D4N 2025
Delivering for Nutrition in South Asia
Towards Impact at Scale
December 3, 2025

Strengthening ICDS for Maternal Health: Scaling Nutrition and Chronic Disease Interventions for Lactating and Pregnant Mothers in India

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1 *Introduction*

- **Maternal health remains a major public health challenge in India**, contributing to adverse health outcomes for both mothers and children, despite improvements in poverty reduction and health services.
- India faces a **dual burden of undernutrition and overnutrition**, highlighting the need for stronger nutrition-sensitive interventions.
- The **ICDS scheme is a key national programme** providing supplementary nutrition, health check-ups, and counselling through Anganwadi centres, especially benefiting vulnerable groups such as rural, SC, ST, and economically weaker populations.
- **Maternal health outcomes such as anaemia, BMI, and blood sugar levels require deeper empirical evaluation**, despite decades of ICDS implementation.
- **Socio-economic determinants, economic status, education, caste, gender, and religion continue to strongly influence maternal health**, contributing to geographic and state-level disparities.
- This study **assesses the impact of ICDS participation on maternal health** using NFHS data, applying PSM and logistic regression to identify state-wise heterogeneity, structural determinants, and policy gaps to strengthen nutrition-sensitive interventions.

2

Objectives

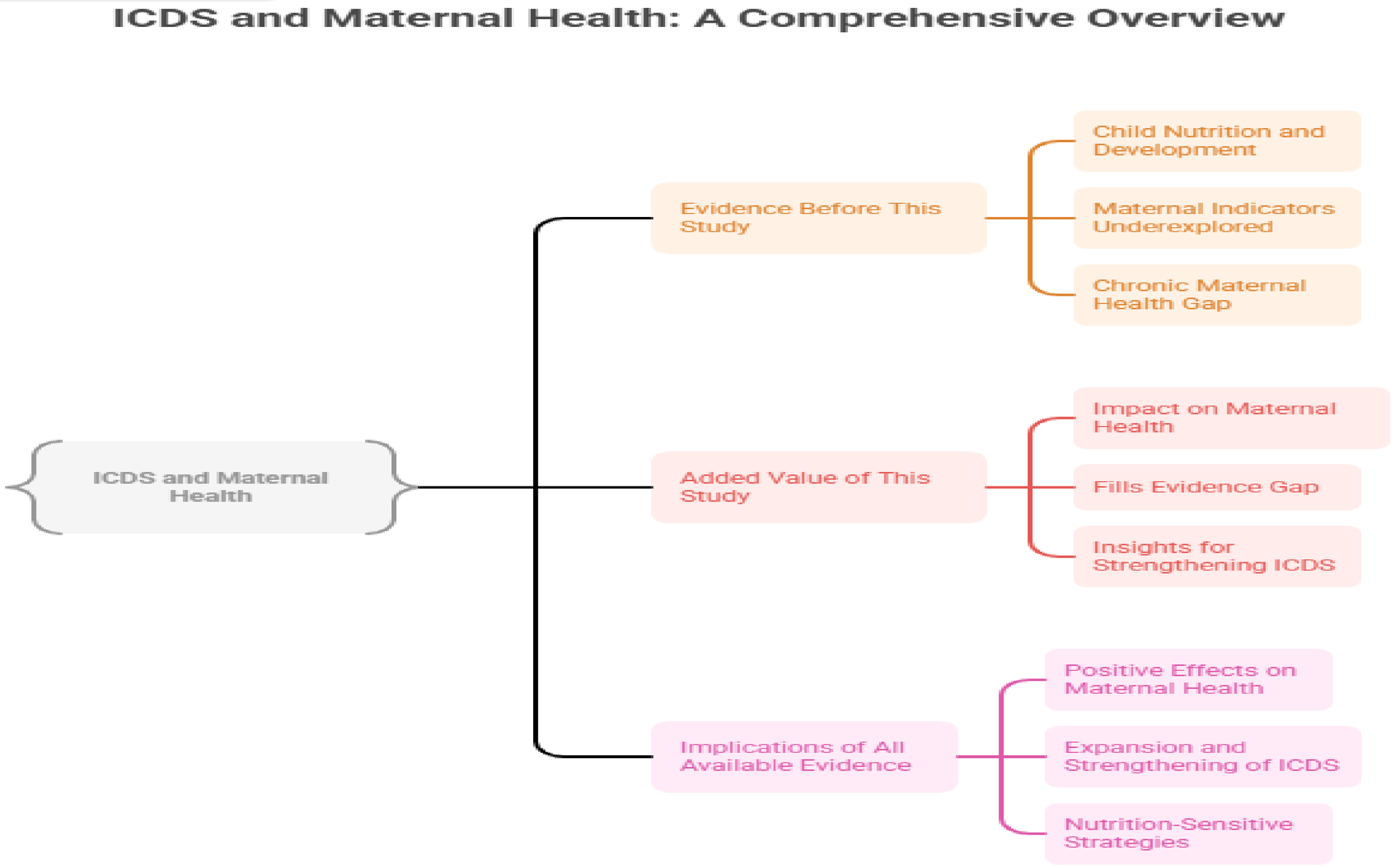
Impact Assessment:

To evaluate the impact of ICDS beneficiaries on maternal health outcomes including anaemia, high blood glucose, underweight, and overweight—among pregnant and lactating mothers in India.

Policy-Relevant Evidence:

To generate policy-relevant evidence that can support the scaling of effective, nutrition-sensitive health interventions across states.

3 Research in context



National Family and Health Surveys - V (2019-21) round unit level data, The analysis focuses on four chronic maternal health indicators

211089 mothers who gave birth in the five years preceding the survey.

High Blood Sugar

High blood sugar is less common but poses serious health risks.

1

Anaemia

Anaemia is highly prevalent and has significant health impacts.

2

Underweight

Underweight is rare and has minimal immediate health consequences.

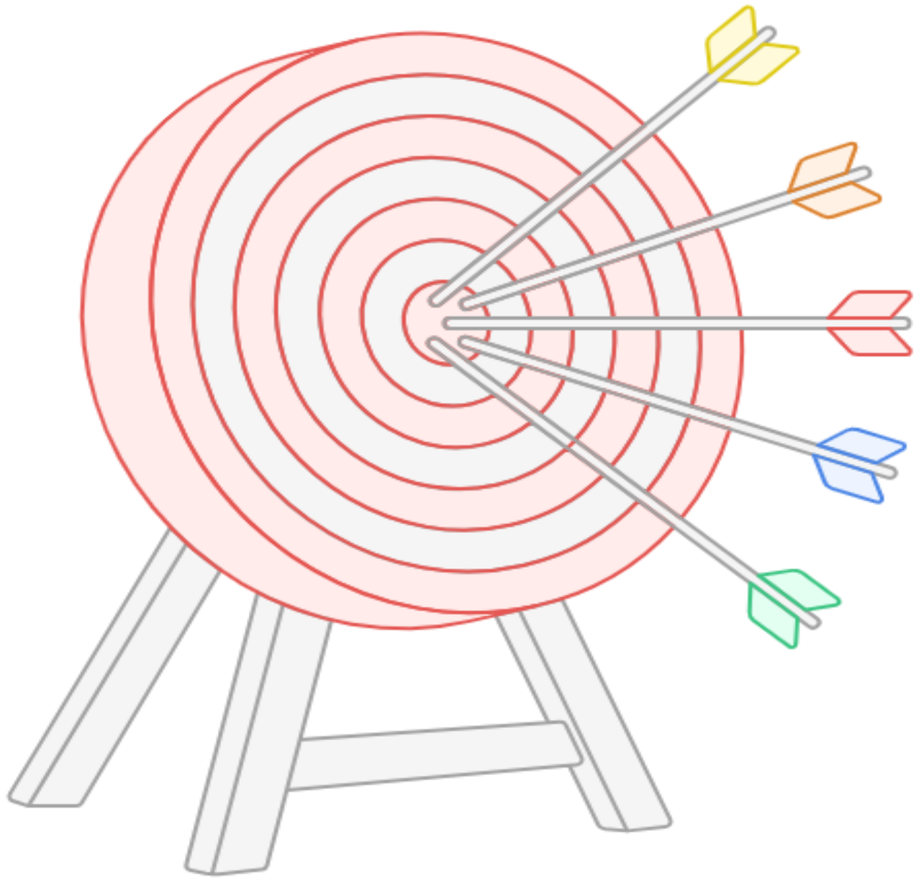
3

Overweight/Obese

Overweight/Obesity is prevalent but has moderate health effects.

4

Study Methodologies for Maternal Health



Maternal Chronic Health Indicators

Outcomes of interest in the study

ICDS Participation

Intervention being evaluated for its effect

Propensity Score Matching

Method to create comparable control groups

Logistic Regression

Statistical model for causal inference

Socio-economic Factors

Determinants influencing maternal health

The propensity score represents the probability that a mother receives ICDS benefits given certain pre-intervention characteristics (X).

$$p(X) = Pr\ (D=1|X)$$

where:

- D =1 if the child is an ICDS beneficiary, D =0 if the child is a non-beneficiary, X represents the vector of pre-intervention characteristics

To evaluate the **impact of ICDS benefits**, the study estimates the following parameters:

Average Treatment Effect (ATE):

Measures the overall effect of ICDS benefits on the population. $ATE = E(Y1-Y0)$

Average Treatment Effect on the Treated (ATT):

Estimates the effect of ICDS on those who **received** the benefit. $ATT = E(Y1|D=1) - E(Y0|D=1)$

Average Treatment Effect on the Untreated (ATU):

Estimates the potential effect of ICDS on those who did not receive the benefit. $ATU = E(Y1|D=0) - E(Y0|D=0)$

where: i) $E(Y1|D=0)$ represents the average observed outcome for those who did not receive ICDS benefits. ii) $E(Y0|D=0)$ is the counterfactual outcome, estimating what the non-beneficiaries' outcomes would have been had they received the benefit (which remains unobserved).

The **logit model** is applied to estimate the determinants of maternal health outcomes, where the dependent variable is binary and represents whether a mother is anaemia, high blood glucose, underweight, and overweight (1 = Yes, 0 = No). The probability of maternal health outcomes, given a set of explanatory variables X, is models using the logistic function: $P\left(Y=\frac{1}{X}\right)=\frac{e^{X'\beta}}{1+e^{X'\beta}}$

Where:

• **P(Y=1|X)** represents the probability of child deprivation, • **X** is the vector of explanatory variables, • **β** is the vector of estimated coefficients, and

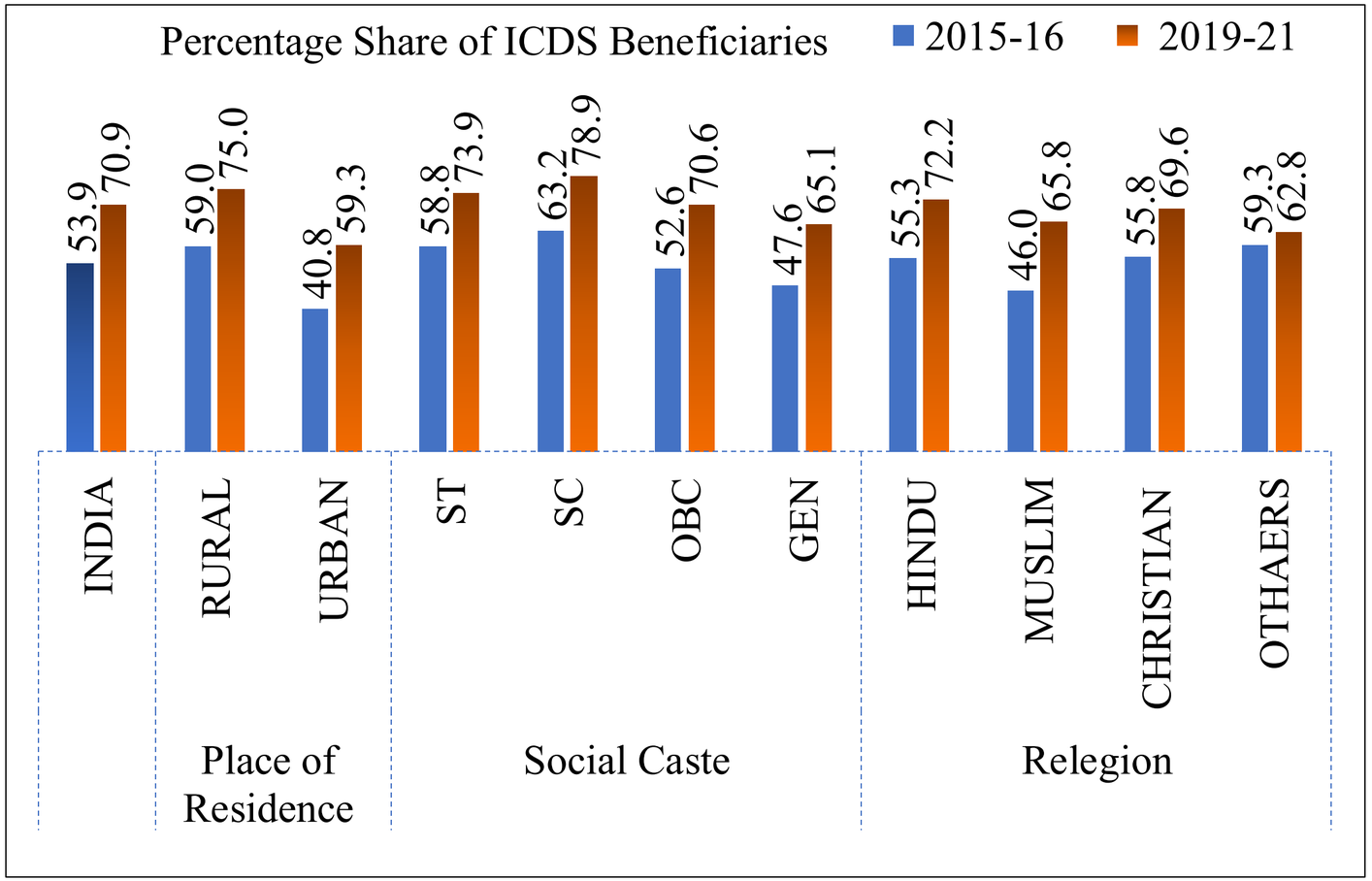
• **e** is the base of the natural logarithm.

The logit model is expressed in its log-odds form as: $$\log\left(\frac{P(Y=1|X)}{1-P(Y=1|X)}\right)=X'\beta$$

This transformation ensures that the dependent variable is unbounded, making it suitable for regression analysis.

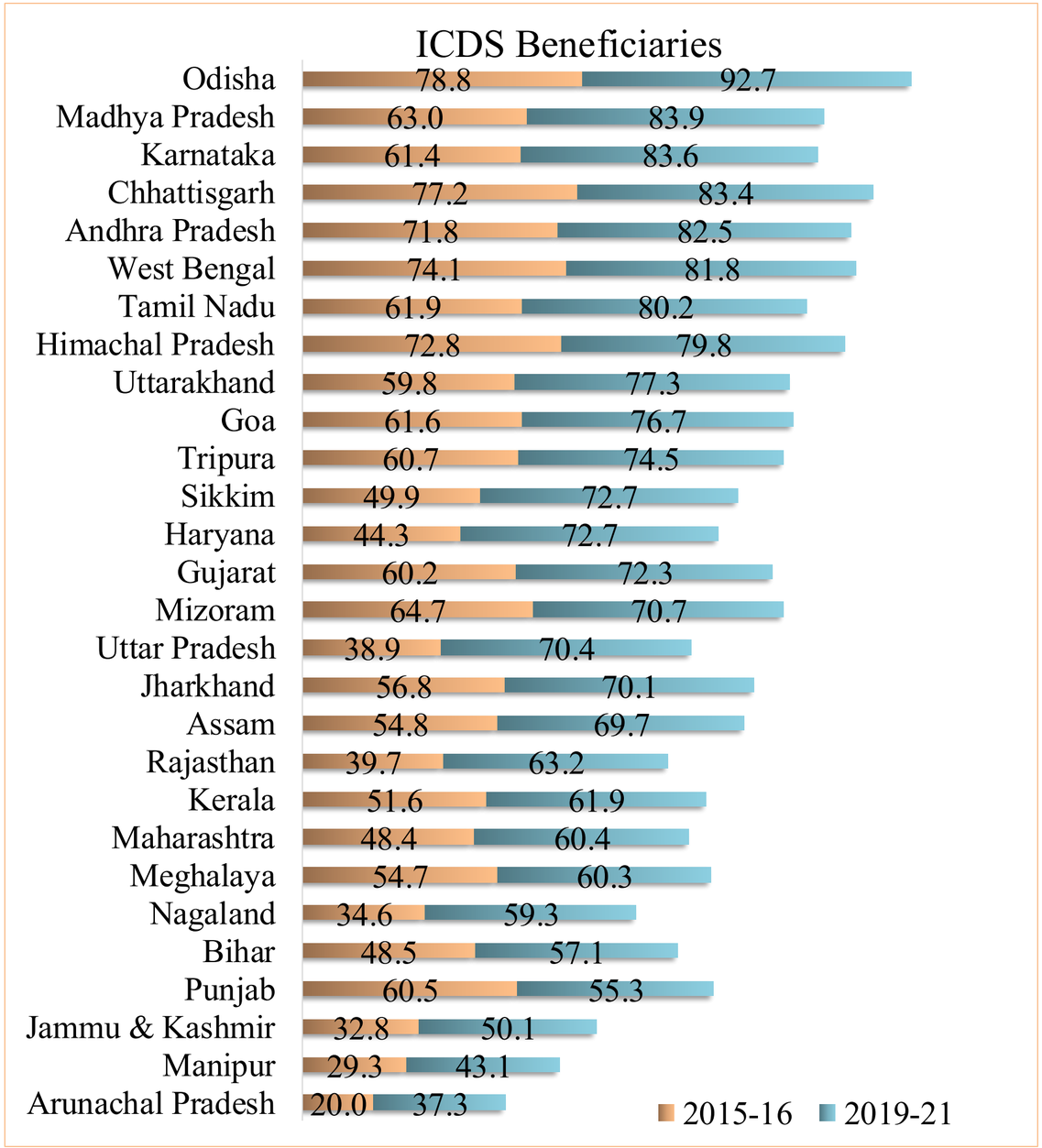
Figure 1 Percentage Share of Pregnant and Lactating Mothers Receiving ICDS Benefits Across Demographic Factors

- ICDS participation increased from **53.9% (2015–16)** to **70.9% (2019–21)**, showing strong programme expansion.
- **Rural–urban contrast**: **Rural coverage rose sharply** (59.0% → 75.0%), while **urban gains were modest**.
- **Caste-wise improvements**: SCs (63.2% → 78.0%) and STs showed major increases; **OBCs** also improved significantly (52.7% → 70.6%).
- **Religion-wise gains**: **Hindus and Christians** showed the highest improvements, indicating broader inclusiveness of ICDS.



Sources: Author's estimation from NFHS-IV (2015-16) and NFHS-V (2019-21),

Figure 2Percentage Share of ICDS Beneficiaries (Pregnant and Lactating Mothers) Across States in India



1. All states show higher ICDS coverage from 2015–16 to 2019–21, indicating expanded outreach.
2. **Top-performing states**: Odisha (92.7%), Madhya Pradesh (89.7%), and Karnataka (87.3%) achieved the highest coverage in NFHS-5.
3. **Moderate improvements**: States like Chhattisgarh and West Bengal recorded notable growth in beneficiary coverage.
4. **Low or limited progress**: Kerala and Manipur saw negligible improvement or slight declines.
5. **Persisting regional gaps**: Arunachal Pradesh (43.1%), Manipur (46.3%), and Punjab (51.1%) remain lowest, highlighting the need for targeted interventions in the northeast and several northern states.

Sources: Author's Compilation from NFHS-4th and NFHS-5th round Unit Level Data

Table 1. Prevalence of Anaemia, High Blood Sugar, Underweight, and Overweight among ICDS Beneficiaries and Non-Beneficiaries across Indian States, 2019-21

States	ICDS Beneficiaries				ICDS non-Beneficiaries			
	Anaemia	*High Blood sugar*	*BMI <18.5 kg/m2*	*BMI ≥25 kg/m2*	*Anaemia*	*High Blood Sugar*	*BMI <18.5 kg/m2*	*BMI ≥25 kg/m2*
Andhra Pradesh	5.8	52.4	18	29.2	8.8	44.2	13.1	39.7
Arunachal Pradesh	5.3	51.4	5.3	24.4	6.1	45.8	4.2	25.1
Assam	6	62	18.5	11.5	6.2	54.8	17.5	14.5
Bihar	6.2	60.7	25.9	11.5	6.8	54.6	22.7	15
Chhattisgarh	4.3	57.9	23.2	11.8	4.5	51.2	20.1	19.6
Goa	9	45.2	8.9	38.7	15.1	24.3	8.7	41.8
Gujarat	6.9	69.7	27.7	18.4	8.5	62.7	19.8	29.9
Haryana	5.7	57.5	13.7	31.1	6.6	50.5	9.8	34.9
Himachal Pradesh	4.2	49.8	14.6	26.9	3.8	38.1	12.1	22.5
Jammu & Kashmir	4.3	68.1	2.7	32.5	3.4	56.8	3.1	34.3
Jharkhand	6	58.2	28.7	9	7.6	52.1	25.7	12.9
Karnataka	5	55.4	18.9	27.4	5.9	42.4	12.8	35.1
Kerala	7.1	36.8	8.6	37.6	10.5	25	5.9	46.1
Madhya Pradesh	5.5	58.2	22.9	15.3	7.1	50.5	19.9	20
Maharashtra	4.2	61.5	23.7	17.8	7.5	49.9	19.6	32.3
Manipur	6.2	39.6	6	32.4	5.9	36.9	5.4	34.1
Meghalaya	5.4	40.9	11.7	10.6	7.4	29.7	9.6	12
Mizoram	6.4	40.6	5.1	23.2	11.8	33.3	4	29.9
Nagaland	4.4	37.8	6.9	14.1	4.6	37.3	9.9	17.7
Odisha	6.7	55.6	22.4	20.5	8	41	15.4	32.9
Punjab	7.5	57.8	10.8	40.2	9	51.7	10.3	43.2
Rajasthan	3.3	60.1	19	10	2.9	54.8	17.6	12.3
Sikkim	8.7	41.2	3	37	9.9	30.3	3.2	52.4
Tamil Nadu	6.6	49.9	12	39.8	8.2	39.5	7.1	49.5
Tripura	9.3	58.4	17.8	16	9.8	51.9	15.6	19.5
Uttar Pradesh	6.1	53.8	16.9	20.2	7.3	47.4	14.3	26.1
Uttarakhand	8.1	45	13	27.1	7	39.5	9.7	38.1
West Bengal	8	59.5	18.9	18.4	11.4	54.2	14	23.1

Sources: Author's Compilation from NFHS-5th round Unit Level Data

- ICDS beneficiaries consistently show lower anaemia prevalence across states (e.g., Andhra Pradesh 5.8% vs. higher in non-beneficiaries; Goa 9% vs. higher), indicating positive programme impact.
- High blood sugar shows mixed patterns—some states report higher prevalence among beneficiaries (e.g., Gujarat: 69.7% vs. 62.7%), while others show lower levels among beneficiaries (e.g., Goa: 45.2% vs. 24.3%).
- Non-beneficiaries generally have higher underweight prevalence (e.g., Jharkhand 28.7% vs. 25.7%), though exceptions exist, showing uneven nutritional improvements.
- In states like Kerala (46.1% vs. 37.6%) and Tamil Nadu (49.5% vs. 39.8%), non-beneficiaries show higher overweight prevalence, suggesting ICDS supports healthier weight outcomes.

- **Large imbalance before matching:** Strong pre-treatment differences between ICDS beneficiaries and non-beneficiaries.
- **Covariates strongly predicted ICDS participation:** Socio-economic and demographic factors heavily influenced treatment assignment in the unmatched sample.
- **Balance achieved after matching**

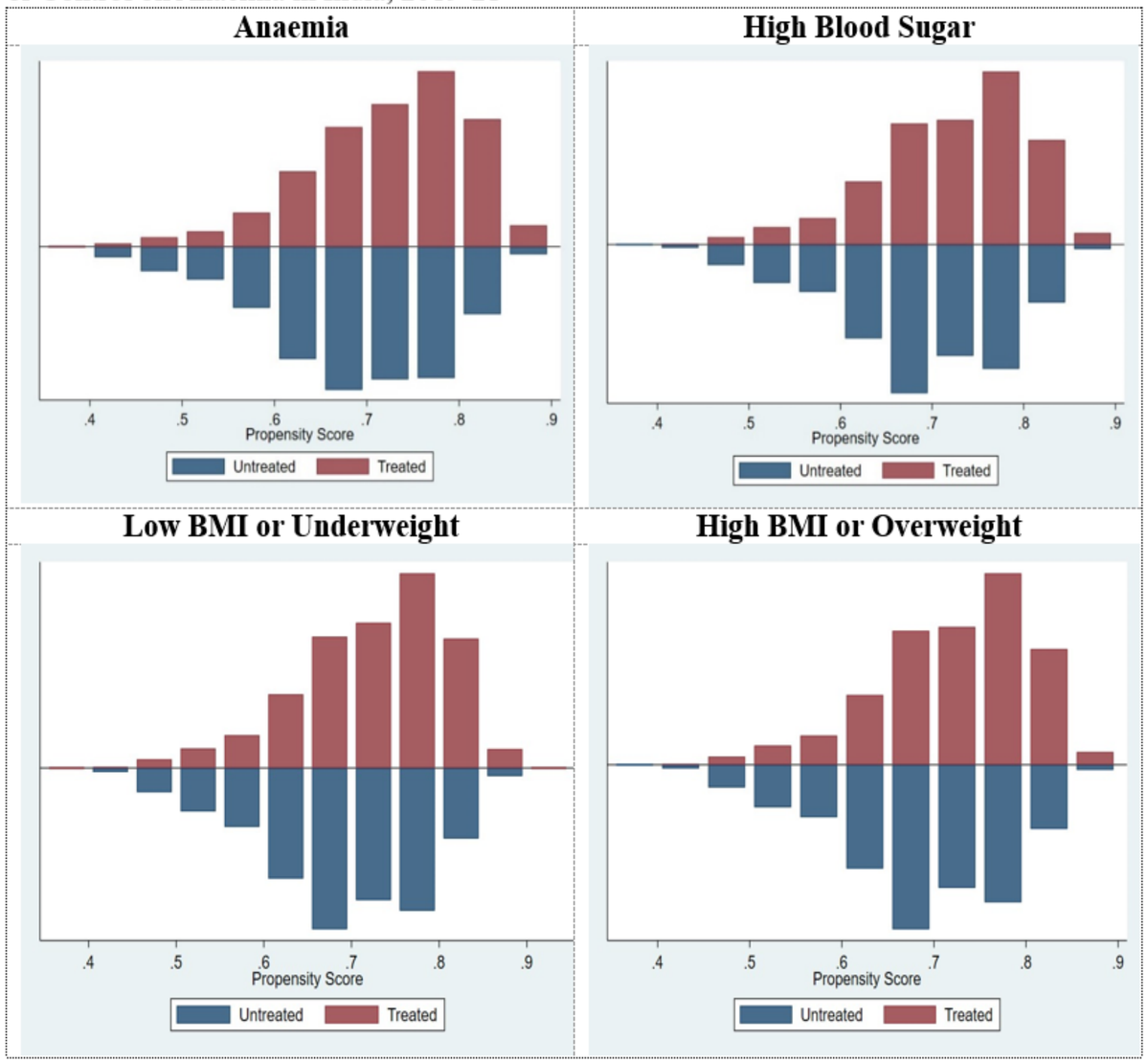
- These results indicate that the matched samples are highly comparable, satisfying the balancing property of PSM.
- The substantial reduction in bias confirms that observable differences between beneficiaries and non-beneficiaries were effectively controlled for.

Table 2. Standardized Bias Reduction and Model Fit Statistics Following PSM

Anaemia								
Sample	*Ps R2*	*LR chi2*	*p>chi2*	*Mean Bias*	*Med. Bias*	*B*	*R*	*%Var*
Unmatched	0.030	7710.5	0.000	8.6	4.9	42.5*	0.88	75
Matched	0.001	500.7	0.000	1.9	1.8	8.2	1.01	50
High Blood sugar								
Unmatched	0.030	7710.5	0.000	8.6	4.9	42.5*	0.88	75
Matched	0.001	356.9	0.000	1.6	1.2	6.9	1.03	50
Low BMI or Underweight								
Unmatched	0.030	7710.5	0.000	8.6	4.9	42.5*	0.88	75
Matched	0.001	417.9	0.000	1.6	1.4	7.5	1.06	50
High MBI or Overweight								
Unmatched	0.030	7710.5	0.000	8.6	4.9	42.5*	0.88	75
Matched	0.001	230.7	0.000	1.3	1.4	5.5	1.03	50

Sources: Authers calculated by using NFHS-V (2019-21) Unit Level data

Figure 3 Predicted probability of ICDS utilization of matched sample of Treated and Untreated or Control on Anaemia in India, 2019-21



Sources: Authers calculated by using NFHS-V (2019-21) Unit Level data

- **Clear overlap in propensity scores:** Kernel density plots for all four outcomes show good common support between ICDS beneficiaries and non-beneficiaries.
- **Higher scores for treated before matching:** Treated mothers consistently display higher propensity scores initially, indicating greater ICDS participation among socio-economically disadvantaged women.
- **Improved overlap after matching:** Post-matching distributions align more closely, demonstrating effective reduction of selection bias through the matching process.

12 Propensity Score Matching Estimations

- **Anaemia**: No significant difference between beneficiaries and non-beneficiaries, indicating limited ICDS impact on anaemia reduction.
- **High Blood Sugar**: Small but **significant decrease** among ICDS beneficiaries, suggesting modest effectiveness.
- **Underweight (BMI <18.5)**: Strong and significant improvement ICDS participation **reduces undernutrition.**
- **Overweight (BMI ≥25)**: Very slight but **significant increase** in overweight among beneficiaries signalling risks of emerging over nutrition.

Table 2 Matching estimates of Anaemia, High Blood Sugar, Low BMI (Underweight) and High BMI (Overweight) among ICDS beneficiaries and non-beneficiaries in India, 2019-21

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
Anaemia	Unmatched	0.6021	0.5380	0.0641	0.0024	27.0400
	ATT	0.6021	0.6036	-0.0016	0.0038	1.4100
	ATU	0.5380	0.5435	0.0055	.	.
	ATE			0.0005	.	.
High Blood Sugar	Unmatched	0.0487	0.0542	-0.0055	0.0010	5.23
	ATT	0.0487	0.0423	0.0064	0.0020	3.19
	ATU	0.0542	0.0451	-0.0091	.	.
	ATE	0.0019	.	.		
BMI <18.5g/m2 (Underweight)	Unmatched	0.1976	0.1545	0.0432	0.0018	-23.11
	ATT	0.1976	0.1865	0.0111	0.0030	3.65
	ATU	0.1545	0.1471	-0.0074	.	.
	ATE	0.0058	.	.		
BMI ≥25 kg/m2 (Overweight)	Unmatched	0.1719	0.2120	-0.0401	0.0018	21.58
	ATT	0.1719	0.1595	0.0123	0.0033	3.66
	ATU	0.2120	0.1954	-0.0166	.	.
	ATE	0.0040	.	.		

Sources: Authers calculated by using NFHS-V (2019-21) Unit Level data

13 Major findings of PSM results

Table 4. Major findings of PSM results

Health Outcomes	ATT	Direction	Interpretation
Anaemia	–0.0016	Small, insignificant	Mild reduction but not statistically meaningful
High Blood Sugar	–0.0065	Significant	ICDS reduces metabolic risk
Underweight	–0.0422	Strong, significant	ICDS substantially lowers undernutrition risk
Overweight	+0.0123	Significant	Slight increase in overweight probability

Sources: Author's Compilation from NFHS-5th round Unit Level Data

Table 4 : Logistic Regression Estimates for Anaemia, High Blood Sugar, Underweight and Overweight among Mothers in India, 2019–21

	Anaemia			High Blood sugar			Underweight			Overweight		
	Coef.	*z*	*P>z*	*Coef.*	*z*	*P>z*	*Coef.*	*z*	*P>z*	*Coef.*	*z*	*P>z*
ICDS Treated	-0.24	-24.1	0.00	-0.06	-2.9	0.00	-0.22	-16.7	0.00	-0.12	-9.2	0.00
Region												
RURAL	0.02	1.5	0.12	-0.05	-1.9	0.05	0.20	11.6	0.00	-0.28	-19.5	0.00
Religion												
HINDU	0.07	6.1	0.00	-0.16	-6.1	0.00	0.10	7.1	0.00	-0.09	-5.7	0.00
MUSLIM	-0.09	-8.7	0.00	-0.12	-4.4	0.00	-0.16	-10.7	0.00	-0.17	-9.9	0.00
Wealth Index												
LWC	-0.02	-1.6	0.11	0.06	2.2	0.03	-0.37	-23.5	0.00	0.59	35.0	0.00
MWC	-0.05	-3.7	0.00	0.14	5.3	0.00	-0.79	-44.4	0.00	1.04	62.3	0.00
Education												
HHYEDU	-0.02	-8.0	0.00	-0.02	-3.2	0.00	-0.02	-0.5	0.61	0.02	5.7	0.00
WEDU	-0.07	-20.5	0.00	0.01	0.8	0.42	-0.06	-11.9	0.00	0.08	19.7	0.00
Households Characteristic												
AOFHHEAD	-0.02	-6.4	0.00	0.00	2.3	0.02	-0.03	-5.9	0.00	0.05	12.3	0.00
HHSSIZE	0.01	2.6	0.01	0.00	-1.2	0.26	0.03	10.9	0.00	-0.04	-14.0	0.00
Health Awareness												
UAM	-0.63	-6.3	0.00	-0.36	-1.3	0.21	0.50	4.7	0.00	-0.58	-3.1	0.00
HINS	-0.04	-3.9	0.00	-0.06	-2.4	0.02	0.01	0.9	0.34	-0.19	-14.3	0.00
HCARD	0.14	14.9	0.00	-0.19	-9.5	0.00	0.18	15.6	0.00	-0.25	-21.5	0.00
Cons….	0.44	20.6	0.00	-2.74	-58.5	0.00	-1.57	-55.3	0.00	-1.77	-64.2	0.00
No. of Obs.	211089			211089			211089			211089		
Wald chi2(13)	2331.7			257.93			5779.06			13001.2		
Prob > chi2	0.000			0.000			0.000			0.000		
Pseudo R2	0.0183			0.0131			0.0301			0.0691		

Sources: Authors calculated by using NFHS-V (2019-21) Unit Level data

Note: LWC: Low wealth Class, MWC: Medium Wealth Class, HHYED: Household Years of Education, WEDU: Level of Education of the mothers, AOFHHEAD: Age of household head, HSIZE: Household Size, UAM: Under age of 18 Marriage, HINS: Household having health insurances, HCARD: Household having any health card.

1. **Impact of ICDS Participation:** ICDS significantly **reduces the** anaemia, high blood sugar, and low BMI among mothers, confirming **strong positive effects on maternal health** but slightly **increases the likelihood of overweight.**
2. **Socio-Economic Influences:** Religion and wealth matter. **Muslim mothers** show higher overweight risk, while **middle-wealth groups** show greater overweight probability but lower risks of anaemia and undernutrition.
3. **Role of Education & Health Access:** Higher maternal education consistently **reduces the likelihood** of anaemia, low BMI, and overweight; access factors like **health card** and **health insurance** also significantly **lower undernutrition risks**.

- **ICDS participation significantly improves maternal health**
  - Reduces anaemia, underweight, and high blood sugar among mothers.
  - However, overweight is rising among beneficiaries, indicating a nutrition transition.

- **Strong socioeconomic gradients persist**
  - Educated and economically secure mothers show better health outcomes.
  - Health insurance and health cards further enhance nutritional wellbeing.

- **Large inter-state disparities**
  - Strong performance: Odisha, Madhya Pradesh.
  - Lagging: Several northeastern states.
  - Highlights governance and implementation gaps.

- **Policy relevance**
  - Need to diversify and rebalance ICDS food basket to tackle both under- and overnutrition.
  - Strengthen convergence with POSHAN Abhiyaan, Ayushman Bharat, and community counselling.
  - Digital dashboards and real-time monitoring can enhance accountability.

- **Looking ahead**
  - Achieving maternal nutritional security is vital for Viksit Bharat @ 2047.
  - A more inclusive, data-driven, and region-sensitive ICDS can bridge persistent nutritional divides.

16 *Systems or Partnerships for Scale-up*

- **Integrate health, nutrition, and social protection systems** to enable coordinated and efficient delivery of maternal health services.
- **Strengthen partnerships** among ICDS, the Ministry of Health, local governance institutions, and civil society to support large-scale implementation.
- **Invest in capacity building, digital monitoring, and equity-focused targeting** to expand program reach and improve overall effectiveness.
- **Enhance behaviour change communication** to improve nutrition awareness among marginalised, low income and rural pregnant and lactating mothers.
- **Refine and scale ICDS interventions** based on evidence to tackle both undernutrition and overnutrition.
- **Contribute to national goals**, particularly **SDG 2 (Zero Hunger)** and **SDG 3 (Good Health and Well-being)**, through targeted maternal nutrition strategies.

Thank You