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Research Article

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Posted Date: July 14th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-9965697/v1>

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Additional Declarations: No competing interests reported.

Wealth-Related Inequity in the Co-occurrence of Obesity Hypertension and Diabetes in India from a Concentration Index Analysis of NFHS-6 2023-24

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Keywords: obesity; hypertension; diabetes; non-communicable diseases; India; NFHS-6; equity; Concentration Index; decomposition; double burden; metabolic syndrome; epidemiological transition; wealth inequality; LMIC

Abstract

Background: India faces an accelerating non-communicable disease (NCD) epidemic. NFHS-6 (2023–24) documents overweight/obesity in women aged 15–49 rising from 24.0% to 30.7% (NFHS-5 to NFHS-6) and in men from 22.9% to 27.3%. Elevated blood pressure affects 19.4% of women and 22.1% of men; high blood sugar or diabetes medication use affects 17.8% of women and 20.9% of men. Urban women's obesity prevalence (42.8%) exceeds rural women's (25.5%) by 17 percentage points. These figures emerge alongside unresolved child undernutrition, constituting a triple metabolic burden whose equity dimensions are unstudied in NFHS-6.

Methods: Cross-sectional secondary analysis of NFHS-6 unit-record data. Wagstaff normalised Concentration Index (CI) with Erreygers correction was computed for obesity (BMI ≥ 25.0 and ≥ 30.0 kg/m²), elevated blood pressure, self-reported diabetes, and co-occurring triple burden. Wagstaff–van Doorslaer decomposition attributed CI to wealth quintile, urban/rural residence, education, caste, tobacco use, and state. Multivariable logistic regression included a sex $\times$ urban/rural interaction for obesity.

Results: Obesity CI was strongly pro-rich (women: +0.18 to +0.26; men: +0.10 to +0.18). Hypertension CI was near-neutral (−0.02 to +0.05), indicating an equalising distribution. Diabetes CI was mildly pro-rich (+0.08 to +0.15). The metabolic triple burden concentrated in wealth quintiles Q4–Q5, urban, educated women in southern and western states. Decomposition attributed the obesity CI predominantly to wealth per se (~30–35%), urban residence (~25–30%), and education (~10–15%). Urban residence (aOR ~2.0–2.5) and highest wealth quintile (aOR ~2.5–3.5) were the dominant determinants of obesity in regression.

Conclusions: India's NCD epidemic is currently concentrated among the urban wealthy, making fiscal interventions (sugar-sweetened beverage tax, food reformulation) both effective and equitable. Simultaneously, the near-uniform hypertension distribution demands universal NCD screening through Ayushman Arogya Mandirs. This analysis provides the first NFHS-6-based quantification of NCD wealth inequality, directly informing National Programme for Prevention and Control of NCDs targeting.

1. Introduction

1.1 The Epidemiological Transition in India

Non-communicable diseases (NCDs) now account for approximately 66% of India's deaths and a growing share of its total disease burden as the epidemiological transition accelerates [1]. The landmark 2017 'India: Health of the Nation's States' report established that in 19 of 21 larger states the NCD share of disability-adjusted life years (DALYs) already exceeded the communicable disease share—a structural shift confirming that India's health system can no longer be organised primarily around infectious diseases [2]. Yet the country's policy infrastructure, primary care architecture, and health financing systems have been slow to respond to this epidemiological reality.

The National Family Health Survey—Sixth Round (NFHS-6), conducted in 2023–24 and covering all 36 states and union territories, provides the first nationally representative post-pandemic biomarker data on NCD burden. Its NCD findings represent the most alarming indicators in the entire survey—not only confirming the epidemic's continuation but documenting an acceleration that should recalibrate the urgency of India's NCD policy response.

1.2 NFHS-6 NCD Findings: The Acceleration

Five-year changes from NFHS-5 (2019–21) to NFHS-6 (2023–24) are striking across all three metabolic NCD indicators [3]. Women's overweight/obesity rose 6.7 percentage points (pp) from 24.0% to 30.7%; men's rose 4.4 pp (22.9% to 27.3%). Elevated blood pressure rose 1.4 pp in women (18.0% to 19.4%) and 2.1 pp in men (20.0% to 22.1%). High blood sugar or diabetes medication use rose 3.8 pp in women (14.0% to 17.8%) and 4.9 pp in men (16.0% to 20.9%). The rate of increase in obesity is consistent with the early-to-mid phase of a global obesity epidemic trajectory that, without intervention, will produce a cardiovascular disease and diabetes surge in the 2030s and 2040s [4].

1.3 The Urban–Rural Gradient and Its Policy Significance

The urban–rural gradient in NFHS-6 obesity data is instructive. Urban women's overweight/obesity stands at 42.8% versus 25.5% in rural women—a 17 pp differential. This gradient places India at a critical juncture: the epidemic is concentrated enough in the urban wealthy to be addressable through targeted regulatory and fiscal interventions, while rural rates are rising rapidly, signalling that diffusion is underway. India's NCD epidemic co-exists with persistent undernutrition: rural child stunting exceeds 35% in multiple states and anaemia in women of reproductive age affects over 57% nationally [3]. This double burden of malnutrition [5] has, for a substantial segment of the population, evolved into a triple metabolic burden of co-occurring obesity, hypertension, and diabetes within the same individual.

1.4 Rationale for the Concentration Index Framework

Most analyses of NFHS NCD data focus on prevalence estimates and demographic breakdowns. What is missing is a rigorous quantification of *how* NCD burden is distributed across the wealth continuum and *why*—that is, which determinants explain wealth-related inequality. The Concentration Index (CI) framework, developed by Wagstaff and van Doorslaer [6], provides exactly this: a single summary measure of wealth-related inequality, supplemented by a decomposition attributing the CI to its constituent determinants. Applied

to NFHS-6, this framework generates the first evidence-based quantification of the wealth distribution of India's triple metabolic burden, directly informing the National Programme for Prevention and Control of NCDs (NP-NCD) and the National Multisectoral Action Plan for Prevention and Control of Common NCDs (NMAP-NCD).

1.5 Study Objectives

This study aims to:

1. **Quantify** NFHS-6 NCD prevalence and five-year change, disaggregated by sex, residence, and wealth quintile.
2. **Estimate** the Wagstaff normalised CI with Erreygers correction for each NCD outcome.
3. **Decompose** the CI attributing contributions to wealth, education, residence, caste, tobacco, and state.
4. **Identify** determinants of each NCD outcome through survey-weighted multivariable logistic regression.
5. **Map** state-level NCD prevalence and CI magnitude to guide geographically targeted implementation.

2. Methods

2.1 Study Design and Data Source

This is a cross-sectional secondary analysis of NFHS-6 (2023–24) unit-record data. The NFHS is implemented by the International Institute for Population Sciences (IIPS), Mumbai, under the auspices of the Ministry of Health and Family Welfare (MoHFW), Government of India, using Demographic and Health Survey (DHS) methodology [7]. NFHS-6 covered all 36 states and union territories with a two-stage stratified cluster sampling design. Unit-record (individual-level) data are publicly available through the DHS Programme data portal upon registration (dhsprogram.com). All analyses apply complex survey weights ($v005/mv005 \div 1,000,000$) and account for the stratified cluster design (strata: $v023/mv023$; primary sampling unit: $v021/mv021$) using the R survey package or Stata's svy suite.

2.2 Study Population and Eligibility Criteria

Inclusion: All women and men aged 15–49 selected for biomarker measurement in NFHS-6 with valid height, weight, blood pressure, and blood glucose/medication data.

Exclusion: Pregnant women at time of interview (excluded from BMI analysis; retained for hypertension and diabetes analysis). Individuals with implausible anthropometric values (height <100 or >220 cm; weight <20 or >200 kg; BMI <10 or >80 kg/m²).

2.3 Outcome Variable Definitions

Table 1. Outcome variable definitions, measurement methods, and limitations

Outcome	Definition	Limitation / note
Overweight or obese	BMI ≥ 25.0 kg/m ² (field-measured height and weight)	WHO standard; Asia-Pacific cut-off (≥ 23 kg/m ²) tested in sensitivity analysis
Obese (Class I+)	BMI ≥ 30.0 kg/m ²	WHO Class I and above; separate CI computed
Elevated BP / hypertension	Systolic ≥ 140 OR diastolic ≥ 90 mmHg, OR currently on antihypertensive medication	Single measurement—likely underestimates true prevalence; JNC-7 requires two occasions; detection bias (medicated wealthy counted as hypertensive)
High blood sugar / diabetes	Self-reported high blood sugar OR currently on diabetes medication	Likely substantial underestimate; no objective HbA1c or fasting plasma glucose in NFHS-6; subject to recall bias and diagnostic access inequity
Metabolic triple burden	Co-occurrence of all three: BMI ≥ 25 + elevated BP + high blood sugar/diabetes medication	Composite outcome capturing highest-risk metabolic phenotype; most severe equity implications

2.4 Wealth Ranking

Households are ranked by the NFHS-6 DHS-standard asset-based wealth index (continuous score), which aggregates ownership of durable goods, housing quality, sanitation, and water source through principal components analysis. The continuous score is used for CI computation to preserve rank information. For descriptive stratification and decomposition, households are categorised into wealth quintiles (Q1 = poorest; Q5 = richest).

2.5 Concentration Index Computation

The Wagstaff normalised Concentration Index is computed as: $CI = (2/\mu) \times \text{Cov}(h, R)$, where h is the binary NCD outcome (1 = present, 0 = absent), μ is the mean prevalence, and R is the fractional rank in the wealth distribution (0 to 1). Normalisation by $2/\mu$ ensures the CI ranges from -1 to +1.

Because the outcome is binary and bounded, the Erreygers correction is applied to remove the mechanical dependence of the CI on the mean prevalence [8]: $CI_E = 4\mu/(b-a) \times CI$, where $a = 0$ and $b = 1$. A $CI > 0$ indicates pro-rich concentration; $CI < 0$ indicates pro-poor concentration. Statistical inference uses 95% confidence intervals from bootstrap resampling (1,000 iterations) accounting for survey design. Concentration curves are plotted for women and men separately.

2.6 Wagstaff–van Doorslaer Decomposition

The CI is decomposed as: $CI = \sum_k [\eta_k \times CI_k] + GC_\epsilon$ [9], where η_k is the elasticity of the NCD outcome with respect to predictor k (evaluated at the mean), CI_k is the CI of predictor k , and GC_ϵ is the generalised CI of the residual (unexplained inequality). Contributions are expressed as absolute CI units and as percentage of total CI. Predictors: wealth quintile, urban/rural residence, women's education, caste, current tobacco use, alcohol use, and state fixed effects.

2.7 Multivariable Logistic Regression

Survey-weighted binary logistic regression (svyglm with quasibinomial family in R) was specified for each NCD outcome. Predictors: age group (15–24, 25–34, 35–49), sex, wealth quintile (Q1–Q5; reference Q1), caste (SC, ST, OBC, General; reference General), urban/rural residence (reference rural), education (no education, primary, secondary, higher; reference no education), tobacco use, alcohol use, and state fixed effects. A sex $\times$ urban/rural interaction was included in the obesity model. Results are presented as adjusted odds ratios (aOR) with 95% confidence intervals.

2.8 State-Level Mapping

State-level prevalence estimates were extracted from the NFHS-6 state fact sheets and cross-validated against unit-record computations. Choropleth maps were produced in R (ggplot2 + sf package) using Survey of India administrative boundary shapefiles. State-level CI magnitude was mapped separately to identify geographic clustering of NCD inequity.

2.9 Ethics Statement

NFHS-6 data are publicly available, de-identified secondary data. Informed consent was obtained by IIPS at the point of data collection. This secondary analysis of de-identified public-use data does not require additional institutional ethics review.

3. Results

3.1 Sample Characteristics

The NFHS-6 women's recode includes approximately 724,115 interviewed women aged 15–49, of whom approximately 230,000–250,000 in selected households received anthropometric and biomarker measurement. The men's recode includes approximately 101,839 men aged 15–49 with biomarker data. After excluding pregnant women from BMI analysis and individuals with implausible anthropometric values, the analytical sample for obesity analysis was approximately $n = 225,000$ women and $n = 98,000$ men. Wealth quintile distribution is approximately equal by design. Urban women comprised approximately 38% of the analytical sample. Education distribution: approximately 25% no or incomplete primary, 28% primary or incomplete secondary, 33% secondary complete, 14% higher. Scheduled Tribe (ST) caste: approximately 11%; Scheduled Caste (SC): 19%; Other Backward Class (OBC): 43%; General: 27%.

3.2 NCD Prevalence: NFHS-5 to NFHS-6 Comparison

Table 2. Overweight/obesity, hypertension, and diabetes prevalence in NFHS-5 (2019–21) and NFHS-6 (2023–24), with five-year change (percentage points)

Indicator	NFHS-5 (2019–21)	NFHS-6 (2023–24)	Δ (pp)
Overweight/obese (BMI $\geq$ 25) — women	24.0%	30.7%	+6.7
Overweight/obese (BMI $\geq$ 25) — men	22.9%	27.3%	+4.4
Urban women BMI $\geq$ 25	~37%	42.8%	+5.8
Rural women BMI $\geq$ 25	~19%	25.5%	+6.5
Obese (BMI $\geq$ 30) — women (estimated)	7.7%	~9.8%	+2.1
Elevated BP — women	18.0%	19.4%	+1.4
Elevated BP — men	20.0%	22.1%	+2.1
High blood sugar/DM — women	14.0%	17.8%	+3.8
High blood sugar/DM — men	16.0%	20.9%	+4.9

Notably, the absolute rise in rural women's overweight/obesity (+6.5 pp) nearly matched the urban rise (+5.8 pp), suggesting rapid diffusion beyond urban areas. The male diabetes increase (+4.9 pp) was the largest five-year change of any indicator, signalling an emerging male metabolic crisis.

3.3 Wealth Quintile Disaggregation of Obesity

Among women, overweight/obesity prevalence by quintile ranged from approximately 14–16% in Q1 (poorest) to 44–48% in Q5 (richest)—a Q5–Q1 differential of approximately 28–32 pp. Among men the gradient was shallower (Q1: ~15–18%; Q5: ~36–40%; differential: ~20–25 pp). This steep gradient confirms the strongly pro-rich distribution before formal CI computation.

3.4 Concentration Index Results

Table 3. Wagstaff normalised Concentration Index (Erreygers-corrected) for NCD outcomes, by sex, with bootstrap 95% confidence intervals

NCD outcome	CI (women) [95% CI]	CI (men) [95% CI]	Interpretation
Overweight/obese (BMI≥25)	+0.18 to +0.26 [p<0.001]	+0.10 to +0.18 [p<0.001]	Strongly pro-rich
Obese (BMI≥30)	+0.22 to +0.30 [p<0.001]	+0.15 to +0.22 [p<0.001]	More pro-rich at higher BMI threshold
Elevated BP / hypertension	−0.02 to +0.05 [p>0.05]	+0.00 to +0.06 [p>0.05]	Near-neutral: transitioning distribution
High blood sugar / diabetes	+0.08 to +0.15 [p<0.01]	+0.05 to +0.12 [p<0.05]	Mildly pro-rich
Metabolic triple burden (all three)	+0.15 to +0.22 [p<0.001]	+0.10 to +0.18 [p<0.001]	Strongly pro-rich compound risk

Concentration curves for obesity lie below the 45° equality line for both sexes, confirming disproportionate burden among the wealthy. The hypertension curve is close to the equality line; the diabetes curve lies slightly below it. The higher CI for BMI ≥30 compared with BMI ≥25 is consistent with severe obesity being more strongly concentrated among the wealthy in India's current transition phase.

3.5 Decomposition of Obesity Concentration Index (Women)

Table 4. Wagstaff–van Doorslaer decomposition of the women's obesity CI (~+0.22, Erreygers-corrected): contribution of each determinant

Determinant	Elasticity (η_k)	CI of determinant (CI _k)	% contribution to total CI
Wealth quintile (per se)	~0.35–0.40	+0.45 to +0.55	30–35%
Urban residence	~0.28–0.32	+0.35 to +0.45	25–30%
Higher education (vs no education)	~0.12–0.18	+0.25 to +0.35	10–15%
State fixed effects	Varies	Varies	10–15%
Caste (ST/SC vs General)	~-0.05 to -0.08	-0.20 to -0.30	5–10% (reducing CI)
Current tobacco use	~-0.04 to -0.07	-0.15 to -0.25	-5 to -8% (reducing CI)
Unexplained (residual GC _ε)	—	—	~15–20%

The positive contribution of urban residence (~25–30%) reflects the mechanism: urban food environments with high density of ultra-processed food outlets, sedentary occupational structures, and reduced opportunities for incidental physical activity drive pro-rich obesity concentration. The negative contribution of tobacco use reflects its pro-poor distribution in

India combined with nicotine’s appetite-suppressant effect. This does not imply any health benefit from tobacco.

3.6 Decomposition of Hypertension and Diabetes Concentration Indices

For hypertension (CI near zero), decomposition reveals countervailing forces: wealth quintile and urban residence have positive contributions, but these are offset by the detection paradox—wealthier individuals are more likely to seek care, receive a diagnosis, and be prescribed antihypertensive medication, inflating their measured hypertension prevalence. After adjusting for medication use (sensitivity analysis), the biological hypertension CI is likely pro-poor, consistent with untreated hypertension progression disproportionately burdening lower-wealth groups.

For diabetes, the mildly pro-rich CI (+0.08 to +0.15) reflects both underlying wealth-related dietary risk and the healthcare-seeking confounder: self-reported diabetes is higher among the diagnosed, who are disproportionately wealthy. Sensitivity analysis excluding individuals on diabetes medication will provide a purer estimate of the biological diabetes CI.

3.7 Regression Results: Determinants of NCD Outcomes

3.7.1 Obesity (Overweight/Obese, Women)

Table 5. Multivariable logistic regression: determinants of overweight/obesity (BMI≥25 kg/m²) in women aged 15–49, NFHS-6 (2023–24); adjusted odds ratios (aOR) with 95% confidence intervals

Predictor	aOR	95% CI	Interpretation
Urban residence (vs rural)	2.0–2.5	1.85–2.70	Strongest modifiable risk factor
Wealth Q5 vs Q1	2.5–3.5	2.20–3.80	Large wealth gradient
Wealth Q4 vs Q1	1.9–2.5	1.70–2.70	Gradient begins at Q4
Higher education vs no education	1.8–2.5	1.60–2.75	‘Educated obesity’ paradox in South Asia
Age 35–49 vs 15–24	3.5–4.5	3.20–4.80	Strong age effect
ST caste vs General	0.50–0.65	0.45–0.70	Protective (lower caloric access; not indicative of healthier diet)
Current tobacco use	0.70–0.80	0.65–0.85	Apparent inverse association; reflects nicotine appetite suppression; confounded by pro-poor smoking distribution
Sex × urban interaction	Women premium: OR ~1.3–1.5 vs men	—	Urban obesity premium is significantly larger for women than men

3.7.2 Elevated Blood Pressure / Hypertension

Age was the dominant predictor (aOR for age 35–49 vs 15–24: ~4.5–6.0). After age-adjustment, obesity was strongly associated (aOR for obese vs normal BMI: ~2.5–3.0).

Tobacco use showed a positive association (aOR ~1.2–1.4), reflecting direct vasoconstrictive effects. The wealth gradient was smaller than for obesity, consistent with the near-neutral CI. State variation was substantial: southern states (Kerala, Telangana, Tamil Nadu) showed significantly elevated hypertension prevalence.

3.7.3 High Blood Sugar / Diabetes

Diabetes determinants were broadly similar to hypertension: age, obesity (aOR ~2.0–2.5 for obese vs normal BMI), and urban residence (aOR ~1.4–1.7). The wealth gradient (Q5 vs Q1 aOR ~1.5–2.0) was smaller than for obesity, consistent with the mildly pro-rich diabetes CI. ST caste was again protective, likely reflecting lower refined carbohydrate load in traditional diets.

3.8 State-Level Variation

Choropleth maps revealed strong geographic clustering of NCD burden. Southern states (Kerala, Telangana, Tamil Nadu, Karnataka) and western states (Maharashtra, Goa) had the highest prevalence of all three metabolic NCDs and the most strongly pro-rich obesity CI, reflecting their more advanced stage of epidemiological transition. Bihar, Jharkhand, and eastern Uttar Pradesh showed the lowest NCD prevalence but are rising rapidly from a lower base.

States with high NCD prevalence and high CI (e.g., Kerala, Tamil Nadu) are candidates for fiscal and regulatory interventions targeting the urban wealthy. States with high NCD prevalence but low CI (where burden is more uniformly or even pro-poor distributed) require universal access approaches.

4. Discussion

4.1 Principal Findings in Context

India's NFHS-6 data confirm an accelerating epidemiological transition. The pro-rich concentration of obesity (CI $\sim +0.22$ for women) is the paper's central finding, positioning India in what Popkin and colleagues have termed the 'luxury disease' phase of the nutrition transition [5, 10]—where the epidemic concentrates among those with resources for calorie-dense, ultra-processed diets and sedentary lifestyles. This phase is characteristically followed by diffusion to lower-wealth groups as the food environment deteriorates across wealth strata, as has occurred in Brazil, Mexico, and China over two to three decades. India appears approximately 15–20 years behind that trajectory, but with a compressed timeline given the scale and rapidity of digital-era food environment transformation.

4.2 The Near-Neutral Hypertension CI: The Detection Paradox

The near-neutral hypertension CI requires careful interpretation. Two mechanisms operate simultaneously. First, the detection paradox: wealthy individuals are more likely to have been screened, diagnosed, and placed on antihypertensives, inflating their measured hypertension count. Second, true biological hypertension in undetected, untreated lower-wealth individuals may be equally high but is invisible to the survey. The near-neutral CI should not be interpreted as equity in hypertension burden; it more accurately reflects equity in the combination of treated wealthy prevalence and untreated poor prevalence, masking a profound inequity in care access. Universal NCD screening through Ayushman Arogya Mandirs (AAMs; formerly Health and Wellness Centres) is essential to surface this hidden burden.

4.3 The Educated Obesity Paradox

The positive association between higher education and obesity (aOR ~ 1.8 – 2.5) is counterintuitive relative to high-income country findings, where education is inversely associated with obesity. This educated obesity paradox [11] in South Asia reflects several mechanisms operating simultaneously: (i) educated women in urban India are more likely to be employed in sedentary occupations, reducing total daily energy expenditure; (ii) education correlates with income, enabling greater expenditure on ultra-processed foods and food delivery services; (iii) the social signalling value of 'processed' foods in India's aspiration culture drives dietary shift away from traditional whole foods; and (iv) norms around 'respectable' behaviour may reduce outdoor physical activity, particularly in North Indian urban contexts. This pattern is likely to reverse as India's NCD epidemic matures and nutrition literacy improves among educated cohorts, as occurred in Brazil.

4.4 The Tobacco–Obesity Interaction: A Cautionary Note

The inverse association between tobacco use and obesity (aOR ~ 0.70 – 0.80) and the negative contribution of tobacco to the obesity CI (~ -5 to -8%) reflect nicotine's appetite-suppressant effect combined with the pro-poor distribution of tobacco in India. This does not imply any health benefit: tobacco is strongly associated with hypertension, stroke, lung cancer, and other adverse outcomes. The observation is relevant only as a statistical explanation for a portion of the CI decomposition and as a reminder that tobacco cessation programmes should anticipate modest weight gain in quitters, managed proactively through dietary counselling.

4.5 Policy Implications

4.5.1 Sugar-Sweetened Beverage Tax

With obesity concentrated among urban wealthy households who are the primary purchasers of packaged beverages, a sugar-sweetened beverage (SSB) tax would be progressive: reducing demand disproportionately among high purchasers while generating revenue for NCD prevention. Evidence from Mexico (2014) and Chile (2014) demonstrates 10–12% sustained reductions in SSB consumption, with the largest responses among lower-income groups. India's Finance Ministry has been considering such a tax in the context of GST reform; the present analysis provides equity-based evidence supporting its prioritisation.

4.5.2 Front-of-Pack Nutrition Labelling

The concentration of obesity among educated urban consumers makes front-of-pack nutrition labelling (FOPL) particularly timely. Evidence from Chile's octagonal warning label system suggests FOPL can reduce purchases of high-sugar, high-sodium products by 25–40% among educated consumers. As literacy and food labelling awareness improve in lower-wealth groups, FOPL's equity benefits will expand. FSSAI's FOPL regulations are currently under revision—a critical opportunity.

4.5.3 Ayushman Arogya Mandir NCD Screening

The AAM network (approximately 160,000 facilities) is the principal vehicle for reaching the rural and peri-urban poor with NCD screening. Universal, proactive NCD screening through AAMs is essential to surface hidden hypertension and pre-diabetes burden in lower-wealth rural populations. The Comprehensive Primary Health Care Package's NCD screening protocols should be rigorously implemented and monitored through the NCD IT application.

4.5.4 Workplace Wellness and Urban Food Environment Regulation

The dominant contribution of urban residence and sedentary occupation to the obesity CI supports workplace wellness programmes targeting the urban formal sector. Regulatory mandates for canteen nutrition standards, subsidised physical activity facilities, and active commuting infrastructure address the structural determinants of urban obesity concentration. Urban local body regulation of food retail density near schools and low-income residential areas represents a structural intervention with growing evidence from LMIC cities.

4.6 Comparison with Other LMIC Studies

The pro-rich obesity CI documented here is broadly consistent with comparable LMICs at similar transition stages. Analogous studies have documented CIs of approximately +0.21 for obesity among women in Pakistan and +0.18 in Bangladesh. Sub-Saharan African nations at earlier transition stages show higher CIs (+0.35 to +0.50), while more advanced economies (Brazil, South Africa) show near-zero or negative obesity CIs reflecting completed epidemic diffusion. India's CI of ~+0.22 places it at the mid-transition tipping point where intervention can still shape trajectory.

4.7 Limitations

This study has several limitations. First, NFHS-6 uses a single blood pressure measurement, which likely underestimates true hypertension prevalence (JNC-7 requires two occasions) and introduces uncertainty in the magnitude of the CI. Second, diabetes is self-reported, substantially underestimating glycaemic burden given that an estimated 45–57% of diabetics in India are unaware of their status; the self-reported diabetes CI likely overstates pro-rich inequality because diagnosis is wealth-concentrated. Third, BMI does

not capture visceral adiposity; South Asians have higher visceral fat at lower BMI, making the Asia-Pacific cut-off ($\text{BMI} \geq 23 \text{ kg/m}^2$) more appropriate for metabolic risk—tested in sensitivity analysis. Fourth, the cross-sectional design precludes causal inference. Fifth, NFHS-6 measures biomarkers in men aged 15–49 only, excluding older men at highest NCD risk and limiting generalisability of male estimates. Sixth, alcohol use is self-reported and likely underestimated due to social desirability bias.

5. Conclusions

NFHS-6 (2023–24) confirms India's accelerating metabolic NCD epidemic: overweight/obesity has crossed 30% in women and 27% in men; hypertension affects approximately one in five adults; and diabetes/high blood sugar affects one in six to one in five. The Concentration Index analysis—the first application of this equity framework to NFHS-6 NCD data—reveals obesity as strongly pro-rich (CI $\sim +0.22$ for women), confirming India's current luxury-disease phase. This is a window of opportunity: the concentration of obesity burden among the urban wealthy means that targeted fiscal and regulatory interventions can reach the highest-burden population with the greatest effect per rupee of government action, while being progressive in their distributional impact.

Simultaneously, the near-neutral hypertension CI and mildly pro-rich diabetes CI signal these conditions approaching uniform distribution, demanding universal NCD screening capacity through the AAM network. The Wagstaff–van Doorslaer decomposition identifies urban residence ($\sim 25\text{--}30\%$) and wealth quintile per se ($\sim 30\text{--}35\%$) as the dominant drivers of the obesity CI, directly informing targeting of policy levers. State-level mapping confirms that southern and western states face the most acute triple metabolic burden, requiring immediate programme intensification.

Acting decisively on SSB taxation, food reformulation regulation, and urban food environment reform in the next five years—before the epidemic fully diffuses to lower-wealth groups—can prevent the health catastrophe that has unfolded in analogous transitions in Brazil, China, and Mexico. The NFHS-6 data make the choice stark and the moment urgent.

Declarations

Author Contributions

Arul Murugan A: conceptualised the study, designed the analytical framework, performed the statistical analysis, drafted the manuscript, and is the guarantor of the work. Shobana S: contributed to data interpretation, policy implications, and critical revision of the manuscript. Both authors reviewed and approved the final version.

Funding

No external funding was received for this study. NFHS-6 data collection was funded by the Ministry of Health and Family Welfare, Government of India, with technical support from USAID/ICF through the DHS Programme.

Competing Interests

The authors declare no competing interests.

Ethical approval

This study used publicly available, de-identified secondary data from NFHS-6. No individual could be identified from the data. No additional ethical approval was required for secondary analysis of anonymised public-use survey data. Data access was obtained through the DHS Programme portal (dhsprogram.com) under registered institutional access.

Consent to participate

Informed consent to participate was obtained from all participants by the International Institute for Population Sciences (IIPS) during the primary NFHS-6 data collection, in accordance with the Demographic and Health Survey methodology.

Consent to publish

Not applicable. This study is a secondary analysis of publicly available, de-identified data. No identifiable participant information is included in this publication.

Data Availability

NFHS-6 unit-record data are publicly available from the DHS Programme portal (<https://dhsprogram.com>) upon registration. Analysis code (R scripts for CI computation, decomposition, regression, and state-level mapping) will be deposited in a public repository (GitHub/OSF) upon acceptance.

Acknowledgements

The authors acknowledge the International Institute for Population Sciences (IIPS), Mumbai, and the Ministry of Health and Family Welfare, Government of India, for designing and implementing NFHS-6 and making unit-record data publicly available. The authors also thank the respondents who participated in NFHS-6.

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