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ORIGINAL RESEARCH ARTICLE

Prevalence and Factors Associated with Non-Communicable Diseases among Women in Aspirational and Non-Aspirational Districts of India: Evidence from NFHS-5

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Abstract

Background: Evidence comparing non-communicable diseases (NCD) prevalence among women in Aspirational Districts (AD) and Non-Aspirational Districts (NAD) remains limited. Present analysis aims to compare the prevalence of selected NCD among women aged 15–49 years in AD and NAD and identify sociodemographic and behavioral correlates of reporting any NCD. Methods: Analyzing the National Family and Health Survey (NFHS-5) data (2019–21) from 724,115 women aged 15–49 across 115 AD and 592 NAD, this study examined self-reported diagnoses of seven major NCDs and a composite "any NCD" using survey-weighted prevalence and associated factors within and between groups using multivariable logistic regression with and without an interaction term. Results: Overall self-reported NCD prevalence was 9.93% with significantly lower in AD than in NAD (6.8% vs. 10.6%; $p<0.001$), with hypertension, thyroid disease, and diabetes being the most prevalent. Women belonging to older age, higher wealth quintile, and smoking tobacco were consistently associated with higher reporting odds across both district categories. The interaction term further indicated that the associations of caste, region, alcohol consumption, and smokeless tobacco use with reporting of any NCD differed significantly between AD and NAD. Conclusion: The lower self-reported NCD burden in Aspirational Districts warrants expanding routine, decentralized NCD screening beyond maternal and child health programs, and is critical in developmental priority districts.

Keywords: NCDs; Aspirational Districts; Women's Health; Health Inequity; NFHS-5; India

Key Points

- Among 724,115 women, self-reported NCD prevalence was lower in AD than NAD (6.77% vs. 10.58%), reflecting under-diagnosis and limited healthcare access rather than lower risk.
- Age, wealth, and smoking showed positive associations with NCD reporting; caste, region, alcohol, and smokeless tobacco showed interaction effects.
- Integrate routine hypertension and diabetes screening into the Aspirational Districts Programme.

1. Introduction

Non-communicable diseases (NCDs) principally cardiovascular diseases, cancers, asthma diseases, and diabetes have emerged the dominant causes of death and disability worldwide, accounting for 73% of global deaths and 82% of premature NCD deaths in low- and middle-income countries [1]. Global projections indicate a continued rise through 2050 that will disproportionately affect rapidly transitioning countries like India [2, 3]. Within this epidemiological transition, women occupy a critical position where biological, social, and health-system factors converge to shape a distinct vulnerability profile. Overweight and obesity prevalence among Indian women rose from 36.14% in the fourth round of the National Family and Health Survey (NFHS-4) to 41.16% in the fifth round of NFHS-5 [4], while hypertension and diabetes show marked geographic variation, with comorbid diabetes–hypertension–obesity clusters increasingly observed among wealthier demographics [5]. Concurrently, NCD multimorbidity is no longer confined to older or affluent urban cohorts, permeating diverse socio-demographic strata [6].

A defining characteristic of India's chronic disease burden is pronounced spatial heterogeneity. District-level analyses of NFHS-5 demonstrate significant geographic clustering of hypertension, tobacco use, alcohol consumption, and obesity, largely associated with wealth, educational attainment, caste/tribe status, and place of residence [7]. Because aggregate national and state indicators often obscure local disparities, the Government of India launched the Aspirational Districts Programme (ADP) via the National Institution for Transforming India (NITI) Aayog in January 2018. The initiative identified 112 socioeconomically lagging districts across India, based on domains including health, nutrition, education, agriculture,

financial inclusion, and basic infrastructure, benchmarking progress in part against independent metric surveys such as the NFHS [8].

Evidence from related health domains demonstrates that pronounced disparities persist across these settings. For example, anemia among women of reproductive age increased from 53% to 57% nationally between NFHS-4 and NFHS-5 but rose from 58.7% to 61.1% in AD, remaining systematically higher across survey rounds [9]. This pattern underscores the concern that structural disadvantages defining "Aspirational" status may intersect with broader chronic disease profiles.

Despite substantial research on regional health disparities, several critical knowledge gaps persist across the current literature. First, existing district-level NCD investigations using NFHS-5 have focused primarily on the general adult population or selected states rather than systematically evaluating the Aspirational versus Non-Aspirational divide at a national scale [7]. Second, evaluations applying the AD framework have largely concentrated on maternal and child health, child nutrition, and anemia, leaving adult chronic conditions under-researched in these resource-constrained settings [9]. Finally, broad epidemiological surveys on chronic disease burden typically disaggregate data by state, gender, and rural-urban residence without accounting for the AD designation [5, 6, 10], obscuring how targeted developmental priority status intersects with women's chronic disease epidemiology.

Consequently, it remains unclear how the prevalence and associated factors of chronic diseases among women compare across these district categories. Given that NFHS-5 fieldwork (2019–2021) coincided with the early implementation window of the ADP (launched in 2018), cross-sectional survey data cannot evaluate causal programme impacts or determine whether the intervention reduced disease risk. Rather, comparing AD and NAD provides a valuable baseline assessment of whether structural disadvantage corresponds to lower self-reported NCD burdens or whether chronic disease-associated factors mirror the widespread gaps observed in other health conditions like anemia.

Against this background, the present study utilized nationally representative data from the fifth round of the National Family Health Survey (NFHS-5), conducted in 2019–2021, to estimate and compare the prevalence of selected NCDs individually and as a composite measure of any NCD among women aged 15–49 years in AD and NAD of India. The study further examined the associations of sociodemographic and behavioural factors with reporting of any NCD in AD and NAD, including whether these associations differed by district status.

2. Methodology

Data

This study draws on secondary data from the fifth round of the National Family Health Survey (NFHS-5, 2019-2021). NFHS is the Indian version of the Demographic and Health Survey, led by the Ministry of Health and Family Welfare, Government of India, and managed by the International Institute for Population Sciences (IIPS), Mumbai. The survey employed a multi-stage stratified sampling design representative at the national, State/union territory (UT), and district levels, covering 28 states and 8 UTs. The survey collected data on demographic characteristics, socioeconomic status, reproductive and child health, and self-reported morbidity, including diagnosed NCDs, through separate household, women's, and men's schedules [11]. The present analysis is restricted to aged 15-46 years completed interviews (n=724,115).

Aspirational Districts

Under NITI Aayog's baseline framework, 112 districts were identified under the ADP [8]. When cross-referenced with the NFHS-5 (2019–2021) sampling frame, 109 districts matched directly as surveyed districts in the ADP list. The remaining three ADP districts, Parvathipuram Manyam and Alluri Sitharama Raju in Andhra Pradesh, and Jayashankar Bhupalpally in Telangana, were established through subsequent state-level administrative reorganizations and were not enumerated as discrete sampling units in NFHS-5 ($112 - 3 = 109$). To preserve demographic coverage and avoid exclusion bias, these three reorganized districts were mapped back to their respective undivided parent districts as sampled in NFHS-5: Visakhapatnam, East Godavari, Srikakulam, and Vizianagaram (parent units for the two Andhra Pradesh districts), and Karimnagar and Warangal Rural (parent units for Jayashankar Bhupalpally).

To ensure consistency between the ADP classification and the district-level sampling frame used in NFHS-5, the original list of 112 AD was increased to 115 districts (**Table A**). For complete mapping details, refer to the **Supplementary Material S1**. Because district restructuring occurred after the NFHS-5 sampling design, the operational sample was harmonized. The final 115 Districts were accordingly disaggregated and categorized into AD (n = 122,338) and the remaining 592 into NAD (n = 601,777) for the present analysis.

Outcome Variables

The primary outcome variables comprised seven self-reported NCDs recorded in NFHS-5. Information on each condition was gathered using the standard survey question *'Do you currently have (a) Diabetes, (b) Hypertension, (c) Chronic respiratory disease including asthma, (d) Goitre or any other thyroid disorder, (e) Any heart disease, (f) Cancer, and (g) Chronic kidney disease?"* with response options categorized as *Yes*, *No*, and *Don't know*. For the present analysis, each condition was dichotomized into a binary variable (1 = *Yes*; 0 = *No* or *Don't know*). Additionally, a composite outcome variable, *'any NCD'*, was computed and coded as 1 if any respondent reported having at least one of the seven conditions, and 0 if they reported none.

Explanatory Variables

The explanatory variables comprised respondents' age (15–24, 25–34, and 35–49 years), educational attainment (no schooling, primary, secondary, and higher), marital status (never in union, currently married, and widowed/divorced/separated), place of residence (urban or rural), religion (Hindu, Muslim, Christian, and others), social group/caste (Scheduled Caste [SC], Scheduled Tribe [ST], Other Backward Class [OBC], and General), and wealth quintile (poorest, poorer, middle, richer, and richest). Substance use was assessed using three binary indicators (Yes/No): consumption of alcohol, use of smoking

Table A. Sample Stratification Protocol.

Step	Description	District Count
Baseline ADP Districts	Total districts identified under the NITI Aayog framework.	**112**
Direct NFHS-5 Matches	Number of Districts that are identical across both administrative frames.	**109**
Unmatched Reorganized Units	Number of Districts that are not identical across both administrative frames. Excluded (*Parvathipuram Manyam, Alluri Sitharama Raju, Jayashankar Bhupalpally*)	**-3**
Surveyed Parent Proxies	Mapped parent districts included (*Visakhapatnam, East Godavari, Srikakulam, Vizianagaram, Karimnagar, Warangal Rural*)	**+6**
Final Analytical Sample Districts	Total units included in the AD category for analysis.	**115**

Note: ADP = Aspirational District Program.

tobacco (e.g., cigarettes, bidis), and use of smokeless tobacco (e.g., gutkha, khaini). To account for geographical heterogeneity, States/UTs were grouped into six regions according to NFHS national report as follow: North (Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Ladakh, Punjab, Rajasthan, Uttarakhand), Central (Chhattisgarh, Madhya Pradesh, Uttar Pradesh), East (Bihar, Jharkhand, Odisha, West Bengal), Northeast (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura), West (Dadra & Nagar Haveli and Daman & Diu, Goa, Gujarat, Maharashtra), and South (Andaman & Nicobar Islands, Andhra Pradesh, Karnataka, Kerala, Lakshadweep, Puducherry, Tamil Nadu, Telangana).

Statistical Analysis

To account for the multi-stage, stratified cluster sampling design of NFHS-5, all statistical analyses were performed using complex survey design commands (svy) in Stata 17. The sampling design was declared using the svyset command, incorporating the Primary Sampling Units (PSUs/clusters; variable v021), sampling strata (variable v022), and individual sampling weights (normalized national weights; variable v005). Incorporating these parameters adjusted standard errors and confidence intervals for clustering, stratification, and unequal selection probabilities. In NFHS-5, standard demographic and socioeconomic variables have very low rates of missingness (typically under 1%). For our multivariable survey logistic regression analyses, we employed complete case analysis.

Descriptive statistics; both unweighted frequencies and survey-weighted percentages were computed to characterize the study population and compare the sociodemographic profile of AD versus NAD. Bivariate associations between dependent and independent variables across district categories were evaluated using Pearson's chi-square tests. Multicollinearity diagnostics were performed, and all variance inflation factor (VIF) values were found to be low (mean VIF = 1.28, range 1.00–1.74), indicating no evidence of collinearity (results are provided in **Supplementary Material S2)**. Multivariable survey logistic regression models (svy: logit) were fitted separately for AD and NAD to identify the associated factors of having "any NCD". Results were reported as adjusted odds ratios (AOR) with 95% confidence intervals (CI) and associated design-adjusted *p*-values. Statistical significance was evaluated at $p < 0.05$.

Further, to assess whether associations between the explanatory variables and reporting of any NCD differed between AD and NAD, a pooled survey-weighted multivariable logistic regression model was fitted, including interaction terms between district status (AD vs. NAD) and each explanatory variable. The interaction terms were assessed using design-adjusted Wald tests, and overall P-values for interaction were reported. A statistically significant interaction was interpreted as evidence that the association between the respective factors and reporting of any NCD differed by district status. All analyses accounted for the complex survey design and sampling weights of NFHS-5.

For geographical representation, district-level prevalence estimates were computed using survey weights, which were then merged with district boundary shapefiles obtained from the DHS Spatial Data Repository (https://dhsprogram.com/). Choropleth maps were generated using QGIS (version 3.x) to depict the spatial distribution of NCD prevalence across AD and NAD.

3. Results

3.1 Sociodemographic profile of the study population.

Table 1 presents the sociodemographic and behavioral characteristics of 724,115 women, including 13.5% from the AD and 86.5% from the NAD categories. Women in AD had lower educational attainment, greater rural residence, higher ST representation, and substantially greater concentration in the poorest wealth quintile than women in NAD. Women in AD were disproportionately concentrated in the East region (42.8% vs. 19.6%). Substance use was uncommon overall, although alcohol and tobacco use were slightly more prevalent in AD. Most participants were aged 35–49 years (36.5%) were currently married (72.0%) and belonged to Hindu (81.4%) and OBC categories in both groups.

3.2 Prevalence of NCD across Aspirational and Non-Aspirational Districts.

Table 2 presents the weighted prevalence of selected self-reported NCDs (N = 724,115) in women. The overall prevalence of NCDs among women in the study population was low, with hypertension being the most commonly reported condition (4.72%), followed by thyroid disorder (2.68%), diabetes (1.88%), and asthma (1.61%).

Heart disease, kidney disease, and cancer were rare, each affecting less than 1% of the sample. The prevalence of most listed diseases was significantly lower in AD compared to NAD, including diabetes (1.60% vs. 1.92%), hypertension (4.17% vs. 4.80%), asthma (1.37% vs. 1.64%), and thyroid disorder (2.00% vs. 2.79%) (all $p < 0.001$). Cancer prevalence was modestly higher in AD than in NAD (0.17% vs. 0.12%, $p = 0.028$). Although statistically significant, differences for cancer and kidney disease are very small in absolute clinical terms and should be interpreted cautiously. Overall, consistent with individual disease patterns, a significantly higher proportion of women in NAD reported having any NCD

Table 1. Sociodemographic profile of the study population across aspirational and non-aspirational districts, NFHS-5, 2019-21. (Weighted%)

Background Characteristics	AD (%)	NAD (%)	Combined (%)	*N*
District status				
AD	-	-	13.5	122,338
NAD	-	-	86.5	601,777
Age Group				
15–24	36.1	33.0	33.4	241,180
25–34	29.7	30.1	30.0	219,428
35–49	34.2	36.9	36.5	263,507
Education				
No schooling	33.2	20.9	22.6	168,285
Primary	18.6	18.5	18.6	134,072
Secondary	38.2	44.0	43.2	319,942
Higher	10.1	16.5	15.7	101,816
Marital Status				
Never married	23.0	23.9	23.8	181,285
Married	72.9	71.9	72.0	512,408
Widowed/divorced/separated	4.1	4.3	4.2	30,422
Residence				
Rural	80.8	65.4	67.5	544,580
Urban	19.2	34.6	32.5	179,535
Religion				
Hindu	80.5	81.5	81.4	546,007
Muslim	14.0	13.4	13.5	90,729
Christian	2.8	2.3	2.4	52,146
Others	2.7	2.8	2.8	35,233
Caste				
SC	18.8	22.4	21.9	139,957
ST	16.9	8.1	9.3	135,239
OBC	45.0	42.6	42.9	276,881
Others	19.3	26.9	25.9	172,038
Wealth Quintile				
Poorest	33.3	16.2	18.5	149,844
Poorer	24.3	19.3	20.0	160,340
Middle	18.6	20.8	20.5	151,505
Richer	14.5	21.8	20.8	139,607
Richest	9.4	21.9	20.2	122,819
Consume alcohol				
Yes	1.2	0.7	0.8	13,528
No	98.8	99.3	99.2	710,587
Use smoking tobacco				
Yes	0.1	0.1	0.1	1,421
No	99.9	99.9	99.9	722694
Use smokeless tobacco				
Yes	0.4	0.3	0.3	5,153
No	99.6	99.7	99.7	718962
Region				
North	8.8	14.9	14.1	147,615
Central	20.9	25.5	24.9	170,002
East	42.8	19.6	22.8	118,357
Northeast	5.3	3.4	3.7	103,433
West	4.7	15.6	14.1	71,841
South	17.5	20.9	20.5	112,867
Total	**100.0**	**100.0**	**100.0**	**724,115**

Note: N = unweighted cases; AD = aspirational districts; NAD = non-aspirational districts; SC = Schedule Caste; ST = Schedule Tribe; OBC = Other Backward Classes, N represents unweighted counts; % represents weighted proportions. Substance-use variables reflect valid responses among eligible respondents. Table presents baseline descriptive characteristics; no hypothesis testing was performed.

Table 2. Prevalence (%) of Non-Communicable Diseases among Women in Aspirational and Non-Aspirational Districts (Weighted %, N = 724,115)

NCDs	AD	NAD	Combined	p-values	*N*
Diabetes	1.60	1.92	1.88	<0.001	12,106
Hypertension	4.17	4.80	4.72	<0.001	33,148
Asthma	1.37	1.64	1.61	<0.001	9,897
Thyroid disorder	2.00	2.79	2.68	<0.001	16,654
Heart disease	0.83	0.70	0.72	0.328	5,331
Cancer	0.17	0.12	0.12	0.028	940
Kidney disease	0.56	0.58	0.58	0.028	4,421
Any NCD	**6.77**	**10.58**	**9.93**	**<0.001**	**66,798**

Note: AD = aspirational districts; NAD = non-aspirational districts; P-values are based on the Pearson Chi-square test of significance; N = unweighted cases.

compared to AD (10.58% vs. 6.77%, $p < 0.001$; **Table 2**).

3.3 Prevalence of Any NCD among Women by Sociodemographic Characteristics across Aspirational and Non-Aspirational Districts.

Table 3 shows that the overall prevalence of any NCD among women aged 15–49 years was substantially lower in AD (6.77%; n=9,168) than in NAD (10.58%; n=57,630). Across both settings, disease prevalence demonstrated a pronounced age gradient (p<0.001), rising from 3.18% in AD and 3.61% in NAD among women aged 15–24 years to 14.62% and 17.16%, respectively, among those aged 35–49 years. Marital dissolution also tracked with higher burden, as widowed, divorced, or separated women reported the highest rates (15.29% in AD; 16.82% in NAD), whereas never-married women reported the lowest (<3.5%). A marked socioeconomic gradient was evident across both groups (p<0.001). Prevalence scaled steeply with household economic status, rising from 5.71% in the poorest quintile to 14.22% in the richest quintile in AD, and from 7.32% to 12.57% in NAD. While rural women in AD reported lower rates than those in NAD (7.61% vs. 9.16%), urban prevalence was virtually identical across district types (12.03% vs. 12.06%). By social group, Scheduled Tribe (ST) women reported the lowest prevalence (4.52% in AD; 6.45% in NAD), whereas women in the "Others" caste category had the highest burden (11.70% and 12.62%, respectively). Geographically and behaviorally, notable divergences emerged. Regionally, NCD prevalence peaked in the South for AD (13.73%) and in the East for NAD (12.66%), while the lowest rates were in the West for AD (4.70%) and the Central region for NAD (6.95%). Women who smoked tobacco exhibited significantly elevated prevalence across both district groups

(13.78% in AD; 13.86% in NAD). Alcohol consumption and smokeless tobacco use were both significantly linked to higher NCD burden in NAD ($p<0.001$), whereas in AD, smokeless tobacco showed no significant association ($p=0.082$) and alcohol consumption was associated with lower reported prevalence (6.50% vs. 8.49%, $p=0.003$).

3.4 District-level prevalence of any self-reported NCD.

Figure 1 illustrates substantial geographic variation in the survey-weighted prevalence of any self-reported NCD across both AD and NAD. Prevalence ranged from 0.89% to 22.21% in AD and from 0.94% to 30.29% in NAD, reflecting a wider spread in NAD. Further, lower prevalence levels (less than 5%) were observed predominantly across districts in the central tribal belt, whereas higher prevalence levels were visible in southern and northwestern India.

Among AD, higher-burden districts were concentrated primarily in Andhra Pradesh and Telangana, with elevated levels also observed in parts of Punjab and Jammu & Kashmir (**Figure 1A**). Within the NAD category, particularly high prevalence was evident across Kerala alongside districts in Punjab and Haryana (**Figure 1B**). Overall, the prevalence distribution was more compressed in AD, whereas NAD exhibited a wider upper tail driven largely by high rates in Kerala.

District sample sizes varied across categories but remained sufficient (above 200 respondents per districts), supporting reliable spatial mapping. The lowest counts were observed in Khandwa (562), Singrauli (643), Chandel (757), Srikakulam (780), and Kiphire (799) among AD, and in Jabalpur (216), Bhopal (337), Raisen (474), Kra Daadi (524), and Mumbai Suburban (552) among NAD.

3.5 Factors associated with the reporting of NCD: Logistic Regression.

Table 4 presents the pooled adjusted logistic regression model results. In the pooled adjusted model, women in NAD had higher odds of reporting any NCD than those in AD (AOR 1.14, 95% CI: 1.11–1.16; $p<0.001$), after adjustment for sociodemographic and behavioural factors.

Further, separate logistic regression models predicting "any NCD" were fitted for the AD and NAD populations. Both models showed similar patterns of association, summarized below. **Table 5** presents logistic regression models examining correlates of reporting any self-reported NCD separately for women in AD and NAD. Overall, the pattern of associations was largely similar across both models. Age showed the strongest association with NCD prevalence. Compared with women aged 15–24 years, the odds of reporting any NCD were substantially higher among women aged 25–34 years (adjusted odds ratio [AOR] 1.91, 95% confidence interval [CI] 1.76–2.08; and AOR 1.81, CI 1.75–1.88) and 35–49 years (AOR 3.80, CI 3.51–4.13; and AOR 3.70, CI 3.57–3.83) for both AD and NAD, respectively, and all $p < 0.001$. Primary and secondary education were associated with modestly higher odds of NCDs in both groups, while higher education was significant only in NAD.

Muslim and other religious groups had higher odds of NCDs than Hindus in both AD and NAD; Christian women had higher odds only in NAD. Relative to SC, ST and OBCs had significantly lower odds of NCDs, whereas women from other caste groups had slightly higher odds. Married and widowed/divorced/separated women had higher odds of NCDs than women never in union, with the strongest association observed among widowed/divorced/separated women. A clear positive wealth gradient was evident in both groups. Compared with the poorest quintile, the odds of NCDs increased progressively across wealth categories, reaching 1.88 (1.70–2.07) in AD and 1.76 (1.69–1.83) in NAD for the richest quintile. Urban residence was associated with a small but significant increase in NCD odds in both groups.

Regional patterns were broadly consistent, with lower odds in the Central and Western regions. The East showed lower odds in AD (AOR 0.78, CI 0.72–0.83) but higher odds in NAD (AOR 1.28, CI 1.24–1.32), indicating a notable divergence by district type. The Northeast and South had modestly higher odds than the North. Among behavioral factors, cigarette smoking was associated with higher NCD odds in both AD (AOR 1.74, CI 1.16–2.62) and NAD (AOR 1.71, CI 1.47–2.00). Alcohol consumption and tobacco chewing were significant associated factors only in NAD, whereas neither was significantly associated with NCD in AD.

Further, to assess whether the observed associations differed statistically between AD and NAD, interaction terms between district status and the explanatory variables were included in a regression model. Interaction analysis showed that the associations of some factors with reporting of any NCD differed significantly between ADs and NADs. Significant interactions were observed for caste, region, alcohol consumption, and smokeless tobacco use ($P<0.05$), indicating that their associations with NCD reporting varied by district status. In contrast, no significant interaction was observed for age, education, marital status, place of residence, religion, wealth quintile, or smoking tobacco ($P>0.05$), suggesting that the associations of these factors with NCD reporting did not differ statistically between AD and NAD.

4. Discussion

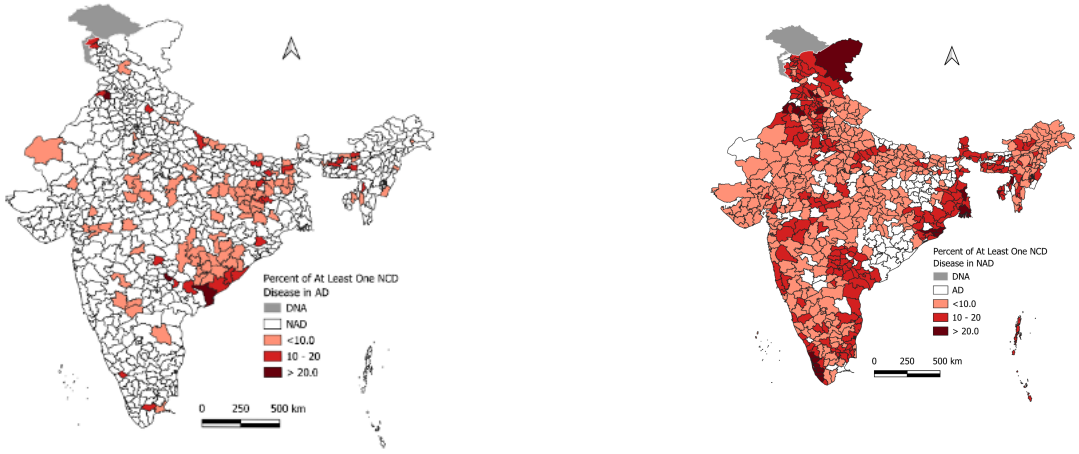
This study evaluated the sociodemographic, economic, and behavioral determinants of self-reported NCD among 724,115 women of reproductive age across India, providing a comparative assessment between AD and NAD using NFHS-5 data. In alignment with the baseline targeting framework of the ADP established by NITI Aayog, women residing in AD displayed markedly higher levels of structural deprivation, being predominantly rural, less educated, concentrated within poorer wealth quintiles, and having higher representation from Scheduled Tribe communities [12]. This pattern aligns with prior evaluations documenting substantial baseline deprivation across health and nutrition indicators in these districts [14]. Despite this pronounced socioeconomic disadvantage, the overall prevalence of reporting any NCD was substantially lower in AD (6.77%) compared to NAD (10.58%), a differential that persisted after multivariable adjustment across the pooled sample (AOR: 1.14; 95% CI: 1.11–1.16). This paradoxical pattern is consistent with the initial phases of the epidemiological transition in low and middle income settings, wherein metabolic and lifestyle disorders manifest first among affluent and urban

Table 3. Prevalence (%) of Any NCD among Women by Background Characteristics across Aspirational and Non-Aspirational Districts (N=724,115).

Background Characteristics	AD (N=122,338) Prevalence^	*n*	NAD (N=601,777) Prevalence^	*n*
Age Group	p<0.001		p<0.001	
15–24	3.18	1,270	3.61	7,088
25–34	7.77	2,514	8.76	15,212
35–49	14.62	5,384	17.16	35,330
Education	p<0.001		p<0.001	
No education	8.99	3,191	11.11	13,518
Primary	10.05	2,013	12.34	12,692
Secondary	7.27	3,146	9.26	23,688
Higher	8.28	818	8.93	7,732
Marital Status	p<0.001		p<0.001	
Never married	2.91	821	3.28	5,291
Married	9.83	7,701	12.06	48,425
Widowed/divorced/separated	15.29	646	16.82	3,914
Place of Residence	p<0.001		p<0.001	
Rural	7.61	7,169	9.16	38,715
Urban	12.03	1,999	12.06	18,915
Religion	p<0.001		p<0.001	
Hindu	8.27	6,516	9.74	40,987
Muslim	8.95	1,617	11.33	8,328
Christian	10.16	503	14.34	4,414
Others	10.04	532	13.60	3,901
Caste	p<0.001		p<0.001	
SC	7.93	1,651	10.10	11,576
ST	4.52	1,454	6.45	7,482
OBC	8.78	3,581	9.35	20,422
Others	11.70	2,482	12.62	18,150
Wealth Quintile	p<0.001		p<0.001	
Poorest	5.71	2,170	7.32	6,987
Poorer	7.37	2,091	8.45	10,311
Middle	9.57	1,914	9.96	12,224
Richer	11.47	1,700	11.57	13,725
Richest	14.22	1,293	12.57	14,383
Region	p<0.001		p<0.001	
North	10.45	1,653	10.78	15,010
Central	5.87	1,503	6.95	9,034
East	7.32	2,746	12.66	8,036
Northeast	10.58	1,389	11.35	8,589
West	4.70	282	8.50	5,060
South	13.73	1,595	12.34	11,901
Consume Alcohol	p<0.003		p<0.001	
No	8.49	8,972	10.14	56,431
Yes	6.50	196	13.57	1,199
Use Smoking Tobacco	p<0.001		p<0.001	
No	8.46	9,139	10.16	57,413
Yes	13.78	29	13.86	217
Use Smokeless Tobacco	p<0.082		p<0.001	
No	8.46	9,096	10.15	57,110
Yes	8.75	72	13.93	520

Note: "Any NCD" refers to self-report of at least one of: diabetes, hypertension, asthma, thyroid disorder, heart disease, cancer, or kidney disease; P-values are based on the Pearson Chi-square test of significance; ^ weighted prevalence; NCD = non-communicable disease; N = unweighted cases; AD = Aspirational Districts; NAD = Non-Aspirational Districts; SC = Schedule Caste; ST = Schedule Tribe; OBC = Other Backward Classes.

Figure 1. District-level prevalence of any self-reported NCD across Aspirational (A) and Non-Aspirational (B) Districts, NFHS-5, 2019–21.



A. Aspirational Districts **B. Non-Aspirational Districts**

Note: "Any NCD" refers to self-report of at least one of: diabetes, hypertension, asthma, thyroid disorder, heart disease, cancer, or kidney disease; AD = Aspirational Districts; NAD = Non-Aspirational Districts.

populations before permeating disadvantaged strata [7, 14, 15]. However, the lower crude morbidity observed in AD must be interpreted with caution, as it largely reflects an awareness and diagnostic gap driven by constrained screening infrastructure, lower health literacy, and limited healthcare access, rather than a genuine biological

Table 4. Adjusted Associations between District Status and Reporting of Any NCD among Women 15 to 49 Years in India.

Variable	AOR (95% CI)ˆ	p-values
Aspirational status		
AD (ref)	1.00	
NAD	1.14 (1.11–1.16)	<0.001
Constant	0.021 (0.020–0.022)	<0.001
Log likelihood	-206331.29	
Pseudo R2	0.074	
LR chi2	32969.01	
Final analytical N	724,115	
Model P values	<0.001	

Note: ˆno multicollinearity detected (mean VIF = 1.28, range 1.00–1.74). Model is adjusted for age, education, marital status, place of residence, religion, caste, wealth quintile, region, alcohol consumption, use of smoking tobacco, and use of smokeless tobacco. "any NCD" refers to self-report of at least one of disease listed in the NFHS data set that are diabetes, hypertension, asthma, thyroid disorder, heart disease, cancer, or kidney disease. AOR = Adjusted Odds Ratio; CI = Confidence Interval.

Table 5. Factors Associated with Reporting of any NCD among Women in Aspirational and Non-Aspirational Districts and Test for Interaction by District Status.

Background characteristics	AD AOR (95% CI)ˆ	p-values	NAD AOR (95% CI)ˆ	p-values	p-values for Interaction Test
Age Group					0.426
(ref: 15–24)					
25–34	1.91 (1.76–2.08)	<0.001	1.81 (1.75–1.88)	<0.001	
35–49	3.80 (3.51–4.13)	<0.001	3.70 (3.57–3.83)	<0.001	
Education					0.983
(ref: No education)					
Primary	1.23 (1.16–1.31)	<0.001	1.23 (1.19–1.26)	<0.001	
Secondary	1.18 (1.11–1.25)	<0.001	1.16 (1.13–1.19)	<0.001	
Higher	1.08 (0.98–1.19)	0.128	1.08 (1.04–1.12)	<0.001	
Marital Status					0.525
(ref: Never in union)					
Married	1.62 (1.48–1.78)	<0.001	1.67 (1.61–1.73)	<0.001	
Widowed/divorced/separated	2.00 (1.77–2.27)	<0.001	1.96 (1.86–2.06)	<0.001	
Place of Residence *(ref: Rural)*					0.983
Urban	1.08 (1.02–1.15)	0.011	1.08 (1.06–1.11)	<0.001	
Religion					0.073
(ref: Hindu)					
Muslim	1.21 (1.13–1.29)	<0.001	1.28 (1.25–1.32)	<0.001	
Christian	1.08 (0.97–1.20)	0.180	1.23 (1.18–1.28)	<0.001	
Others	1.34 (1.21–1.48)	<0.001	1.33 (1.28–1.38)	<0.001	
Caste *(ref: SC)*					<0.001
ST	0.59 (0.54–0.64)	<0.001	0.67 (0.65–0.70)	<0.001	
OBC	0.91 (0.85–0.97)	0.003	0.86 (0.83–0.88)	<0.001	
Others	1.09 (1.01–1.17)	0.025	1.06 (1.03–1.09)	<0.001	
Wealth Quintile					0.758
(ref: Poorest)					
Poorer	1.22 (1.15–1.31)	<0.001	1.18 (1.14–1.22)	<0.001	
Middle	1.43 (1.33–1.54)	<0.001	1.37 (1.32–1.42)	<0.001	
Richer	1.65 (1.52–1.79)	<0.001	1.60 (1.54–1.65)	<0.001	
Richest	1.88 (1.70–2.07)	<0.001	1.76 (1.69–1.83)	<0.001	
Region					<0.001
(ref: North)					
Central	0.67 (0.62–0.73)	<0.001	0.71 (0.69–0.73)	<0.001	
East	0.78 (0.72–0.83)	<0.001	1.28 (1.24–1.32)	<0.001	
Northeast	1.13 (1.03–1.23)	0.007	1.09 (1.05–1.13)	<0.001	
West	0.50 (0.44–0.58)	<0.001	0.68 (0.66–0.70)	<0.001	
South	1.17 (1.08–1.27)	<0.001	1.08 (1.05–1.11)	<0.001	
Consume Alcohol *(ref: No)*					0.017
Yes	0.92 (0.79–1.08)	0.319	1.13 (1.06–1.21)	<0.001	
Use Smoking Tobacco *(ref: No)*					0.946
Yes	1.74 (1.16–2.62)	0.008	1.71 (1.47–2.00)	<0.001	
Use Smokeless Tobacco *(ref: No)*					0.023
Yes	0.95 (0.74–1.22)	0.703	1.30 (1.18–1.43)	<0.001	
Constant	**0.021 (0.02–0.02)**	**<0.001**	**0.021 (0.02–0.02)**	**<0.001**	**0.021 (0.02-0.02)**
Log likelihood	**-29906.125**		**-176203.88**		**-206110**
Pseudo R2	**0.0818**		**0.0725**		**0.0750**
Final analytical N	**122,338**		**601,777**		**724,115**
Model *P values*	**<0.001**		**<0.001**		**<0.001**

Note: ˆno multicollinearity detected (mean VIF = 1.28, range 1.00–1.74). AOR = Adjusted Odds Ratio; CI = Confidence Interval. Reference categories in parentheses. AORs are exponentiated regression coefficients of reporting any NCD; "any NCD" refers to self-report of at least one of: diabetes, hypertension, asthma, thyroid disorder, heart disease, cancer, or kidney disease; AD = Aspirational Districts; NAD = Non-Aspirational Districts; SC = Schedule Caste; ST = Schedule Tribe; OBC = Other Backward Classes.

advantage [16].

The multivariable regression models further clarify this structural dynamic. While unadjusted estimates in AD suggested complex patterns, adjusted analyses demonstrated a monotonic positive wealth gradient across both AD and NAD, with women in the richest wealth quintile exhibiting nearly twofold higher odds of reporting an NCD relative to the poorest quintile. This alignment indicates that once structural confounding is controlled, economic affluence functions as a marker for nutrition and sedentary lifestyle transitions, corroborating earlier epidemiological observations across Indian cohorts [7, 17, 18]. Moreover, the convergence of prevalence between urban women in AD (12.03%) and NAD (12.06%) reinforces the hypothesis that spatial disparities equalize where physical and financial access to diagnostic facilities are comparable. Across both district categories, older age (35–49 years) and marital dissolution (widowed, divorced, or separated status) emerged as significant independent risk factors, reflecting cumulative metabolic exposure and the adverse impacts of psychosocial stress, economic precarity, and social vulnerability on women's health. Scheduled Tribe women demonstrated significantly lower odds of NCD diagnosis relative to Scheduled Caste groups in both settings, which likely mirrors severe barriers to routine clinical contact in remote tribal geographies rather than

true clinical absence.

Spatial mapping highlighted substantial geographic heterogeneity, with high-prevalence clusters concentrated in southern India (such as Kerala, Andhra Pradesh, and Telangana) as well as northwestern states (Punjab and Haryana), driven by advanced demographic transitions and higher health-seeking behaviors [5, 7]. In contrast, districts across the central tribal belt exhibited lower reported rates. Behavioral indicators demonstrated that tobacco smoking remained a significant risk factor across both AD (AOR: 1.74) and NAD (AOR: 1.71), underscoring the critical need for targeted cessation interventions among young and marginalized women [19]. Conversely, alcohol and smokeless tobacco use were significantly associated with NCD reporting only in NAD, an inconsistency likely explained by low statistical power from small user cell counts in AD, social desirability bias, or delayed health-seeking behavior whereby substance-related chronic ailments remain undiagnosed until advanced symptomatic stages.

5. Limitations

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional nature of the NFHS-5 survey precludes causal inference, restricting all identified associations between district status, sociodemographic factors, and NCD outcomes to correlational interpretations. Second, the outcome measures relied entirely on self-reported, physician-diagnosed conditions without confirmation from clinical or laboratory biomarkers (such as direct blood pressure or fasting blood glucose measurements), which introduces substantial under-reporting bias in resource limited districts where screening availability is low. Third, the study population was restricted to women aged 15–49 years, limiting the generalizability of these findings to men and older post-reproductive women who bear the highest cumulative burden of chronic disease. Fourth, behavioral variables such as smoking, tobacco chewing, and alcohol consumption were self-reported and subject to recall and social desirability biases, which frequently lead to under-reporting among women in South Asian cultural contexts.

6. Conclusion and Recommendations

This study examined the prevalence and correlates of self-reported NCDs among 724,115 women aged 15–49 years in India, comparing AD with NAD using NFHS-5 (2019-21) data. Women in AD were consistently more socioeconomically disadvantaged than those in NAD, being more rural, less educated, poorer, and disproportionately concentrated in the Eastern region and among ST populations. Despite this greater structural disadvantage, the unadjusted prevalence of nearly all individual NCDs, as well as the composite "any NCD" outcome, was paradoxically lower in the AD category (6.77% vs. 10.58%). Adjusted logistic regression, however, revealed that once age, education, wealth, and other sociodemographic factors were held constant, wealth emerged as a strong positive predictor of NCD odds in both district categories, and regional associations diverged notably between AD and NAD particularly in the East, which was protective in AD but a risk factor in NAD indicating that the crude relationship between district deprivation and NCD prevalence is confounded by underlying demographic and geographic structure. The interaction analysis further indicated that the associations of caste, region, alcohol consumption, and smokeless tobacco use with reporting of any NCD differed significantly between AD and NAD, highlighting the importance of considering district context when interpreting associated factors of NCDs.

As India's epidemiological transition continues to extend the NCD burden beyond urban, affluent populations into poorer and more rural communities, more focused programs in ADs for early diagnosis and management of NCDs can be helpful for the already vulnerable population. These findings carry clear implications for policy and programme design. Strengthening of NCD screening infrastructure, particularly community-based blood pressure and blood glucose screening, etc., should be prioritized within the ADP alongside its existing focus on nutrition, maternal-child health, and infrastructure development. Future research employing clinically measured NCD indicators and longitudinal designs would help disentangle true epidemiological differences and would support more precisely targeted interventions.

Declarations

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Google Gemini to improve language and readability. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the final content of the publication.

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Conflict of interest

The authors declare no conflict of interest.

Ethics approval

Not applicable; This study involved secondary analysis of de-identified data from the National Family Health Survey (NFHS-5), 2019–21. Ethical approval for the NFHS-5 survey was obtained from the Institutional Review Board (IRB) of the International Institute for Population Sciences, Mumbai, India. Written and informed consent was obtained from each respondent participating in the survey. No separate institutional ethical approval was required for this secondary data analysis. Access to the NFHS-5 data was obtained by making a formal request on the official website (https://dhsprogram.com/) of the Demographic and Health Surveys (DHS) Program.

Consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and material

The data used in this study are from the National Family Health Survey (NFHS), the Indian version of the Demographic and Health Surveys (DHS) Program, which is publicly available through the DHS Program at https://dhsprogram.com, subject to the applicable data-access requirements. The shape file of spatial data was

downloaded from the Spatial Data Repository Boundaries at https://dhsprogram.com/data/dataset/India_Standard-DHS_2020.cfm?flag=1.

Code availability

The Stata analysis scripts are available from the corresponding author upon reasonable request.

Authors' contributions

Channabassappa Noolvi: Conceptualization, Methodology, Data curation, Formal analysis, Writing – review and editing. *Javeed Golandaj*: Conceptualization, Methodology, Supervision, Formal analysis, Writing – original draft, Writing – review and editing. *Siddapp Mali*: Data curation, Formal analysis. *Mallikarjun S. Kampli*: Formal analysis, Writing – review and editing, and *Sangamesh Godenavar*: Data curation, Formal analysis.

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