth gradient: it was higher in the poorest quintile (23.5%) than in the richest (17.0%) and higher after home births (24.0%) than after facility births (17.8%). Adequate antenatal iron supplementation reached 29.4% of women overall, rising from 17.7% in the poorest to 51.7% in the richest quintile and from 18.9% among women without schooling to 55.8% among those with higher education. This pro-rich pattern in service coverage is typical of maternal and child health interventions in low and middle income countries (Barros et al., 2012).

Table 4: *Infant and Young Child Feeding and Antenatal Iron Supplementation by Background Characteristics (%)*

Characteristic	MDD	MMF	MAD	Iron-rich foods	Early BF	Any iron	Iron days	90+
Pakistan (total)	19.7	57.8	12.0	36.2	19.6	58.5	29.4	
<i>Residence</i>								
Urban	24.1	62.5	14.4	44.2	20.8	66.7	38.7	
Rural	17.5	55.4	10.8	32.1	19.0	54.3	24.8	
<i>Wealth quintile</i>								
Lowest	8.6	46.4	5.9	22.6	23.5	42.5	17.7	
Second	12.1	53.4	7.3	30.6	22.8	48.8	18.8	
Middle	22.3	58.6	13.3	34.9	17.2	55.6	25.9	
Fourth	22.5	64.8	13.2	43.5	17.1	68.4	35.3	
Highest	33.4	66.6	20.6	50.9	17.0	79.4	51.7	

Characteristic	MDD	MMF	MAD	Iron-rich foods	Early BF	Any iron	Iron days	90+
<i>Education</i>								
No education	13.1	52.8	8.3	27.0	21.7	47.1	18.9	
Primary	12.9	55.4	7.5	35.0	18.6	59.6	27.7	
Middle	25.9	62.3	12.9	46.2	20.3	64.0	32.6	
Secondary	34.3	66.1	22.3	48.5	17.1	71.2	40.9	
Higher	30.5	65.7	18.9	48.7	15.1	81.7	55.8	
<i>Region</i>								
Punjab	23.6	55.9	13.8	39.9	12.0	60.3	30.5	
Sindh	14.9	55.8	8.8	31.4	28.3	59.7	33.4	
Khyber Pakhtunkhwa	16.5	64.0	12.1	32.8	18.1	54.3	26.2	
Balochistan	14.0	58.2	7.6	33.4	59.6	49.9	13.7	
ICT	34.3	65.8	21.3	50.3	39.8	78.3	52.1	
FATA	6.9	70.5	6.4	24.2	19.9	47.9	19.7	

Note. Weighted percentages. MDD = minimum dietary diversity; MMF = minimum meal frequency; MAD = minimum acceptable diet; iron-rich foods and MDD-MAD refer to the youngest child aged 6-23 months living with the mother (N = 2,708); early BF = breastfed within one hour of birth, last-born child in the past 24 months (N = 3,872); iron = iron tablets or syrup during the most recent pregnancy in the past five years (N = 6,803). Source: Authors' calculations from PDHS 2017-18.

Concentration Curves and Concentration Indices

The concentration indices in Table 5 summarise these gradients across the entire wealth distribution. All child undernutrition indicators were significantly concentrated among the poor. The CI for stunting was -0.182 (95% CI -0.220 to -0.144); inequality was greater for severe stunting (-0.307) and underweight (-0.266) and smaller for wasting (-0.147). The ordering reflects the chronic, poverty-linked nature of linear growth failure (Prendergast & Humphrey, 2014) compared with the more episodic, illness-driven nature of wasting and the finding that severe forms of undernutrition are more unequally distributed than moderate forms is consistent with Van de Poel et al. (2008). Child overweight was pro-rich (+0.231) but because it was rare its Erreygers index was close to zero (+0.023).

Every nutrition input was concentrated among the better-off: minimum dietary diversity (+0.253), minimum acceptable diet (+0.250), adequate antenatal iron (+0.234) and iron-rich food consumption (+0.161). Early initiation of breastfeeding was the only practice that was mildly pro-poor (-0.082). Among women, underweight was strongly pro-poor (-0.368) whereas overweight or obesity (+0.185) and obesity (+0.243) were pro-rich. Because the attainable range of the standard index depends on the mean of a binary outcome (Wagstaff, 2005), the Erreygers index gives a different ranking in absolute terms. By this measure, women's overweight or obesity (+0.387) was the most unequally distributed outcome and stunting (-0.272) was more unequal than severe stunting (-0.210).

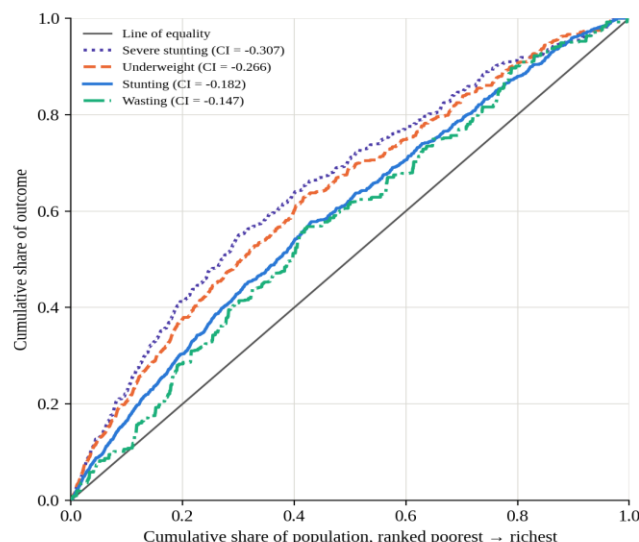
Table 5: Concentration Indices for Nutritional Outcomes and Nutrition Inputs

Indicator	Mean (%)	CI	SE	95% confidence interval	Erreygers index	N
Child stunting (HAZ < -2 SD)	37.3	-0.182	0.019	-0.220 to -0.144	-0.272	3,431
Severe stunting (HAZ < -3 SD)	17.1	-0.307	0.033	-0.372 to -0.242	-0.210	3,431
Child wasting (WHZ < -2 SD)	7.0	-0.147	0.046	-0.238 to -0.056	-0.041	3,442
Child underweight (WAZ < -2 SD)	22.7	-0.266	0.026	-0.318 to -0.214	-0.242	3,547
Child overweight (WHZ > +2 SD)	2.5	+0.231	0.077	+0.079 to +0.383	+0.023	3,442
Minimum dietary diversity (6-23 months)	19.7	+0.253	0.031	+0.192 to +0.315	+0.200	2,708
Minimum acceptable diet (6-23 months)	12.0	+0.250	0.043	+0.165 to +0.335	+0.120	2,708
Iron-rich food consumption (6-23 months)	36.2	+0.161	0.023	+0.116 to +0.205	+0.233	2,708
Early initiation of breastfeeding	19.6	-0.082	0.033	-0.147 to -0.018	-0.064	3,872
Women: underweight (BMI < 18.5)	8.5	-0.368	0.040	-0.446 to -0.291	-0.125	3,660
Women: overweight/obese (BMI ≥ 25)	52.2	+0.185	0.015	+0.157 to +0.214	+0.387	3,660
Women: obese (BMI ≥ 30)	21.8	+0.243	0.023	+0.199 to +0.287	+0.212	3,660
Maternal iron 90+ days in pregnancy	29.4	+0.234	0.023	+0.189 to +0.279	+0.275	6,803

Note. CI = concentration index; SE = standard error. Individuals are ranked by the continuous DHS wealth-index score. Negative values indicate concentration among the poor and positive values concentration among the better-off. Standard errors are from a stratified cluster bootstrap (500 replications). All indices are statistically different from zero ($p < 0.05$). Erreygers index = $4\mu C$. Source: Authors' calculations from PDHS 2017-18.

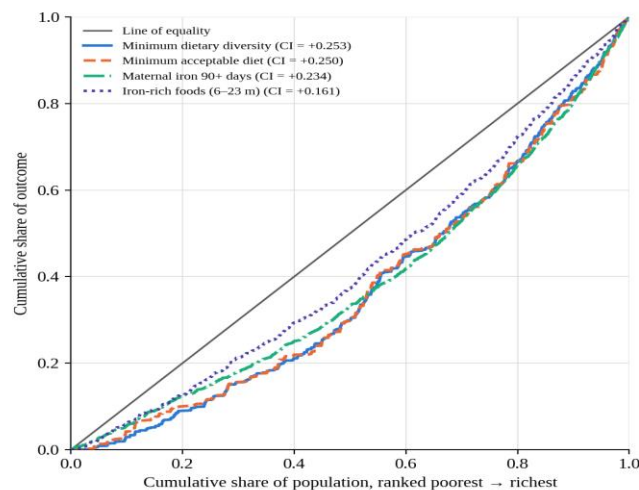
Figures 1-4 display these results graphically. In Figure 1, all four child undernutrition curves lie above the line of equality, and the curves for severe stunting and underweight lie furthest from it. The poorest 20% of children accounted for about 30% of all stunted children and about 40% of all severely stunted children. Figure 2 shows the opposite pattern for nutrition inputs: the curves for dietary diversity, minimum acceptable diet, iron-rich foods and antenatal iron all lie below the diagonal so the richest households receive a disproportionate share of adequate diets and supplementation. Figure 3 captures the double burden among women. The underweight curve lies well above the line of equality and the overweight/obesity curve below it so poor women disproportionately bear undernutrition and better-off women disproportionately bear overnutrition. This divergence agrees with the socioeconomic polarisation documented by Di Cesare et al. (2015) and with the multi-country pattern described by Subramanian et al. (2011). Figure 4 ranks all 13 indices with their confidence intervals and shows that inequality in women's underweight, severe stunting and child underweight is as large as inequality in access to adequate diets.

Figure 1: Concentration Curves for Child Undernutrition Indicators



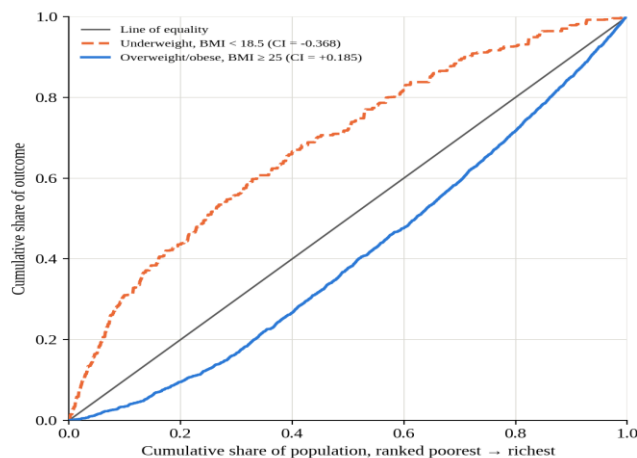
Note. The diagonal is the line of equality. Curves above the diagonal indicate that the outcome is concentrated among poorer children. CI values are shown in the legend. Source: Authors' calculations from PDHS 2017-18.

Figure 2: Concentration Curves for Nutrition Inputs



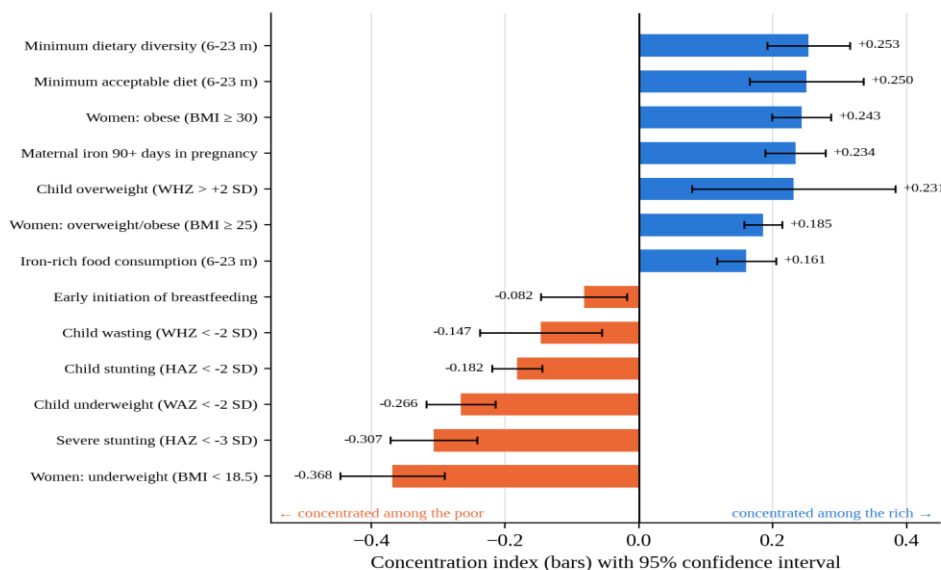
Note. Curves below the diagonal indicate that the input is concentrated among better-off households. Diet indicators refer to children aged 6-23 months; iron supplementation refers to women's most recent pregnancy. Source: Authors' calculations from PDHS 2017-18.

Figure 3: Concentration Curves for Underweight and Overweight or Obesity Among Women



Note. The underweight curve lies above and the overweight/obesity curve below the line of equality, illustrating the double burden of malnutrition. Source: Authors' calculations from PDHS 2017–18.

Figure 4: Concentration Indices With 95% Confidence Intervals for All Indicators



Note. Orange bars indicate concentration among the poor (CI < 0); blue bars indicate concentration among the better-off (CI > 0). Error bars are bootstrap 95% confidence intervals. Source: Authors' calculations from PDHS 2017–18.

Stratifying the indices by place of residence adds a further insight. The CI for stunting was almost identical in urban (-0.170) and rural (-0.174) areas which suggests that wealth-related inequality in child growth operates similarly in both settings. By contrast, the CI for women's overweight or obesity was much flatter among urban women (+0.079) than among rural women (+0.225). This indicates that overnutrition has already spread across the urban wealth distribution, as predicted by the global shift of overweight towards poorer groups (Jones-Smith et al., 2012; Popkin et al., 2020).

Decomposition of Inequality in Child Stunting

Table 6 decomposes the stunting CI (-0.182) into the contributions of its determinants and Figure 5 summarises the grouped contributions. Household wealth accounted for 40.4% of the measured inequality and maternal education for 34.6%. Together, these two factors explained about three-quarters of the pro-poor concentration of stunting. Region contributed a further 15.0%, most of it through Sindh (9.5%) where children are both poorer and at higher risk. Child characteristics contributed 8.3% while urban residence, maternal BMI and facility delivery contributed almost nothing once the other factors were taken into account. The residual was small (1.2%) indicating that the model captures nearly all the measured inequality.

Two features of the decomposition deserve comment. First, the contribution of wealth came mainly from the fourth and richest quintiles which are both protective and heavily concentrated among the rich ($C_k = +0.44$ and $+0.82$). Second, the contribution of education was dominated by higher education (24.9% on its own) reflecting both its strong protective effect and its concentration among wealthier households. The dominant role of wealth agrees with the original decomposition for Vietnam by Wagstaff et al. (2003). The large share of maternal education is consistent with the inequality of opportunity analysis of Sriram and Naz (2025) and with the multi-country evidence of Ijaiya et al. (2024), although these studies use different decomposition methods.

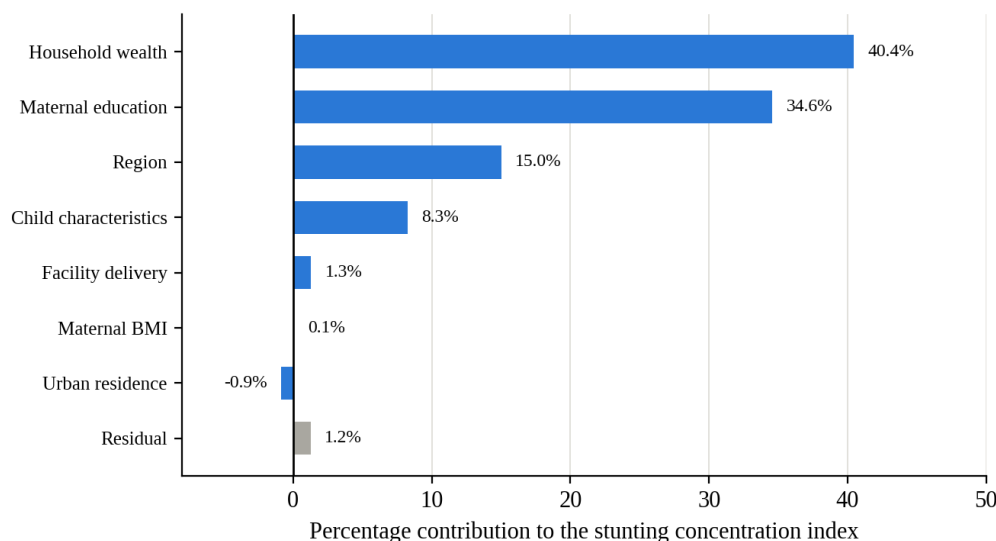
Table 6: *Decomposition of the Concentration Index for Child Stunting*

Determinant	Mean	Marginal effect	Elasticity	C_k	Contribution (SE)	% of CI
<i>Household wealth (ref.: poorest)</i>						
Second quintile	0.208	-0.076	-0.043	-0.379	+0.0162	-8.9
Middle quintile	0.203	-0.151	-0.082	+0.033	-0.0027	15
Fourth quintile	0.201	-0.126	-0.068	+0.437	-0.0296	16.3
Highest quintile	0.181	-0.145	-0.070	+0.819	-0.0574	31.5
Subtotal					-0.0736 (0.0292)	40.4
<i>Maternal education (ref.: none)</i>						
Primary	0.151	-0.003	-0.001	+0.021	-0.0000	0.0
Middle	0.087	-0.107	-0.025	+0.307	-0.0077	4.2
Secondary	0.137	-0.061	-0.022	+0.439	-0.0098	5.4
Higher	0.140	-0.199	-0.075	+0.609	-0.0454	24.9
Subtotal					-0.0630 (0.0154)	34.6
Urban residence	0.329	+0.004	+0.004	+0.438	+0.0016	-0.9

Determinant	Mean	Marginal effect	Elasticity	C _k	Contribution (SE)	% of CI
<i>Region (ref.: Punjab)</i>						
Sindh	0.239	+0.172	+0.110	-0.156	-0.0172	9.5
Khyber Pakhtunkhwa	0.157	+0.071	+0.030	-0.083	-0.0025	1.4
Balochistan	0.050	+0.096	+0.013	-0.290	-0.0037	2.0
ICT	0.006	-0.000	-0.000	+0.534	-0.0000	0.0
FATA	0.024	+0.122	+0.008	-0.497	-0.0039	2.1
Subtotal					-0.0273 (0.0084)	15.0
<i>Child characteristics</i>						
Child age (months)	28.7	+0.004	+0.292	-0.019	-0.0056	3.1
Male child	0.511	+0.022	+0.030	+0.015	+0.0005	-0.2
Birth interval < 24 months	0.246	+0.077	+0.051	-0.076	-0.0039	2.1
Small size at birth	0.175	+0.134	+0.063	-0.096	-0.0061	3.3
Subtotal					-0.0151 (0.0039)	8.3
<i>Maternal BMI</i>						
Mother underweight	0.091	-0.001	-0.000	-0.302	+0.0001	0.0
Mother's BMI not available	0.209	+0.033	+0.018	-0.010	-0.0002	0.1
Subtotal					-0.0001 (0.0029)	0.1
Facility delivery	0.685	-0.008	-0.015	+0.153	-0.0023	1.3
Residual					-0.0023	1.2
Total concentration index					-0.182	100.0

Note. Marginal effects are average marginal effects from the probit model in Table 7. Elasticity = $\beta_k \bar{x}_k / \mu$, with $\mu = 0.373$; contribution = elasticity $\times$ C_k. Bootstrap standard errors for subtotals in parentheses (200 replications). Positive percentages indicate factors that increase the concentration of stunting among the poor. Source: Authors' calculations from PDHS 2017-18.

Figure 5: *Percentage Contributions of Grouped Determinants to the Concentration Index for Child Stunting*



Note. Contributions are from Table 6. The residual is the part of the concentration index not explained by the determinants. Source: Authors' calculations from PDHS 2017-18.

Determinants of Child Stunting and Women's Nutritional Status

Table 7 reports the average marginal effects from the survey-weighted probit model for child stunting ($N = 3,431$; pseudo $R^2 = 0.111$). Each coefficient is interpreted below together with the mechanism that explains its sign.

Household wealth

Household wealth was negatively associated with stunting. Relative to the poorest quintile, the probability of stunting was 7.6 percentage points lower in the second quintile, 15.1 points lower in the middle quintile, 12.6 points lower in the fourth and 14.5 points lower in the richest. The negative sign reflects the ability of wealthier households to purchase diverse and nutrient-dense foods, to live in dwellings with safe water and sanitation and to use preventive and curative health care (Smith & Haddad, 2015; Van de Poel et al., 2008). The flattening of the effect above the middle quintile suggests diminishing marginal returns once basic food security and hygiene needs are met in line with the South Asian evidence that the steepest gains occur at the bottom of the wealth distribution (Kim et al., 2017; Krishna et al., 2018).

Maternal education

Maternal education was also negatively associated with stunting but the effect was concentrated at higher levels. Children of mothers with middle schooling were 10.7 percentage points and those of mothers with higher education 19.9 points less likely to be stunted than children of mothers without schooling whereas primary and secondary education were not significant. Educated mothers are more likely to understand the value of appropriate feeding, hygiene and timely health care, to have greater decision-making power within the household and to use health services (Frost et al., 2005; Glewwe, 1999; Thomas et al., 1991). The stronger effect at higher levels agrees with the evidence that the nutritional returns to parental education increase with the level of schooling (Alderman & Headey, 2017).

Urban residence

Urban residence had a small positive but insignificant coefficient (+0.004). The absence of an independent urban effect indicates that the urban advantage shown in Table 2 is explained mainly by the higher wealth and education of urban households, a finding reported across many developing countries (Fotso, 2007; Smith et al., 2005; Van de Poel et al., 2007).

Region

Region had positive and significant coefficients for Sindh (17.2 percentage points), FATA (12.2), Balochistan (9.6) and Khyber Pakhtunkhwa (7.1) relative to Punjab, whereas ICT did not differ significantly from Punjab. The positive signs capture structural disadvantages beyond household characteristics including food insecurity, poor water and sanitation infrastructure and weaker health services in these regions (Bhutta, Hafeez, et al., 2013; Di Cesare et al., 2015). Similar regional excesses for Sindh and Balochistan were reported by Siddiqi et al. (2023) and Khalig et al. (2021).

Child age

Child age was positively associated with stunting (an average increase of 0.4 percentage points per month). The positive sign reflects the cumulative nature of linear growth faltering which begins in utero and accelerates between 6 and 24 months as breast milk alone becomes insufficient and exposure to infection increases (Prendergast & Humphrey, 2014; Victora et al., 2010).

Male sex

Male sex had a positive but insignificant coefficient (+0.022). The direction is consistent with the greater biological vulnerability of boys to undernutrition documented in meta-analyses (Thurstans et al., 2020; Wamani et al., 2007) and in Pakistan (Khan et al., 2019), although in Pakistan this biological disadvantage may be offset by son preference in feeding and care.

A preceding birth interval of less than 24 months

A preceding birth interval of less than 24 months raised the probability of stunting by 7.7 percentage points. Short intervals deplete maternal nutritional reserves, shorten the duration of breastfeeding for the older child and increase competition among siblings for care and household resources (Dewey & Cohen, 2007; Rutstein, 2005); Burki (2025) likewise identified short birth intervals as a leading risk factor in Punjab.

Small size at birth

Small size at birth raised the probability of stunting by 13.4 percentage points, the largest effect among child characteristics. Fetal growth restriction and preterm birth are among the leading global risk factors for stunting because children who are born small rarely achieve full catch-up growth (Danaei et al., 2016; Prendergast & Humphrey, 2014) and Siddiga et al. (2023) found the same association in Pakistan.

Maternal underweight

Maternal underweight showed no association with stunting (-0.001) and the indicator for missing maternal BMI was also insignificant. This null result suggests that the effect of current maternal thinness operates largely through household wealth and regional disadvantage which are already controlled for. Siddiga et al. (2023) likewise found no significant association between maternal BMI and stunting in the same survey and Khan et al. (2019) found maternal underweight to be associated with underweight and wasting but not with stunting and multi-country evidence indicates that maternal stature (a marker of the mother's own early-life nutrition) is a stronger predictor of child stunting than current BMI (Özaltin et al., 2010).

Facility delivery

Facility delivery had a small negative but insignificant coefficient (-0.008) implying that institutional birth which is strongly correlated with wealth and education, does not by itself protect against stunting once these factors are held constant; the coverage of maternal health services in low and middle income countries is itself strongly patterned by wealth (Barros et al., 2012).

Table 7: *Probit Model of Child Stunting: Average Marginal Effects*

Variable	AME	SE	p value
<i>Household wealth (ref.: poorest)</i>			
Second quintile	-0.076**	(0.036)	0.032
Middle quintile	-0.151***	(0.042)	< 0.001
Fourth quintile	-0.126***	(0.048)	0.009
Highest quintile	-0.145**	(0.058)	0.012

Variable	AME	SE	p value
<i>Mother's education (ref.: none)</i>			
Primary	-0.003	(0.032)	0.937
Middle	-0.107**	(0.045)	0.017
Secondary	-0.061	(0.039)	0.123
Higher	-0.199***	(0.036)	< 0.001
<i>Residence</i>			
Urban	+0.004	(0.030)	0.888
<i>Region (ref.: Punjab)</i>			
Sindh	+0.172***	(0.030)	< 0.001
Khyber Pakhtunkhwa	+0.071**	(0.031)	0.023
Balochistan	+0.096***	(0.037)	0.009
ICT	-0.000	(0.043)	0.995
FATA	+0.122**	(0.060)	0.043
<i>Child characteristics</i>			
Age (months)	+0.004***	(0.001)	< 0.001
Male	+0.022	(0.021)	0.303
Birth interval < 24 months	+0.077***	(0.022)	< 0.001
Small size at birth	+0.134***	(0.030)	< 0.001
<i>Maternal and delivery characteristics</i>			
Mother underweight (BMI < 18.5)	-0.001	(0.040)	0.986
Mother's BMI not available	+0.033	(0.027)	0.226
Facility delivery	-0.008	(0.024)	0.732
Pseudo R ²	0.111		
Observations	3,431		

Note. AME = average marginal effect (discrete change for binary variables; for age, the average derivative including the quadratic term). Estimates are survey-weighted, with Taylor-linearised standard errors (SE) that account for strata and clusters. *** p < 0.01; ** p < 0.05; * p < 0.10. Source: Authors' calculations from PDHS 2017-18.

Table 8 presents the models for women's nutritional status (N = 3,660). The OLS model for BMI explained 20.3% of the variation and the probit models for underweight and overweight/obesity had pseudo R² values of 0.119 and 0.140. The sign of each association is interpreted below.

Household wealth

Household wealth was positively associated with BMI and overweight/obesity and negatively associated with underweight. Women in the richest quintile had a BMI 5.15 kg/m² higher than women in the poorest quintile were 12.4 percentage points less likely to be underweight and 41.2 points more likely to be overweight or obese. Wealth relieves food insecurity which explains the negative effect on underweight but it also increases access to energy-dense processed foods and

labour-saving technologies and reduces occupational physical activity which explains the positive effect on overweight (Monteiro et al., 2004; Popkin et al., 2012; Subramanian et al., 2011). These opposite signs are the regression counterpart of the divergent concentration curves in Figure 3.

Education

Education was positively associated with overweight/obesity: primary, middle, secondary and higher education raised the probability of overweight by 6.7, 8.7, 9.3 and 7.4 percentage points, respectively. Its association with underweight was negative but significant only for secondary education (-0.041). In lower-income settings, education is a marker of higher socioeconomic status and more sedentary occupations and is therefore positively associated with overweight among women (Monteiro et al., 2004). The smaller effect for higher than for secondary education is consistent with the finding that education can moderate the wealth-obesity relationship through greater health literacy (Aitsi-Selmi et al., 2012).

Urban residence

Urban residence was not significant in any model once wealth was controlled for confirming that the urban-rural difference in women's BMI is largely a socioeconomic difference (Neuman et al., 2013).

Region

Region had marked effects. Women in Sindh had a lower BMI (-1.40 kg/m²) and a 4.7 percentage-point higher probability of underweight than comparable women in Punjab reflecting the province's high levels of poverty and food insecurity (Di Cesare et al., 2015). By contrast, women in FATA (+2.79), Balochistan (+1.37) and Khyber Pakhtunkhwa (+1.35) had higher BMI and women in FATA and Balochistan were less likely to be underweight. This is consistent with the clustering of overweight in northern Khyber Pakhtunkhwa reported by Naz et al. (2025) and may reflect regional differences in diet and in women's physical mobility.

Age

Age was positively associated with BMI (+0.145 kg/m² per year) and overweight and negatively with underweight, reflecting the gradual accumulation of weight and the decline in physical activity across adulthood (NCD Risk Factor Collaboration, 2024).

Parity

Parity was positively associated with BMI and overweight, as each pregnancy can leave retained weight particularly in wealthier settings (Kim et al., 2007).

Table 8: *OLS and Probit Models of Women's BMI and Nutritional Status*

Variable	OLS: BMI	Probit underweight	AME: Probit overweight/obese
<i>Household wealth (ref.: poorest)</i>			
Second quintile	+2.08*** (0.40)	-0.079*** (0.022)	+0.147*** (0.039)
Middle quintile	+3.44*** (0.43)	-0.092*** (0.026)	+0.290*** (0.039)
Fourth quintile	+4.07*** (0.48)	-0.112*** (0.028)	+0.308*** (0.046)
Highest quintile	+5.15*** (0.58)	-0.124*** (0.028)	+0.412*** (0.049)
<i>Education (ref.: none)</i>			
Primary	+0.99*** (0.36)	-0.022 (0.016)	+0.067** (0.030)
Middle	+1.09* (0.57)	-0.002 (0.027)	+0.087** (0.041)
Secondary	+1.38*** (0.51)	-0.041** (0.019)	+0.093** (0.037)
Higher	+0.57 (0.46)	-0.027 (0.022)	+0.074* (0.040)
<i>Residence</i>			
Urban	+0.18 (0.36)	-0.003 (0.012)	+0.045 (0.030)
<i>Region (ref.: Punjab)</i>			
Sindh	-1.40*** (0.34)	+0.047*** (0.016)	-0.101*** (0.031)
Khyber Pakhtunkhwa	+1.35*** (0.40)	-0.023 (0.019)	+0.106*** (0.033)
Balochistan	+1.37*** (0.45)	-0.043*** (0.015)	+0.090** (0.040)
ICT	+0.32 (0.48)	-0.022 (0.022)	+0.009 (0.039)
FATA	+2.79*** (0.54)	-0.069*** (0.014)	+0.234*** (0.042)
<i>Demographic</i>			
Age (years)	+0.145*** (0.017)	-0.003*** (0.001)	+0.010*** (0.002)
Parity	+0.105* (0.055)	-0.003 (0.003)	+0.014*** (0.005)
R ² / pseudo R ²	0.203	0.119	0.140
Observations	3,660	3,660	3,660

Note. OLS coefficients are in kg/m²; probit columns report average marginal effects on the probability scale. Standard errors in parentheses are survey-weighted and Taylor-linearised. The sample excludes pregnant women and women within two months of delivery. *** p < 0.01; ** p < 0.05; * p < 0.10. Source: Authors' calculations from PDHS 2017-18.

Discussion

This study provides a comprehensive, microdata-based assessment of socioeconomic inequality in the nutritional status of children and women in Pakistan. Three principal findings emerge. First, child undernutrition is heavily concentrated among the poor with the greatest inequality in its most severe forms. Second, the double burden among women runs in opposite directions: underweight is concentrated among poor women and overweight among better-off women. Third, household wealth and maternal education together account for about three-quarters of the inequality in child stunting and region accounts for most of the remainder.

The pro-poor concentration of stunting ($CI = -0.182$) is consistent with the evidence for developing countries generally (Van de Poel et al., 2008) and for South Asia in particular (Krishna et al., 2018). Its persistence despite a decade of modest national progress (Ataullahjan et al., 2025) suggests that improvements have not reached the poorest households proportionately. The decomposition shows that this inequality arises mainly because wealth and maternal education are both protective and unequally distributed. The large contribution of maternal education agrees with the inequality of opportunity analysis of Sriram and Naz (2025) and with the substantial nutritional returns to schooling documented by Alderman and Headey (2017). In the present decomposition, however, wealth contributes slightly more than education. This difference may reflect methodology: concentration-index decomposition attributes to wealth the component of inequality that runs through the ranking variable whereas Shapley decomposition of the dissimilarity index distributes shared variance differently across circumstances.

The regression results refine this picture in two ways. First, the protective effect of wealth is largest when households move out of the two poorest quintiles so policies that raise the living standards of the bottom 40% are likely to yield the greatest reductions in stunting. Second, current maternal underweight is not independently associated with stunting once household resources are controlled for which agrees with Siddiga et al. (2023). The proximate factors that do remain significant are small size at birth and short birth intervals which point to intrauterine growth and birth spacing as key pathways. This is consistent with global comparative risk assessments (Danaei et al., 2016) and with the evidence on birth spacing (Dewey & Cohen, 2007; Rutstein, 2005). The persistence of regional effects for Sindh, FATA, Balochistan and Khyber Pakhtunkhwa after adjustment indicates that community-level and institutional factors, such as sanitation infrastructure and the reach of health services, shape nutrition beyond household characteristics (Bhutta, Hafeez, et al., 2013; Di Cesare et al., 2015).

The divergent concentration curves for women's underweight and overweight illustrate Pakistan's position in the nutrition transition (Popkin et al., 2012; Popkin et al., 2020). The gap in overweight or obesity between the richest and poorest quintiles (49.8 percentage points) is very large. The much flatter overweight curve among urban women, however, suggests that overnutrition is already spreading across the urban wealth distribution and may soon do so in rural areas as observed in other low and middle income countries (Jones-Smith et al., 2012). Because the double burden intensifies as national income rises from low to middle levels (Seenivasan et al., 2023), policies that address undernutrition among the poor must be designed so as not to aggravate overnutrition among the better-off (Wells et al., 2020).

The analysis of nutrition inputs identifies specific points of intervention. Only 12.0% of young children receive a minimum acceptable diet and dietary adequacy is strongly concentrated among the better-off in agreement with the regional evidence of Tariqujjaman et al. (2022). Early initiation of breastfeeding shows the reverse pattern: it is slightly pro-poor and lower after facility births. Because facility births are concentrated among wealthier and better-educated women and caesarean delivery is known to delay the initiation of breastfeeding (Prior et al., 2012), current

practices in maternity facilities appear to be eroding a benefit that home births preserve. Improving breastfeeding support in facilities therefore offers an equity-neutral opportunity with substantial returns for child health (Rollins et al., 2016; Victora et al., 2016). The pro-rich distribution of antenatal iron supplementation mirrors the broader inequity in maternal health service coverage (Barros et al., 2012) and points to the potential of community-based delivery.

The study has several limitations. The data are cross-sectional so the regression and decomposition results describe associations rather than causal effects. Child anthropometry was drawn from the children's recode file (children of interviewed mothers) rather than the household member file used for the official tables which explains small differences from published figures. Anthropometry was collected in a subsample of households which limits precision for smaller regions such as ICT and FATA. The decomposition relies on a linear approximation to a non-linear model. The wealth index measures relative asset ownership rather than income or consumption (Filmer & Pritchett, 2001; Rutstein & Johnson, 2004). Feeding indicators rely on maternal recall of the previous day. Finally, Azad Jammu and Kashmir and Gilgit-Baltistan were excluded in line with the national survey estimates. Despite these limitations, the study benefits from a large nationally representative sample standardised measurement, and design-based inference throughout.

Conclusion and Policy Implications

This study demonstrates that nutritional inequality in Pakistan is steep, multidimensional and socioeconomically structured. Child undernutrition and the lack of adequate diets and antenatal supplementation are concentrated among the poor. Women's nutritional status is polarized with underweight among poorer women and overweight among the better-off. Household wealth and maternal education account for about three-quarters of the inequality in child stunting and region, birth spacing and birth size are further independent determinants.

These findings carry several implications for policy. First, social protection should be targeted at the poorest 40% of households where the marginal protective effect of wealth is greatest. Nutrition-sensitive cash transfers such as those channelled through the Benazir Income Support Programme should be prioritised in rural Sindh, Balochistan and the former FATA (Ataullahjan et al., 2025; Ruel & Alderman, 2013). Second, keeping girls in school beyond the primary level is a long-term but high-return investment, given the strong protective effect of higher maternal education (Alderman & Headey, 2017). Third, family planning services that promote adequate birth spacing, and antenatal interventions that improve fetal growth should be integrated into the Lady Health Worker programme and routine maternal care (Bhutta, Das, et al., 2013; Dewey & Cohen, 2007). Fourth, breastfeeding support in maternity facilities should be strengthened so that institutional delivery does not delay the initiation of breastfeeding (Rollins et al., 2016). Fifth, complementary feeding counselling, home fortification and free, community-based iron supplementation should be delivered preferentially to the two poorest quintiles. Finally, nutrition policy should address the double burden in an integrated manner, combining food security for

poor households with measures to improve the food environment and promote physical activity among better-off and urban women (Popkin et al., 2020; World Health Organization, 2017).

Future research should use repeated survey rounds to track changes in these concentration indices over time, incorporate maternal height and water and sanitation variables into the decomposition and use district-level data to identify the geographic hotspots where inequality-reducing interventions would be most effective.

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