Socioeconomic patterns in tobacco consumption over time in India: Examining trends from NFHS 2 and 3 in light of the Cigarette Epidemic Model

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Socioeconomic patterns in tobacco consumption over time in India: Examining trends from NFHS 2 and 3 in light of the Cigarette Epidemic Model

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ABSTRACT: (250 words)

Objectives: India bears a significant portion of the global tobacco burden with high prevalence of tobacco among men (47%) and women (14%). Smoking, chewing and dual use (smoking and chewing) in India show socioeconomic and spatial gradients among both men and women.

Design: Cross-sectional Surveys, NFHS -2 and 3, India

Setting & participants: 131,464 men and 130,886 women (NFHS-2) and 69,755 men and 124,142 women (NFHS -3) in India

Outcomes & methods: Survey-weighted age-standardized prevalence and relative percentage change over time in smoking, chewing tobacco and Dual Use of tobacco. Multi-level models with state, local area and individual as analytical levels were used to estimate probability of smoking and chewing, and significance of the trend.

Findings: a) increases in tobacco consumption among men with sharper inequalities in smoking compared to chewing; higher risks for the less educated, poorer, rural and lower caste populations, b) greater change in risk and percentage increases among high educated, urban, richer groups, previously unreported, c) low and declining smoking risks and unclear patterns in chewing among women, d) significant increases in smoking and chewing prevalence among younger men, and in chewing prevalence among younger women.

Conclusions: Our results add qualitatively to the propositions of the *Cigarette Epidemic Model* showing significant diversions in the patterns in India compared to developed countries – from gender and socioeconomic perspectives. Given the twin burden of smoking and chewing and their unique challenges, we recommend separate analyses by tobacco type to understand the unique drivers of smoking and chewing in India.

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Article Summary

Article Focus

- India bears a significant burden of tobacco consumption, with high prevalence of smoking and chewing among men & women, and previous studies have established a unique social and spatial gradient in consumption.
- No studies have provided estimates and inferences on changing trends in tobacco consumption over time, either through prevalence or relative risks.
- This study estimates socioeconomic trends and identifies the changing dynamics of tobacco consumption in light of the *Cigarette Epidemic Model.*

Key Messages

- Sharper and rising inequalities for smoking compared to chewing among men, versus low and declining risks for women.
- Higher risks of smoking and chewing among men for the less educated, poorer, rural and lower caste populations, but greater increases in risks among the high educated, urban, richer groups, previously unreported.
- significant increases in smoking and chewing prevalence among younger men, and in chewing prevalence among younger women.

Strengths & limitations

- First systematic examination of socioeconomic trends in tobacco consumption in India and linking it to a previously developed model to understand tobacco consumption transition.
- Estimates for relative risk, age-standardised prevalence and percentage change over time, highlighting vulnerable groups.
- Limitations include inability to differentiate between type of cigarette and estimate the volume of consumption.

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INTRODUCTION

Global estimates indicate that one in ten adult deaths can be attributed to tobacco consumption, leading to approximately 5 million global deaths per year[1]. Of these, 2.4 million deaths occur in developing countries. India bears a significant portion of this global tobacco burden[2-3]. Consumption of both smoked and smoke-less (chewed and inhaled) forms of tobacco is highly prevalent among men (47%) and women (14%)[4]. However, previous studies have indicated that tobacco use, like other Non-Communicable Disease risk factors, is unequally distributed across different social determinants in India – education, caste and wealth – among both men and women[1,4,5,6], indicating a distinct "economic and spatial distribution" in tobacco use[5]. No studies have yet systematically examined trends and changes in the prevalence of tobacco consumption in India by socioeconomic factors over time.

This research paper provides estimates and inferences on the changing gradient of tobacco consumption in India, analysing prevalence patterns from the National Family Health Surveys[7-8]. We discuss our findings in light of the Cigarette Epidemic Model[9-10] and examine what populations show higher and lower prevalence of tobacco consumption over time.

METHODS

Data from the National Family Health Surveys in 1998-9 and 2005-6 (NFHS 2 & 3) was analysed and survey-weighted age-standardized prevalence estimates together with percentage change were estimated. Analysis was restricted to men and women in the age group 15-49 years for comparability. NFHS data covers 99% of India's population and is representative of all states. Details on sample design and survey implementation are provided in the basic survey reports[7-8]. Dependent variables in the analyses included **smoking** (cigarettes, *bidis* and pipes/cigar), **chewing tobacco** (*paan masala, gutkha* or other chewed forms of tobacco) and **dual use** (consuming both smoked and smoke-less

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forms) of tobacco. Independent variables in the analysis include age categories, marital status and education level at the individual level, and household wealth, area of residence, religion and caste/tribe status at the household level (*Variable definitions are provided Table 1*). Multi-level models with state, local area and individual as analytical levels were used to estimate the log odds and probability of smoking and chewing by education and wealth among men and women. Tests for trend including joint tests for significance of time trends and significance of random effects were estimated. Model estimates were maximum likelihood-based using the Iterative Generalized Least-Squares (IGLS) algorithm and controlled for age, marital status and religion.

RESULTS

Data used in this analysis covers 131,464 men and 130,886 women residing in 92,486 households in NFHS-2 and 69,755 men and 124,142 women residing in 109,041 households in NFHS-3, with an overall response rate of 96% for NFHS-2 and 98% for NFHS-3 (Table 1). Change in prevalence of smoking, chewing and dual use of tobacco over survey rounds by education, wealth and caste is shown in table 1, and figures 1-3 show the percentage change in and probability of smoking and chewing by wealth and education among men and women. Additional results on the multilevel models and tests of significance for trends are presented in web tables 1-2, while web table 3 presents the prevalence of smoking and chewing by age, residence, religion and marital status.

Among men, the prevalence of smoking, chewing and dual use of tobacco are seen to unanimously increase across all socioeconomic groups. While the relative prevalence of tobacco use is higher among socioeconomically disadvantaged groups – less educated, lower wealth, living in rural areas or lower caste; higher proportional increase in prevalence over time is seen among social groups with higher SES. E.g. change in smoking prevalence among men in the richest quintile is 63% while that in the poorest quintile is 13%; similarly smoking prevalence among those with post graduate level of education increases by 98% and those with no education increases by 13%. Sharper

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inequalities with greater inter-group differences are seen in smoking compared to chewing. Prevalence of chewing among men in the richest quintile and with post graduate education increased by 49%, while that for the poorest increased by 35% and for the illiterate increased by 37%. Prevalence trends among women were less clear with overall rates staying significantly low compared to men; women in most social groups showed a declining trend for smoking and only scheduled caste women and those with college education showed small increases in smoking and chewing. All prevalence estimates were age standardized. Adjusted probability estimates for smoking and chewing were calculated from multi-level models (figure 3) and probability trends are seen to resonate with prevalence estimates. Tests for trend over time for smoking among men are significant for wealth, education and residence, while for chewing are significant for wealth only (web table 1). Tests for trend over time for smoking among women are significant for wealth and residence, while for chewing significant trend is seen for wealth, education and residence (web table 2). Random effects estimates are seen to be significant at both local area and state level, with higher variation at local area level.

DISCUSSION

In 1994, Lopez et al.[9] proposed the Cigarette Epidemic Model that discussed the transition of smoking prevalence, consumption amount and mortality in developed countries in four stages. In stage I, male prevalence is comparatively low (<15%) and female smoking due to sociocultural factors does not exceed 5%; in stage II, male prevalence rises to 50-80% and female smoking increases at a lagged pace behind men. In stage III, prevalence of smoking among men and women stabilizes at 40% and 35% respectively, and younger populations are seen to smoke more than older populations. In Stage IV, prevalence of smoking gradually declines among both men and women, but the effects of previous stages are seen in high mortality attributable to smoking. In 2011, Thun et al.[10] proposed a modification to this model relevant for developing countries

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where smoking patterns among men and women distinctly differ from patterns noted in developed countries.

Our results show that India is somewhere between stages II and III of the Cigarette Epidemic model for the smoking rates seen for men, but distinctly differs in the prevalence rates seen for women. We note several distinctions in the Indian scenario from the propositions of this model. ***First*****,** the burden of tobacco consumption in India follows two separate trajectories for smoking and chewing, and even within smoking, differences may be seen in the consumption of cigarettes and *bidis* that are combined in most analyses. ***Second****,* a unique socioeconomic and spatial gradient (not reported in the model) is seen in India by the diverse axes – wealth, education and caste – and prevalence results indicates a dichotomy in the understanding of this gradient. We find higher prevalence rates among socioeconomically disadvantaged groups (lower caste, wealth and education levels) but higher relative percentage increases among the socioeconomically advantaged groups (higher caste, wealth and education levels). No other study has reported this finding. We also recommend that analyses by type and amount of tobacco consumed be examined systematically to understand the direction of these trends. ***Third****,* despite women's empowerment in India, large-scale increases in women's smoking are yet to be seen, as seen in the developed countries[11]. Aggregate estimates show that women are far behind men in prevalence rates; and smoking and chewing rates among women, barring a few groups are seen to be declining. ***Finally***, a missing component in understanding the burden of tobacco in India needs to come from cause-specific or cancer mortality studies[12]. Currently, only ecological analyses of these are possible due to lack of surveillance data in India[13], and hence a systematic examination of mortality attributable to tobacco consumption will assist in understanding where India is vis-a-vis this model.

This study is the first systematic examination of trends in socioeconomic distributions of tobacco consumption in India. Data from this analysis is representative and generalizable to the Indian population. However, the limitations of this study include that data is cross-sectional and categories of tobacco consumed are not available for NFHS -2. Despite these, we believe that India is experiencing a unique economic and social transition that

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is likely to manifest in a number of health inequalities including tobacco consumption. In order to ensure policy effectiveness over time, there is a need to systematically monitor and examine the social inequities in tobacco consumption over time and channel interventions to the social groups that are most vulnerable to these inequalities.

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Table 1: Frequency and prevalence of tobacco smoking, chewing and dual use (smoking and chewing) in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Caste/ tribe status																		
General	(M) 50,939 (F) 50,526	(M) 21,850 (F) 41,844	22.2 (21.4, 22.9)	28.8 (27.7, 29.9)	30	22.2 (21.4,23 .02)	33.2 (31.8, 34.5)	50	7.4 (6.9,7 .8)	10.8 (10. 0,11 .5)	1.0 (0.9, 1.1)	0.8 (0.55, 1.0)	-20	6.6 (6.1, 7.1)	7.24 (6.6,7. 85)	10	0.24 (0.17, 0.3)	0.2 (0.11,0 .27)
SC	(M) 21,491 (F) 21,045	(M) 11,953 (F) 20,566	31.5 (30.5, 32.5)	39.3 (37.8, 40.9)	25	27.8 (26.6, 29.1)	40.5 (38.8, 42.1)	46	12.1 (11.4, 12.8)	15.8 (14. 7,16 .9)	2.3 (1.9,2. 8)	2.4 (2.05,2 .8)	4	10.9 (10.1,11 .8)	12.1 (11.2,1 2.9)	11	0.5 (0.4,0. 7)	0.4 (0.3,0. 6)
ST	(M) 16,187 (F) 16,520	(M) 8,453 (F) 16,518	30.6 (28.8, 32.3)	36.6 (34.1, 39.1)	20	38.6 (36.9, 40.4)	52.6 (49.9, 55.3)	36	14.5, (13.3, 15.6)	18.6 (16. 7,20 .4)	3.0 (2.5,3. 6)	2.7 (2.04,3 .4)	-10	18.5 (17.0,20 .1)	25.08 (22.8,2 7.4)	36	1.0 (0.7,1. 2)	0.9 (0.6,1. 3)
OBC	(M) 36,381 (F) 36,290	(M) 25,144 (F) 29,561	24.7 (23.9, 25.5)	31.2 (30.2, 32.2)	26	25.4 (24.5, 26.3)	36.2 (35.0, 37.5)	43	9.9 (9.4,1 0.5)	13.1 (12. 3,13 .8)	1.5 (1.3,1. 7)	1.4 (1.2,1. 7)	- 7	7.3 (6.8,7.7)	7.08 (6.6,7. 6)	-3	0.3 (0.26,0 .4)	0.14 (0.09,0 .21)
No caste	(M) 6,466 (F) 6,505	(M) 2,355 (F) 5,653	31.8 (29.4, 34.3)	37.9 (34.2, 41.6)	19	23.3 (20.9, 25.6)	35.5 (31.6, 39.3)	52	10.7 (9.3, 12.1)	13.0 (10. 9,15 .2)	1.4 (0.8,1. 9)	0.9 (0.36,1 .48)	-36	10.3 (9.1,11. 6)	12.8 (10.8,1 4.8)	24	0.4 (0.2,0. 6)	0.31 (0.03,0 .59)
Education Level																		
Post graduat e	(M) 3,432 (F) 1,963	(M) 2,920 (F) 3,526	7.6 (6.5,, 8.7)	15.05 (13.0 1,17. 1)	98	12.4 (10.8,14 .1)	18.5 (16.0, 21.1)	49	1.7 (1.2,2 .2)	4.04 (3.0, 5.1)	0.2 (- 0.2, 0.6)	0.02 (- 0.007, 0.05)	-90	1.2 (0.45,1. 9)	0.33 (0.14,0 .5)	-73	0.2 (- 0.17,0. 5)	0.004 (- 0.002, 0.012)
College	(M) 11,340 (F) 6,586	(M) 7,811 (F) 9,424	11.1 (10.2, 11.9)	20.7 (19.2, 22.1)	86	14.9 (13.9,15 .8)	23.9 (22.3, 25.6)	60	3.5 (3.1,3 .9)	6.7 (5.8, 7.6)	0.1 (- 0.01,0. 2)	0.11 (0.03, 0.19)	10	1.3 (0.9,1.6)	1.8 (1.4,2. 2)	39	0.05 (- 0.04,0. 14)	0.04 (- 0.017, 0.1)
High school	(M) 69,996 (F) 46,629	(M) 26,100 (F) 34,338	21.2 (20.7,2 1.8)	24.7 (23.8, .25.5)	17	23.3 (22.7,23 .9)	33.1 (32.0, 34.1)	42	7.8 (7.5, 8.2)	9.9 (9.3, 10.6)	0.2 (0.17, 0.3)	0.07 (0.04, 0.1)	-65	4.2 (3.9, 4.6)	3.4 (3.04,3 .7)	-19	0.1 (0.06,0 .13)	0.04(0. 02,0.0 6)
Primary school	(M) 21,730 (F) 20,604	(M) 12,622 (F) 19,451	32.7 (31.7,3 3.6)	35.6 (34.3, 36.9)	1	30.2 (29.2, 31.2)	41.9 (40.5, 43.4)	39	12.1 (11.4, 12.7)	14.8 (13. 8, 15.7)	0.7 (0.5,0. 8)	0.2 (0.13,0 .3)	-71	9.0 (8.4,9.6)	7.4 (6.8,8. 02)	-18	0.18 (0.13,0 .24)	0.07 (0.03,0 .11)
Illiterate	(M) 24,966	(M) 20,302	38.9	43.9	13	34.4	47.1	37	(15.9	18.9	2.6	2.3	-12	11.9	13.3	12	0.6	0.42

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	(F) 55,104	(F) 57,403	(37.9,, 39.9)	(42.8, 45.2)		(33.2,35 .5)	(45.7, 48.5)		(15.1, 16.6)	(17. 9,19 .9)	(2.4,,2. 9)	(2.02,2 .6)		(11.4, 12.6)	(12.6, 13.0)		(0.53,0 .72)	(0.33,0 .51)
Wealth Quintiles																		
Richest	(M) 26,291 (F) 26,177	(M) 13,706 (F) 24,837	11.9 (11.2, 12.5)	19.9 (18.8, 21.1)	63	13.7 (12.8,14 .6)	20.4 (19.0, 21.8)	49	3.3 (2.97, 3.6)	5.8 (5.1, 6.4)	0.2 (0.1,0. 3)	0.14 (0.08,0 .2)	-30	2.2 (1.9,2.5)	2.02 (1.7,2. 3)	-8	0.05 (0.01,0 .07)	0.042 (0.009, 0.07)
Richer	(M) 26,293 (F) 26,177	(M) 13,946 (F) 24,837	19.3 (18.5, 20.04)	25.8 (24.6, 27.1)	37	19.0 (18.1,19 .9)	30.2 (28.7, 31.7)	59	5.6 (5.2,6 .02)	9.3 (8.4, 10.2)	0.46 (0.37,0 .54)	0.37 (0.27,0 .47)	-20	5.4 (4.9,5.9)	4.9 (4.4,5. 4)	-9	0.1 (0.07,0 .18)	0.06 (0.02,0 .09)
Middle	(M) 26,294 (F) 26,174	(M) 14,075 (F) 24,826	25.6 (24.7,2 6.4)	31.4 (30.1, 32.7)	25	22.9 (22.0,23 .9)	34.9 (33.4, 36.3)	52	7.6 (7.2,8 .1)	11.5 (10. 6,12 .3)	1.1 (0.9,1. 3)	0.7 (0.6,0. 9)	-36	7.8 (7.2,8.3)	6.9 (6.4,7. 4)	-11	0.23 (0.16,0 .3)	0.07 (0.04,0 .11)
Poorer	(M) 26,293 (F) 26,179	(M) 14,007 (F) 24,814	30.6 (29.7,3 1.5)	36.5 (35.2, 37.8)	21	28.9 (28.0,29 .9)	39.5 (38.0 3,40. 9)	37	11.6 (10.9, 12.2)	14.5 (13. 6,15 .5)	1.7 (1.5,1. 9)	1.7 (1.4,1. 9)	0	10.9, (10.3,11 .6)	10.5 (9.8,12 .2)	-4	0.4 (0.3,0. 5)	0.24 (0.17,0 .31)
Poorest	(M) 26,293 (F) 26,179	(M) 14,021 (F) 24,828	35.5 (34.4,, 36.5)	40.6, 39.3, 41.9)	13	36.8 (35.7,37 .9)	49.7 (48.2, 51.2)	35	16.7 (15.9, 17.5)	19.4 (18. 4,20 .5)	3.5 (3.1,3. 9)	3.2 (2.8,3. 7)	-9	14.1 (13.3,15 .0)	17.1 (16.03, 18.1)	21	0.9 (0.7,1. 0)	0.7 (0.52,0 .86)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142																

[1]Large city: urban population ≥1 million; Small city: 100000-1 million; Town: ≤100000 million

[2]Scheduled *c*astes and scheduled tribes are identified by the Government of India as socially and economically backward and needing protection from social injustice and exploitation. Other backward class is a diverse collection of intermediate castes that were considered low in the traditional caste hierarchy but are clearly above scheduled castes. General is thus a default residual group that enjoys higher status in the caste hierarchy.

[3]Others include Sikh, Buddhist, Jain, Jewish, Zoroastrian and Others

[4] Post graduate:15 or more years of education; college: 13-15 years of education; high school: 8-12 years of education; secondary: 5-8 years of education; primary: 0-5 years of education; illiterate: 0 years of education

*Percentage change (**% Δ)** numbers have been rounded to the nearest integer.

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Web Tables:

Table 1: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among men and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.37 (1.32,1.43)	1.51 (1.44,1.59)	1.37 (1.31,1.42)	1.36 (1.3,1.41)	1.37 (1.31,1.42)	1.43 (1.38,1.48)	1.33 (1.27,1.4)	1.42 (1.36,1.47)	1.42 (1.36,1.47)	1.41 (1.36,1.47)
Middle	1.71 (1.64,1.78)	1.99 (1.89,2.1)	1.71 (1.64,1.78)	1.68 (1.61,1.75)	1.7 (1.63,1.77)	1.75 (1.68,1.82)	1.63 (1.55,1.72)	1.73 (1.66,1.8)	1.72 (1.65,1.8)	1.72 (1.65,1.79)
Poorer	2.06 (1.97,2.16)	2.51 (2.37,2.65)	2.05 (1.96,2.14)	2.02 (1.93,2.11)	2.04 (1.95,2.14)	1.92 (1.84,2.01)	1.77 (1.67,1.87)	1.89 (1.8,1.97)	1.86 (1.78,1.95)	1.87 (1.79,,1.96)
Poorest	2.33 (2.22,2.46)	2.88 (2.72,3.06)	2.31 (2.19,2.43)	2.29 (2.18,2.41)	2.3 (2.19,2.42)	2.1 (1.99,2.2)	1.93 (1.82,2.05)	2.03 (1.92,2.13)	2.03 (1.932.13)	2.02 (1.93,2.12)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.38 (1.28,1.49)	1.41 (1.31,1.53)	1.34 (1.19,1.5)	1.4 (1.29,1.51)	1.4 (1.3,1.51)	1.26 (1.17,1.36)	1.28 (1.19,1.39)	1.14 (1.02,1.27)	1.29 (1.19,1.39)	1.29 (1.2,1.39)
High School	1.81 (1.69,1.95)	1.91 (1.78,2.05)	2.16 (1.95,2.4)	1.87 (1.74,2.01)	1.87 (1.74,2.01)	1.53 (1.43,1.65)	1.64 (1.53,1.76)	1.46 (1.33,1.61)	1.65 (1.54,1.77)	1.66 (1.54,1.78)
Primary	2.73 (2.54,2.94)	2.81 (2.61,3.04)	3.4 (3.05,3.78)	2.77 (2.57,2.99)	2.77 (2.57,2.99)	1.98 (1.84,2.13)	2.04 (1.9,2.2)	1.84 (1.66,2.04)	2.05 (1.9,2.21)	2.06 (1.91,2.21)
No education	3.18 (2.96,3.43)	3.27 (3.03,3.53)	4.07 (3.66,4.53)	3.19 (2.96,4.34)	3.18 (2.95,3.42)	2.09 (1.94,2.26)	2.06 (1.91,2.22)	1.93 (1.74,2.14)	2.07 (1.92,2.23)	2.08 (1.93,2.24)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.77 (0.72,0.82)	0.81 (0.76,0.87)	0.8 (0.74,0.85)	0.82 (0.75,0.9)	0.79 (0.74,0.84)	0.96 (0.89,1.02)	1.02 (0.96,1.09)	1.02 (0.96,1.09)	1.06 (0.97,1.16)	1.03 (0.97,1.1)
Town	0.78	0.83(0.79,0	0.81(0.77,0	0.88	0.81	0.92	1.01	1.01	1.06	1.01

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	(0.74,0.82)	.88)	.85)	(0.82,0.95)	(0.77,0.85)	(0.87,0.97)	(0.95,1.06)	(0.95,1.06)	(0.98,1.15)	(0.96,1.07)
Village	0.68 (0.65,0.71)	0.75 (0.71,0.78)	0.73 (0.7,0.77)	0.87 (0.82,0.92)	0.73 (0.7,0.76)	0.76 (0.73,0.79)	0.92 (0.88,0.96)	0.92 (0.88,0.96)	0.93 (0.88,0.99)	0.93 (0.88,0.97)
Caste/Tribe (Other)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SC	1.16 (1.12,1.2)	1.15 (1.11,1.19)	1.15 (1.11,1.18)	1.15 (1.11,1.19)	1.16 (1.11,1.21)	1.12 (1.08,1.15)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.14)
ST	1.14 (1.09,1.2)	1.13 (1.08, 1.2)	1.14 (1.08,1.18)	1.14 (1.09,1.2)	1.15 (1.09,1.21)	3.02 (2.88,3.15)	1.1 (1.06,1.15)	1.1 (1.05,1.15)	1.1 (1.05,1.15)	1.17 (1.11,1.24)
OBC	1.00 (0.98,1.04)	0.99 (0.97,1.02)	0.99 (0.96,1.02	0.99 (0.97,1.02)	1.03 (0.99,1.07)	1.05 (1.02,1.08)	1.01 (0.97,1.03)	1.002 (0.97,1.03)	1.003 (0.97,1.03)	1.04 (0.99,1.07)
No Caste or missing	1.06 (1.01,1.13)	1.07 (1.01,1.13)	1.07 (1.01,1.13)	1.08 (1.02,1.14)	1.05 (0.98,1.13)	0.97 (0.92,1.03)	1.02 (0.96,1.08)	1.01 (0.96,1.08)	1.02 (0.96,1.08)	0.97 (0.9,1.04)
Survey Year (Yr)		1.74 (1.7,1.88)	1.67 (1.46,1.91)	1.49 (1.4,1.58)	1.24 (1.19,1.3)		1.47 (1.38,1.56)	1.34 (1.17,1.54)	1.69 (1.58,1.8)	1.72 (1.65,1.79)
Yr *Richer		0.78 (0.73,0.84)					1.15 (1.07,1.24)			
Yr*Middle		0.68 (0.63,0.73)					1.13 (1.05,1.22)			
Yr *Poorer		0.60 (0.56,0.65)					1.15 (1.07,1.24)			
Yr *Poorest		0.58 (0.53,0.62)					1.11 (1.03, 1.2)			
Yr *College			1.13 (0.97,1.32)					1.27 (1.1,1.48)		
Yr * High School			0.78 (0.68,0.89)					1.28 (1.11,1.47)		
Yr * Primary			0.66 (0.57,0.77)					1.02 (0.88,,1.18)		
Yr * No education			0.61 (0.53,0.70)					1.01 (0.87,1.17)		
Yr *Small City				0.99 (0.87,1.12)					0.94 (0.82,1.06)	
Yr * Town				0.89 (0.81,0.98)					0.9 (0.82,0.99)	
Yr * Village				0.73 (0.68,0.79)					0.98 (0.91,1.05)	
Yr *SC					0.99 (0.92,1.05)					0.99 (0.93,1.06)
Yr *ST					0.97 (0.9,1.05)					0.84 (0.78,0.91)

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Yr*OBC					0.92 (0.87,0.97)					0.92 (0.87,0.97)
Yr*No Caste					1.07 (0.94,1.21)					1.15 (1.02,1.29)
Fixed Part of the Model										
Joint Chi Test for Interaction (p-value)		174.31 (p<0.001)	13.31 (p=0.009)	13.44 (p=0.003)	0.318 (p=0.98)		15.63 (p=0.003)	8.52 (p=0.074)	2.6 (p=0.46)	1.387 (p=0.85)
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)		12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)
Chi square for Level 2: Local Area (p-value)		650.41 (p<0.001)	655.7 (p<0.001)	654.2 (p<0.001)	660.7 (p<0.001)		801.6 (p<0.001)	802.4 (p<0.001)	802.4 (p<0.001)	801.7 (p<0.001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Table 2: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among women and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.48 (1.28,1.71)	1.82 (1.49,2.22)	1.48 (1.28,1.71)	1.48 (1.28,1.71)	1.49 (1.29,1.72)	1.48 (1.41,1.56)	1.41 (1.32,1.51)	1.48 (1.4,1.55)	1.51 (1.43,1.59)	1.48 (1.41,1.56)
Middle	1.9 (1.64,2.19)	2.63 (2.17,3.19)	1.87 (1.62,2.16)	1.88 (1.62,2.18)	1.9 (1.64,2.19)	1.75 (1.66,1.85)	1.58 (1.47,1.7)	1.75 (1.65,1.84)	1.81 (1.72,1.92)	1.76 (1.66,1.85)
Poorer	2.75 (2.37,3.19)	3.72 (3.07,5.52)	2.8 (2.41,3.25)	2.81 (2.42,3.26)	2.85 (2.45,3.30)	2.14 (2.02,2.27)	1.86 (1.72,2.002)	2.13 (2.01,2.25)	2.2 (2.07,2.32)	2.14 (2.02,2.27)
Poorest	3.95 (3.39,4.6)	4.83 (3.97,5.88)	4.03 (3.46,4.69)	4.05 (3.47,4.72)	4.08 (3.5,4.75)	2.67 (2.5,2.84)	2.14 (1.99,2.32)	2.65 (2.49,2.82)	2.7 (2.54,2.88)	2.7 (2.5,2.84)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.59 (0.91,2.8)	1.61 (0.92,2.82)	0.98 (0.37,2.58)	1.58 (0.9,2.78)	1.57 (0.9,2.75)	1.84 (1.55,2.19)	1.83 (1.54,2.17)	1.1 (0.85,1.42)	1.82 (1.53,2.17)	1.84 (1.55,2.19)
High School	1.78 (1.06,2.99)	1.67 (1.01,,2.82)	1.95 (0.83,4.56)	1.62 (0.96,2.72)	1.61 (0.99,2.7)	2.19 (1.86,2.57)	2.13 (1.82,2.51)	1.47 (1.17,1.85)	2.15 (1.82,2.54)	2.21 (1.88,2.6)
Primary	2.78 (1.66,4.68)	2.62 (1.56,4.41)	3.32 (1.42,7.76)	2.54 (1.51,4.29)	2.52 (1.5,4.24)	2.87 (2.44,3.4)	2.83 (2.4,3.33)	2.03 (1.61,2.56)	2.86 (2.42,3.37)	2.89 (2.45,3.41)
No education	4.78 (2.84,8.04)	4.91 (2.93,8.23)	6.89 (2.53,13.73)	4.72 (2.81,7.93)	4.66 (2.77,7.81)	3.85 (3.27,4.53)	3.75 (3.19,4.42)	2.58 (2.04,3.24)	3.8 (3.22,4.48)	3.85 (3.27,4.53)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.91 (0.75,1.09)	0.98 (0.82, 1.17)	1.01 (0.84,1.21)	0.78 (0.58,1.04)	1.004 (0.84,1.2)	1.23 (1.13,1.32)	1.25 (1.15,1.35)	1.22 (1.13,1.32)	0.97 (0.86,1.1)	1.2 (1.11,1.29)
Town	1.19 (1.03,1.37)	1.2 (1.04,1.38)	1.22 (1.05,1.4)	1.31 (1.06,1.62)	1.23 (1.1,1.41)	1.36 (1.27,1.45)	1.37 (1.29,1.47)	1.36 (1.27,1.45)	0.95 (0.86,1.04)	1.34 (1.25,1.43)
Village	1.4 (1.24,1.59)	1.28 (1.13,1.46)	1.31 (1.16,1.49)	1.37 (1.14,1.66)	1.32 (1.16,1.49)	1.07 (1.01,1.14)	1.09 (1.02,1.16)	1.08 (1.02,1.15)	0.69 (0.64,0.75)	1.07 (1.005,1.13)
Caste/Tribe	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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(Other)										
SC	1.5 (1.39,1.62)	1.55 (1.43,1.67)	1.54 (1.43,1.67)	1.54 (1.43,1.67)	1.4 (1.27,1.55)	1.28 (1.23,1.33)	1.28 (1.23,1.36)	1.28 (1.23,1.33)	1.29 (1.24,1.34)	1.28 (1.22,1.35)
ST	2.04 (1.86,2.24)	2.11 (1.92, 2.3)	2.11 (1.93,2.31)	2.11 (1.93,2.31)	1.99 (1.79,2.23)	1.53 (1.46,1.6)	1.53 (1.46,1.61)	1.53 (1.46,1.61)	1.52 (1.45,1.6)	1.48 (1.39,1.58)
OBC	1.11 (1.03,1.2)	1.17 (1.08,1.26)	1.16 (1.08,1.26)	1.16 (1.08,1.25)	1.13 (1.03,1.24)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.06 (1.02,1.12)
No Caste or missing	0.7 (0.6,0.81)	0.74 (0.64,0.86)	0.72 (0.62,0.85)	0.73 (0.62,0.85)	1.01 (0.85,1.2)	1.02 (0.95,1.09)	1.02 (0.96,1.09)	1.02 (0.95,1.09)	1.01 (0.95,1.08)	0.92 (0.85,1.01)
Survey Year (Yr)		1.004 (0.98,1.03)	0.89 (0.31,2.56)	0.67 (0.55,0.83)	0.57 (0.51,0.63)		0.81 (0.75,0.87)	0.54 (0.4,0.74)	0.52 (0.47,0.56)	1.02 (0.97,1.07)
Yr*Richer		0.66 (0.5,0.87)					1.09 (0.99,1.21)			
Yr*Middle		0.47 (0.36,0.61)					1.21 (1.1,1.34)			
Yr *Poorer		0.56 (0.44,0.72)					1.3 (1.18,1.43)			
Yr *Poorest		0.71 (0.56,0.91)					1.5 (1.37,1.64)			
Yr *College			1.98 (0.6,6.52)					2.26 (1.6,3.21)		
Yr * High School			0.77 (0.26,2.22)					1.94 (1.41,2.67)		
Yr * Primary			0.61 (0.21,1.75)					1.74 (1.27,2.4)		
Yr * No education			0.7 (0.24,2.0)					1.94 (1.41,2.66)		
Yr*Small City				1.44 (0.99,2.07)					1.61 (1.38,1.88)	
Yr * Town				0.89 (0.68,1.16)					1.94 (1.72,2.19)	
Yr * Village				0.92 (0.74,1.15)					2.26 (2.06,2.48)	
Yr *SC					1.29 (1.11,1.51)					0.99 (0.93,1.07)
Yr *ST					1.16 (0.99,1.36)					1.07 (0.98,1.16)
Yr*OBC					1.1 (0.96,1.27)					0.95 (0.89,1.01)
Yr*No Caste					0.45 (0.32,0.63)					1.22 (1.07,1.38)
Fixed Part of the Model										
Overall Chi for Interaction (p-		19.128 (p<0.001)	0.041 (p=0.99)	50.195 (p<0.001)	0.992 (p=0.91)		31.96 (p<0.0001)	17.42 (p=0.001)	157.008 (p<0.0001)	2.665 (p=0.615)

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value)										
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.91 (p=0.011)	12.91 (p=0.011)	12.91 (p=0.004)	12.91 (p=0.011)		12.94 (p=0.011)	12.94 (p=0.011)	12.94 (p=0.004)	12.94 (p=0.011)
Chi square for Level 2: Local Area (p-value)		260.98 (p<0.001)	266.3 (p<0.001)	264.9 (p<0.001)	263.5 (p<0.001)		844.91 (p<0.0001)	839.3 (p<0.0001)	824.92 (p<0.0001)	837.64 (p<0.0001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Table 3: Frequency and prevalence of tobacco smoking, chewing and dual use (smoking and chewing) in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Area of residence																		
Large city	(M) 17,640 (F) 16,081	(M) 19,092 (F) 26,272	17.7 (16.6, 18.9)	27.2 (25.7, 28.8)	54	19.1 (17.4,21.1)	30.3 (28.2, 32.5)	59	6.05 (5.4,6.8)	10.2 (9.2, 11.3)	0.3(0.2, 0.4)	0.4 (0.3,0.6)	33	5.8 (4.9,6.9)	4.9 (4.1,5.9)	-16	0.09 (0.06,0.14)	0.055 (0.03,0.1)
Small city	(M) 8,957 (F) 8,573	(M) 4,723 (F) 9,318	18.3 (16.4,20.2)	28.8 (26.5, 31.2)	57	19.4 (17.1, 22.0)	34.2 (31.1, 37.4)	76	5.8 (4.95, 6.8)	10.9 (9.6, 12.5)	0.3 (0.2,0.5)	0.5 (0.35,0.7)	67	5.9 (4.8,7.1)	6.6 (5.5,8.1)	12	0.06 (0.03,0.14)	0.09 (0.04,0.2)
Town	(M) 18,837 (F) 18,803	(M) 12,078 (F) 21,256	19.9 (18.6,21.2)	30.3 (28.4, 32.2)	52	20.6 (18.7,22.5)	31.1 (28.6, 33.7)	51	6.3 (5.6,7.1)	10.5 (9.4, 11.7)	0.6 (0.5,0.8)	0.6 (0.4,0.8)	0	6.7 (5.8,7.8)	7.2 (6.1,8.4)	8	0.2 (0.15,0.3)	0.1 (0.07,0.2)
Village	(M) 86,030 (F) 87,429	(M) 33,862 (F) 67,296	28.9 (28.2,29.6)	35.2 (34.2, 36.2)	22	28.2 (27.4,28.9)	40.9 (39.8, 41.9)	45	11.4 (10.9, 11.8)	15.02 (14.3,15.7)	2.04 (1.85,2.24)	1.98 (1.75,2.24)	-3	9.8 (9.3,10.3)	11.3 (10.6,11.9)	15	0.5 (0.43,0.6)	0.4 (0.3,0.5)
Age-groups																		
15-24	(M) 50,266 (F) 52,299	(M) 25,511 (F) 46,688	8.6 (8.2, 9.1)	19.2 (18.4, 20.1)	123	14.3 (13.7, 14.9)	30.3 (29.27,31.4)	112	3.5 (3.3,3.8)	9.45 (8.9, 10.1)	0.4 (0.31,0.45)	0.3 (0.21,0.36)	-25	3.1 (2.8,3.3)	4.4 (3.99,4.7)	42	0.098 (0.07,0.14)	0.08 (0.05,0.13)
25-34	(M) 38,650 (F) 40,764	(M) 20,794 (F) 38,441	29.1 (28.3, 29.9)	36.3 (35.2, 37.4)	25	29.9 (29.1, 30.7)	43.1 (41.9, 44.3)	44	11.5 (10.9, 12.0)	16.0 (15.2,16.8)	1.4 (1.26,1.62)	1.3 (1.1,1.56)	-7	9.0 (8.5,9.5)	10.1 (9.45,10.7)	12	0.33 (0.27,0.4)	0.23 (0.2,0.3)
35-49	(M) 42,548 (F) 37,823	(M) 23,450 (F) 39,013	43.4 (42.5, 44.2)	44.1 (42.9, 45.2)	1.6	35.3 (34.4, 36.2)	40.2 (39.02,41.3)	14	15.7 (15.1, 16.3)	15.2 (14.4,16.01)	3.4 (3.1,3.8)	3.2 (2.84,3.57)	-6	16.5 (15.8,17.3)	15.7 (14.9,16.4)	-5	0.9 (0.76,1.02)	0.6 (0.5,0.7)
Marital Status																		
Currently married	(M) 77,233 (F) 95,398	(M) 40,529 (F) 87,754	36.9 (36.2,37.6)	40.6 (39.7, 41.5)	10	33.7 (32.9, 34.4)	42.9 (41.9, 43.9)	27	13.9 (13.5, 14.4)	15.9 (15.3,16.6)	1.8 (1.6, 1.94)	1.8 (1.6,2.02)	0	9.8 (9.3,10.3)	10.9 (10.4,11.5)	11	0.43 (0.37,0.5)	0.3 (0.26,0.4)

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Single	(M) 52,443 (F) 29,623	(M) 28,377 (F) 30,606	7.6 (7.3, 8.04)	18.9 (18.2, 19.7)	14 9	12.5 (11.9,12 .9)	27.4 (26.4, 28.4)	11 9	2.9 (2.7,3 .2)	8.6 (8.1, 9.2)	0.3 (0.22,0 .4)	0.09 (0.06,0 .14)	-70	1.9 (1.8,2.2)	2.8 (2.5,3. 2)	47	0.12 (0.08,0 .18)	0.03 (0.01,0 .06)
Widowed	(M) 1,070 (F) 4,038	(M) 415 (F) 3,909	48.7 (45.1,5 2.3)	50.1 (43.9, 56.3)	2.8	41.6 (38.0,45 .3)	59.5 (53.2, 65.6)	43	19.5 (16.8, 22.5)	23.7 (18. 7,29 .6)	4.7 (3.86, 5.6)	3.5 (2.78,4 .3)	-26	21.3 (19.7,22 .9)	18.5 (16.9,2 0.2)	-13	1.4 (1.05,1 .89)	0.9 (0.6,1. 4)
Divorced/ separated	(M) 718 (F) 1,827	(M) 434 (F) 1,873	41.7 (37.2,4 6.4)	46.6 (39.9, 53.3)	12	33.4 (29.01, 38.1)	55.9 (49.0 3,62. 7)	67	15.7 (12.5, 19.5)	25.2 (19. 7,31 .6)	2.5 (1.8,3. 6)	1.6 (1.01,2 .6)	-36	18.1 (15.9,20 .6)	18.6 (16.4, 21.01)	3	0.31 (0.13,0 .75)	0.6 (0.3,1. 2)
Religion																		
Hindu	(M) 100,339 (F) 99,430	(M) 51,174 (F) 89,888	26.1 (25.5,2 6.7)	33.01 (32.2, 33.8)	27	26.6 (26.0, 27.3)	38.2 (37.3, 39.1)	44	10.2 (9.8,1 0.5)	13.7 (13. 2,14 .3)	1.5 (1.4,1. 7)	1.5 (1.35,1 .7)	0	8.8 (8.3,9.2)	9.6 (9.1,10 .2)	9	0.37 (0.31,0 .43)	0.25 (0.2,0. 3)
Muslim	(M) 16,278 (F) 16,215	(M) 9,145 (F) 16,731	28.3 (26.7,2 9.9)	36.2 (34.3, 38.2)	28	23.4 (21.7,25 .1)	37.4 (35.0 2,39. 8)	60	9.5 (8.7,1 0.5)	13.1 (11. 9,14 .5)	1.9 (1.6,2. 3)	1.73 (1.25,2 .4)	-9	9.1 (8.3,9.9)	9.9 (8.9,10 .9)	9	0.5 (0.37,0 .7)	0.4 (0.3,0. 7)
Christian	(M) 8,055 (F) 8,547	(M) 6,250 (F) 10,974	28.2 (25.9,3 0.5)	33.1 (29.9, 36.4)	17	17.5 (15.1, 20.1)	29.1 (25.0 1,33. 5)	66	8.2 (6.9,9 .6)	12.7 (10. 4,15 .5)	2.4 (1.7,3. 3)	1.3 (0.98,1 .62)	-46	9.9 (8.4,11. 6)	10.7 (9.1,12 .5)	8	0.98 (0.72,1 .33)	0.6 (0.5,0. 7)
Others	(M) 6,792 (F) 6,694	(M) 3,186 (F) 6,549	11.1 (9.5,12 .8)	16.2 (14.2, 18.4)	46	19.3 (17.1,21 .7)	26.0 (23.1, 29.2)	35	4.4 (3.4,5 .6)	6.5 (5.2, 8.0)	0.6 (0.4, 0.9)	0.4 (0.2,0. 65)	-33	7.5 (5.8,9.6)	7.6 (6.2,9. 4)	1	0.27 (0.13,0 .55)	0.2 (0.1,0. 6)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142																

[1]Large city: urban population ≥1 million; Small city: 100000-1 million; Town: ≤100000 million

[2]Scheduled castes and scheduled tribes are identified by the Government of India as socially and economically backward and needing protection from social injustice and exploitation. Other backward class is a diverse collection of intermediate castes that were considered low in the traditional caste hierarchy but are clearly above scheduled castes. General is thus a default residual group that enjoys higher status in the caste hierarchy.

[3]Others include Sikh, Buddhist, Jain, Jewish, Zoroastrian and Others

[4] Post graduate:15 or more years of education; college: 13-15 years of education; high school: 8-12 years of education; secondary: 5-8 years of education; primary: 0-5 years of education; illiterate: 0 years of education

*Percentage change (**% Δ)** numbers have been rounded to the nearest integer. Estimates are not age-standardized

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Figure 1: Percentage change in smoking among men and women by education level and wealth quintiles

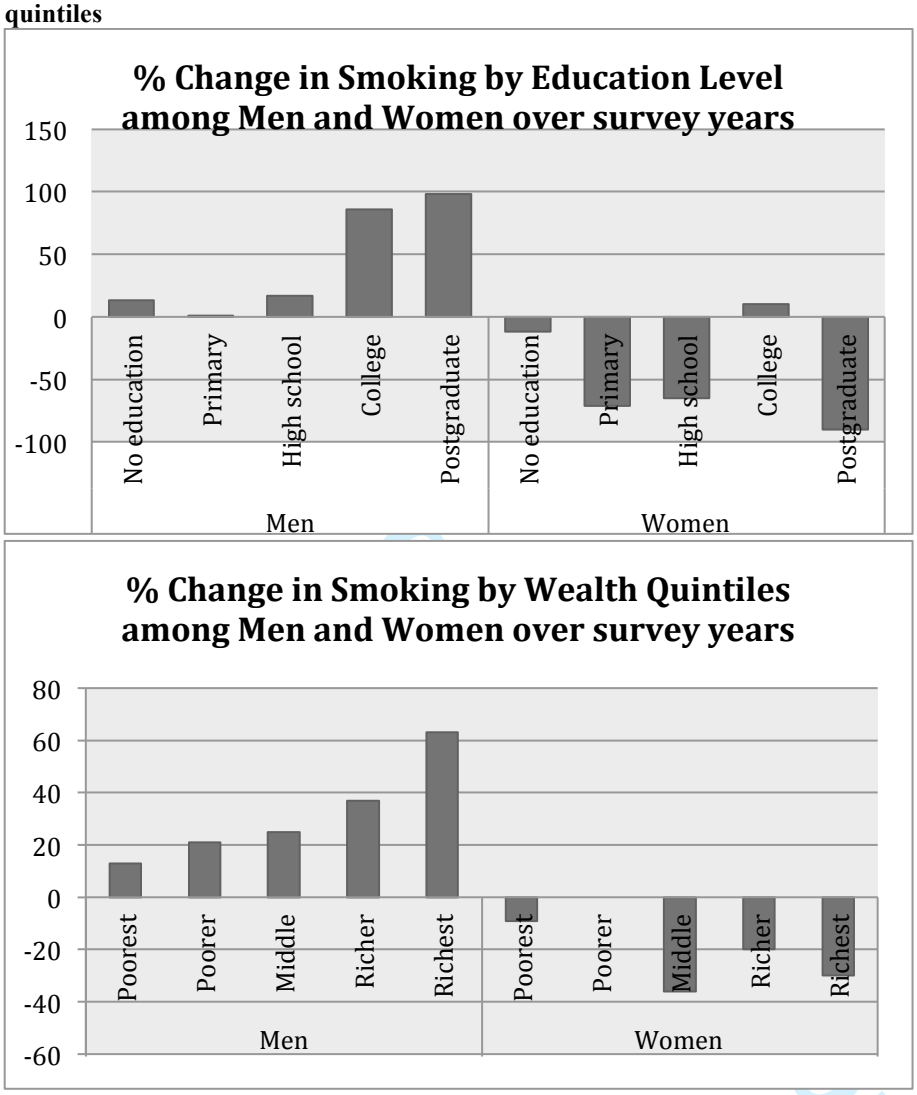


Figure 2: Percentage change in chewing among men and women by education level and wealth quintiles

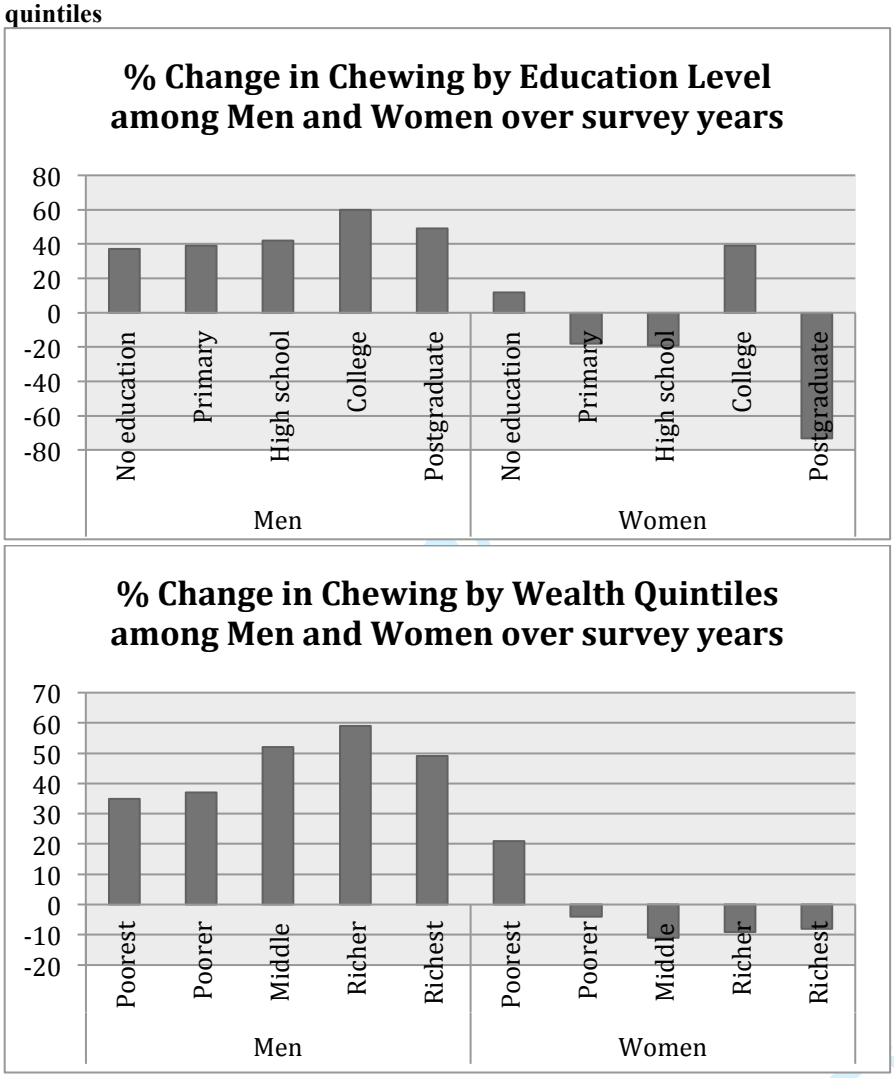
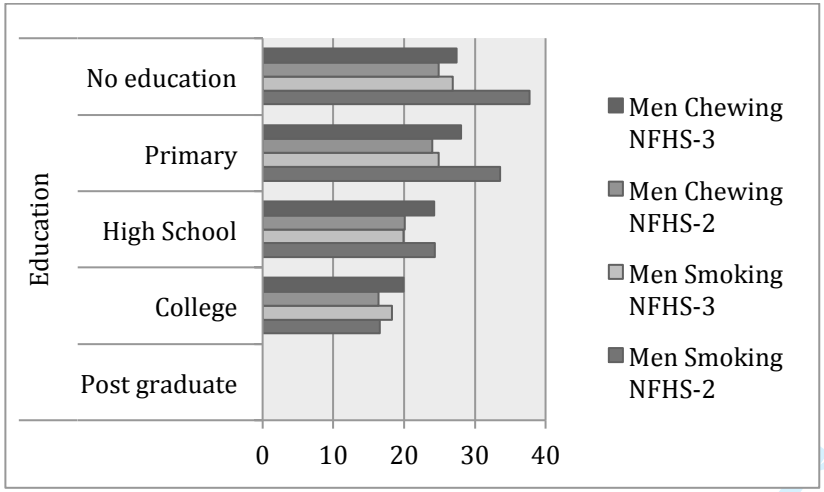
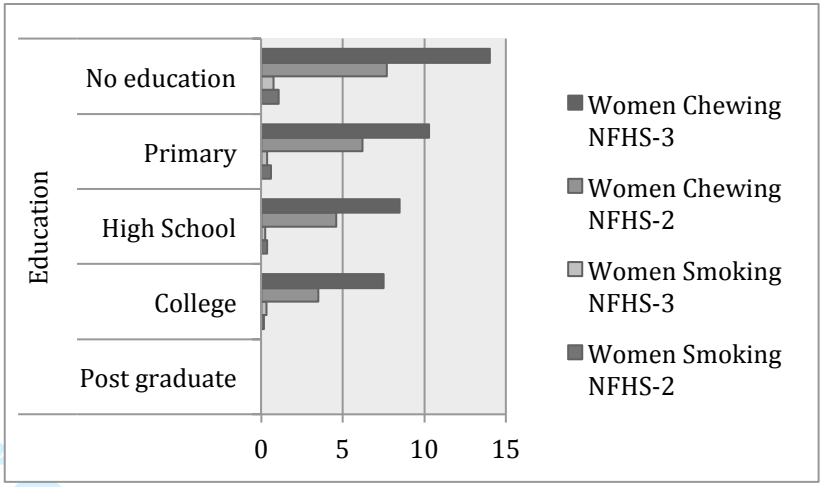
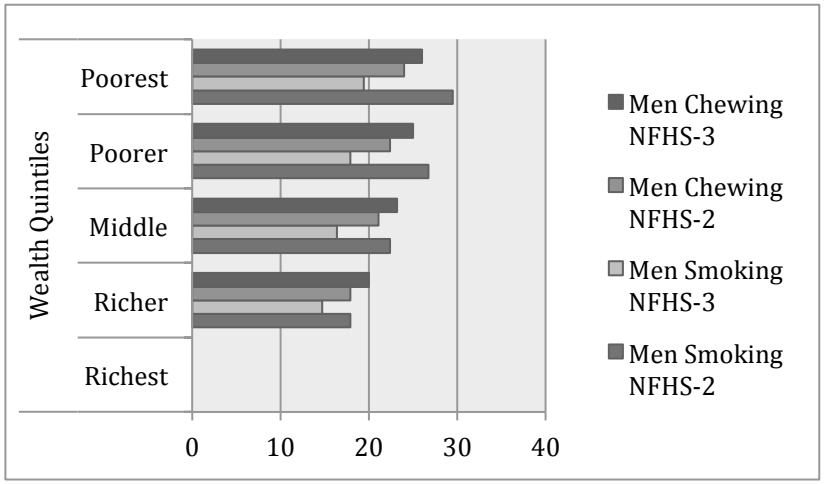
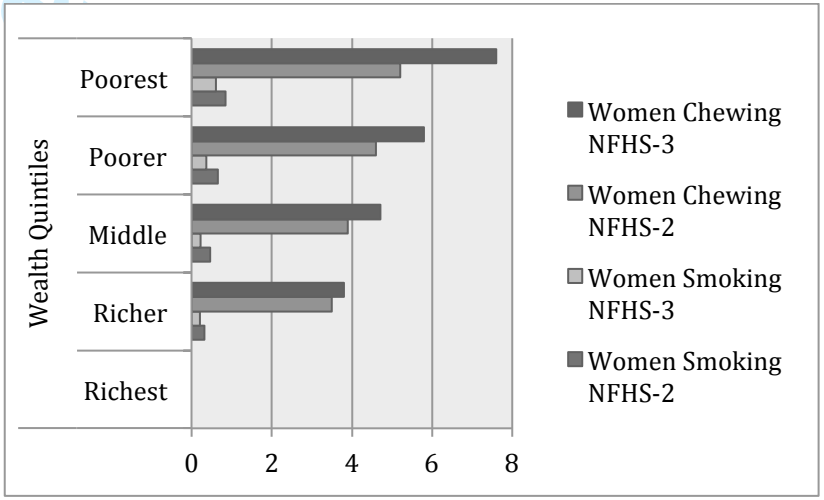


Figure 3: Probability of smoking and chewing among men and women by education and wealth









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Are socioeconomic disparities in tobacco consumption increasing in India? A repeated cross-sectional multilevel analysis

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Figure 1: Percentage change in smoking among men and women by education level and wealth quintiles

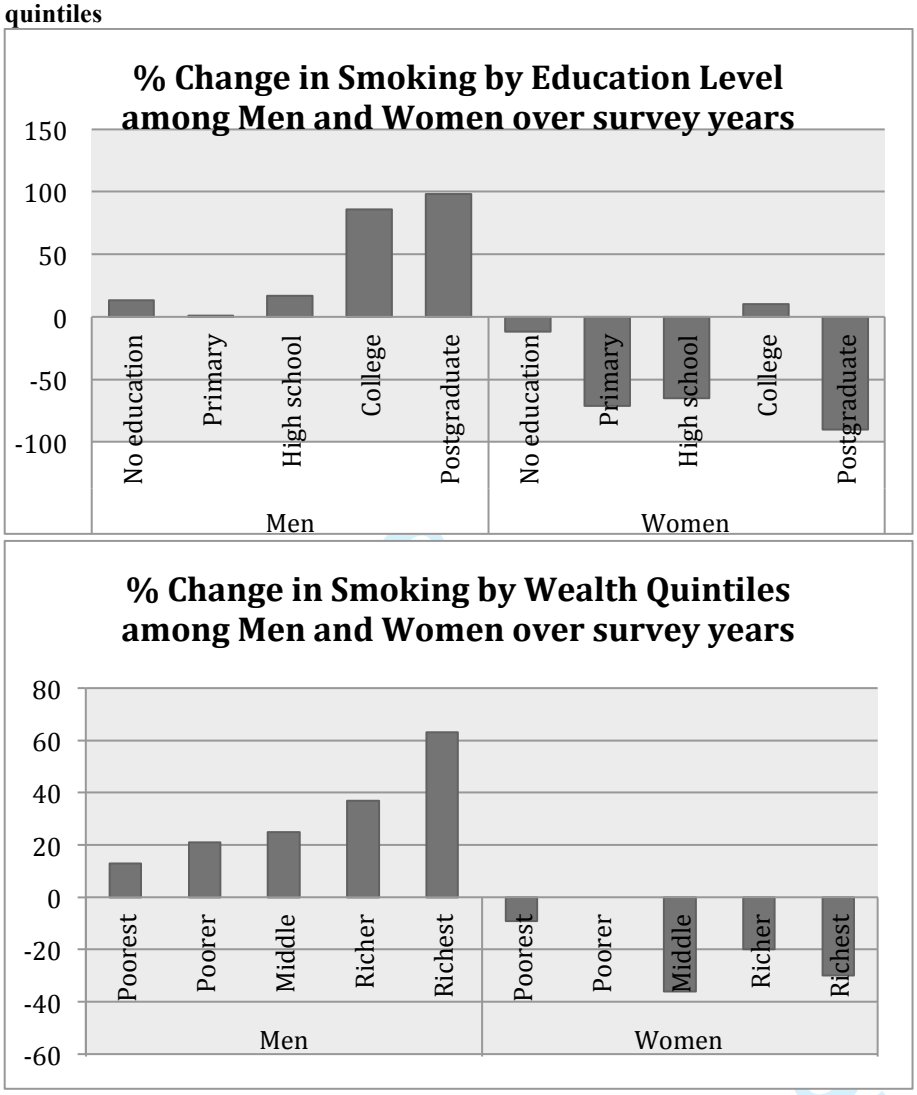


Figure 2: Percentage change in chewing among men and women by education level and wealth quintiles

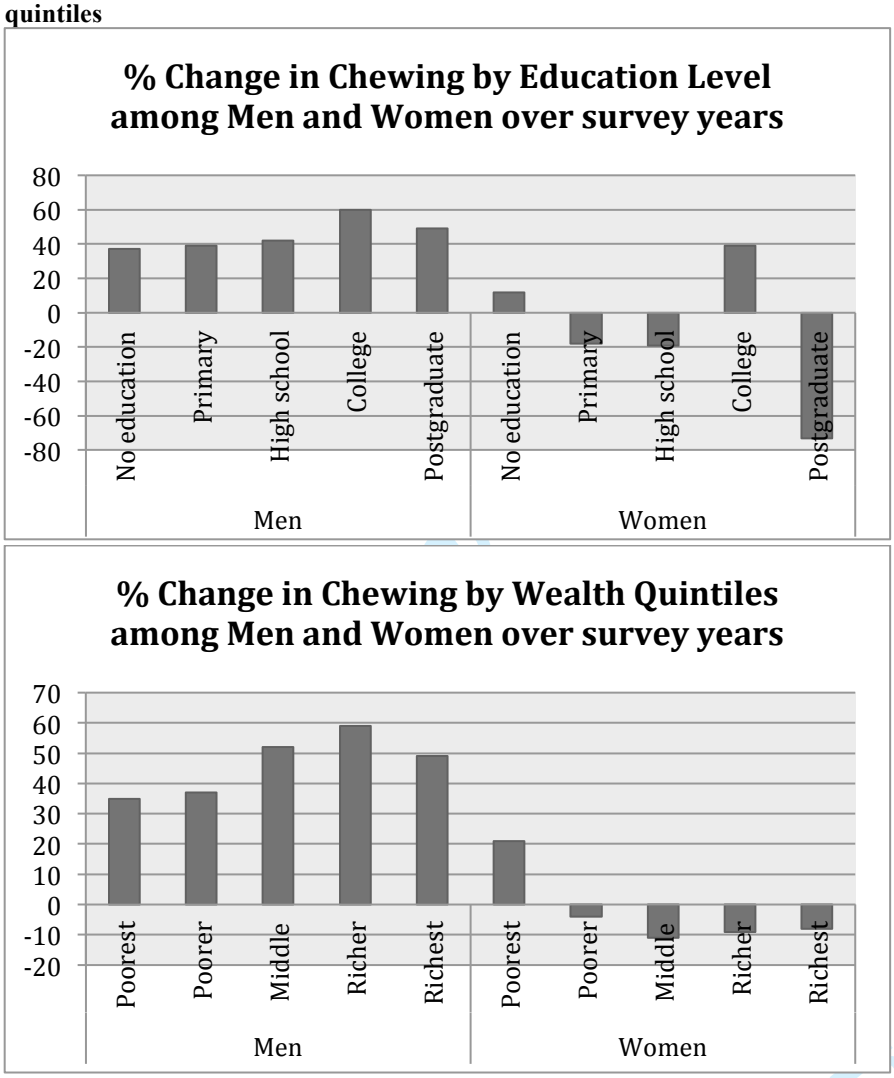
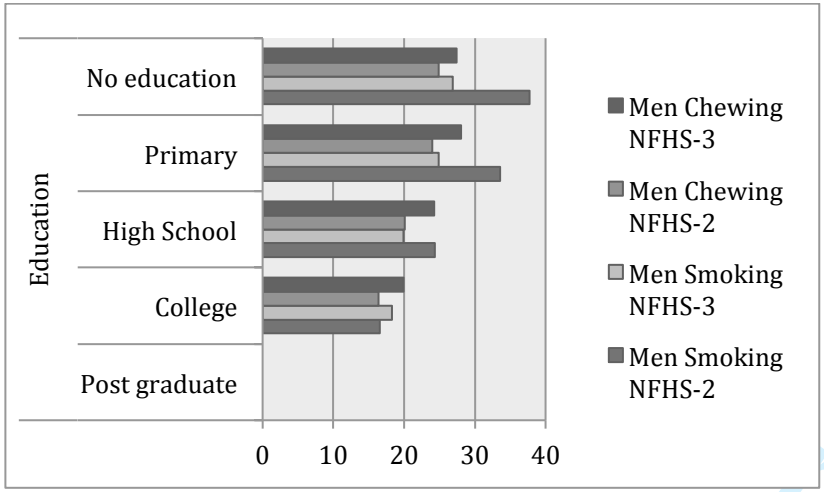
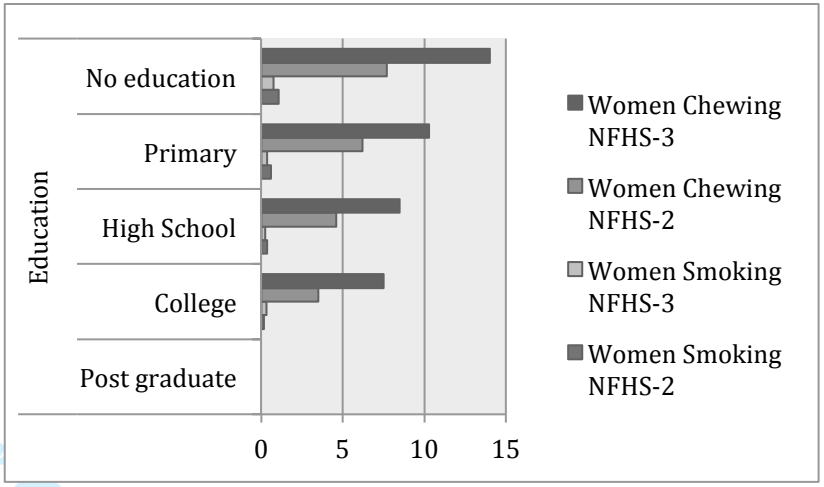
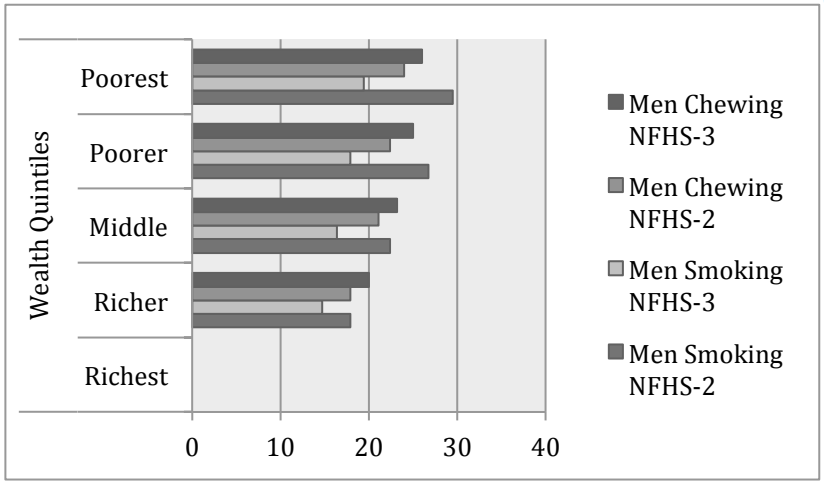
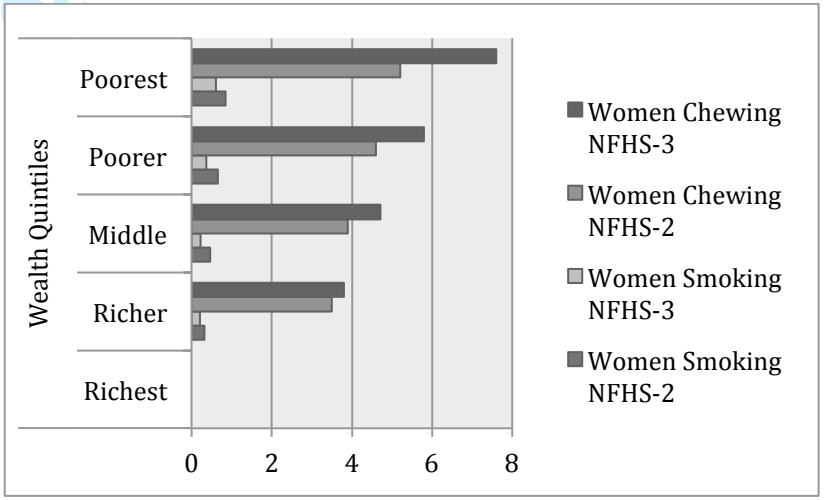


Figure 3: Probability of smoking and chewing among men and women by education and wealth









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Are socioeconomic disparities in tobacco consumption increasing in India? A repeated cross-sectional multilevel analysis

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ABSTRACT: (298 words)

Objectives: India bears a significant portion of the global tobacco burden with high prevalence of tobacco use among men and women. This study examines the socioeconomic patterning of tobacco use and identifies the changing gender and socioeconomic dynamics in light of the *Cigarette Epidemic Model.*

Design: Population-based cross-sectional surveys, NFHS -2 and 3, India

Setting & participants: 131,464 men and 130,886 women (NFHS-2) and 69,755 men and 124,142 women (NFHS -3) – ages 15-49 years.

Outcomes & methods: Outcomes include **smoking** (cigarettes, *bidis* and pipes/cigar), **chewing tobacco** (*paan masala, gutkha* or other chewed forms of tobacco) and **dual use** examined by education, wealth, living environment and caste/tribe. Standardized prevalence and percentage change were estimated. Pooled multilevel models estimate the effect of socioeconomic covariates on the log odds of tobacco use by gender, estimating fixed and random parameters.

Findings: Among men (2005-6), SES gradients in smoking (Illiterate: 44% vs. Postgraduates: 15%) and chewing (Illiterate: 47% vs. Postgraduate: 19%) were observed. Similar gradients observed by education, living environment and caste. Chewed tobacco prevalence among women showed inverse SES gradients comparing the illiterate (7.4%) vs. postgraduate (0.33%), and poorest (17%) vs. richest (2%) quintiles. However, change estimates showed greater percentage rises in smoking and chewing respectively by higher SES groups among men – postgraduates (98%) and richest (49%) compared to those with high schooling only (17%) and poorest (35%). Among women, higher educated showed larger declines - 90% (postgraduates) vs. 12% (illiterates). Younger men (15-24 years) showed increasing tobacco use (Smoking: 123% and Chewing: 112%). Older women (35-49 years) show higher prevalence 3.2% compared to 0.3% (15-24 years) for smoking.

Conclusions: Indian tobacco use patterns show significant diversions from the *Cigarette Epidemic Model*– from gender and socioeconomic perspectives. Separate analysis by type is needed to further understand social determinants of tobacco use in India.

Article Summary

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Article Focus

- India bears a significant burden of tobacco consumption, with high prevalence of smoking and chewing among men & women.
- Previous studies have established a unique social and spatial gradient in tobacco use. However, no studies have yet reported estimates for changing patterns in tobacco use prevalence or relative risk over time.
- This study estimates socioeconomic patterns and examines the changing gender and socioeconomic dynamics of tobacco use in light of the *Cigarette Epidemic Model.*

Key Messages

- Among men, higher prevalence of smoking and chewing for less educated, poorer, rural and lower caste. Sharp and rising inequalities by survey year, but percentage change shows increases are greater among higher SES groups – higher education, urban, richer populations, previously unreported.
- Low and declining risks of smoking and chewing among women. Higher rates of chewing compared to smoking. Increase in smoking with urbanization for women. Greater declines over time for higher educated women.
- Significant changing trend by wealth, education and living environment in smoking among men and in chewing among women. Increases in smoking prevalence among younger men (15-24 years) and chewing among younger women (15-24 years).

Strengths & limitations

- First systematic examination of socioeconomic patterns in tobacco use in India, highlighting SES gradients in use and risks among vulnerable populations.
- Large sample, representative and generalizable surveys providing repeated and comparable estimates over time.
- Limitations: a) cross-sectional data, limiting scope for causal inference, b) lack of data by tobacco type or volume of use, c) data from a reproductive health survey may suffer from social desirability bias.

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INTRODUCTION

Global estimates indicate that one in ten adult deaths can be attributed to tobacco consumption, leading to approximately 5 million global deaths per year[1-4]. Of these, 2.4 million deaths occur in developing countries. India bears a significant portion of this global tobacco burden[3-4]. Consumption of both smoked and smoke-less (chewed and inhaled) forms of tobacco is highly prevalent among men (47%) and women (14%)[5]. However, previous studies have indicated that tobacco use, like other non-communicable disease risk factors, is unequally distributed across different social determinants in India – education, caste and wealth – among both men and women[1,5-7], indicating a distinct 'economic and spatial distribution' in tobacco use[6]. No studies have yet systematically examined patterns and changes in the prevalence of tobacco consumption in India by socioeconomic factors over time.

In this study, we aim to provide estimates and inferences on the changing gradient of tobacco consumption in India, analysing prevalence and odds ratio patterns from the National Family Health Surveys[8-9]. We discuss our findings in light of the Cigarette Epidemic Model[10-11] and examine what populations show higher and lower prevalence of tobacco consumption over time.

METHODS

Data was analysed from two rounds of the Indian National Family Health Survey (NFHS 2 & 3) conducted during 1998-99 and 2005-6. The NFHS is a nationally representative cross-sectional survey that is collected and managed by the Indian Institute of Population Sciences (IIPS) in Mumbai, India. These surveys provide vital sources of information on demographic, health and socioeconomic behaviour of Indian households. Data from men and women in the age group of 15-49 years was used from both survey rounds to ensure comparability. Data is representative of all Indian states (except the small Union Territories), hence covering almost 99 per cent of the country's population. The surveys were collected using multistage cluster random sampling techniques. Rural and urban

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areas are sampled separately and a uniform sample design was followed in each state; states and PSUs are considered as levels. Individual questionnaires for men and women were used to interview usual residents of the household or visitors who stayed in the house the night before. Further details on sample design, including sampling framework and sample implementation, are provided in the basic survey reports by IIPS [8-9].

Outcomes of interest include **smoking** (cigarettes, *bidis*[1] and pipes/cigar), **chewing tobacco** (*paan masala*[2], *gutkha*[3] or other chewed forms of tobacco) and **dual use** (consuming both smoked and smoke-less forms) of tobacco. NFHS-3 provides details on the different types of smoked and smokeless tobacco products, but this information was unavailable in NFHS-2. The main covariates of interest were age, marital status and education at the individual level, and household wealth, area of residence (urban/rural), religion and caste/tribe status at the household level (*Variable definitions are provided in Table 1*). Survey-weighted age-standardised prevalence estimates of smoking, chewing and dual use of tobacco along with percentage change were calculated. Pooled multi-level models with state, local area and individual as analytical levels were used to estimate the effect of wealth, education, living environment and caste on the log odds of smoking and chewing among men and women. Regression models are adjusted for age, religion and marital status. Survey year was used in the interaction terms to estimate a time trend in socioeconomic determinants of tobacco. Tests for trend include joint tests for significance of fixed parameters and significance tests for random parameters. Model estimates were maximum likelihood-based using the Iterative Generalized Least-Squares (IGLS) algorithm as implemented within the MLwin software programme (version 2.23).

RESULTS

Data used in this analysis covers 131,464 men and 130,886 women residing in 92,486 households in NFHS-2 and 69,755 men and 124,142 women residing in 109,041 households in NFHS-3, with an overall response rate of 96% for NFHS-2 and 98% for NFHS-3. Prevalence (%) of smoking, chewing and dual use of tobacco over two survey

[1] *Bidis* are local inexpensive cigarettes, that are thinner and contain tobacco flakes rolled inside tendu leaves. Bidis are often smoked by poorer populations.
[2] *Paan Masala* is a powdered preparation of betel leaves combined with cured tobacco and/or areca nut, which has stimulating properties
[3] *Gutkha* is a savoury or sweet preparation containing areca nut, tobacco, catechu, paraffin and slaked lime.

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rounds are presented by the three primary markers of socioeconomic status - education, wealth and caste (table 1) along with percentage change estimates. Estimates by living environment, marital status, age and religion are presented in the appendix (Web Table 1). Among men, the prevalence of tobacco use (smoking, chewing and dual use) is seen to increase across all socioeconomic groups. For instance, smoking rises from 35.5% to 40.6% in the fifth (poorest) quintile, 30.6% to 36.5% in the fourth quintile, 25.6 to 31.4% in the middle quintile, 19.3% to 25.8% in the second quintile and 11.9% to 19.9% in the first (richest) quintile (table 1). Chewed tobacco use increased from 34.4% to 47.1% among the illiterate populations, 30.2% to 41.9% among those with primary schooling only, 23.3% to 33.1% among those with high school education, 14.9% to 23.9% among those with college education and 12.4% to 18.5% among those with postgraduate degree. Higher prevalence of tobacco use among men in each survey round is seen for socioeconomically disadvantaged groups – with less educated, lower wealth, living in rural areas or lower caste showing an inverse SES gradient; however, greater proportional increases in prevalence over time are seen among higher SES groups. For instance, higher absolute smoking prevalence in NFHS 3 is seen among men in lower wealth quintiles compared to those in higher wealth quintiles (41% for fifth (poorest) quintile and 37% for fourth quintile, compared to 20% in first (richest) quintile and 26% in second quintile); higher percentage increases in smoking are recorded among first (richest) quintile (63%) and second quintile (37%) compared to fourth quintile (21%) and fifth (poorest) quintile (13%). Similar trend is seen for education with a 98% increase in prevalence among those with postgraduate education and 13% increase in prevalence among those with no education over the two survey rounds. Sharper inequalities with higher inter-group differences are seen for smoking compared to chewing. Prevalence of chewing among men in the richest quintile and with postgraduate education each increased by 49%, while that for the poorest increased by 35% and for those with no education increased by 37%.

Socioeconomic patterns for tobacco use among women differ distinctly. Overall prevalence rates of tobacco use among women are significantly lower than men. In 2005-06, prevalence of smoking and chewing among women with no education was 2.3% and 13.3% respectively, while the same for men was 43.9% and 47.1% respectively (table 1).

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Women in most SES categories showed a declining trend for tobacco use, and only scheduled caste women and those with college education showed small increases in smoking and chewing. Higher and more consistent declines in prevalence are seen for education, compared to wealth and caste/tribe status. For instance, women with postgraduate education noted a 90% decrease in smoking and a 73% decrease in chewing (table 1). Women in the first (richest) quintile showed a decline of 30% for smoking and 8% for chewing (table 1). Results by area of residence (Web Table 1) show an increase in risks for tobacco use with urbanization among both men and women, except in the prevalence of chewed tobacco among women. Figures 1-2 show the percentage change in smoking and chewing by education and wealth for men and women reflecting findings from table 1.

Tables 2-3 present results from pooled multilevel models showing odds ratios for smoking and chewing by education, wealth, living environment and caste, along with interactions with survey year. Gradients in odds ratios (95% CI) are seen by all four markers of SES among men and women for smoking and chewing with sharper inequalities seen for education and wealth, compared to other markers. Controlling for wealth, caste and living environment and compared to those with postgraduate education, the odds ratio of smoking for men with no education: 3.18 (95% CI: 2.96,3.43), with primary education: 2.73 (95% CI: 2.54,2.94), with high school education: 1.81 (95% CI: 1.69,1.85) and with college education: 1.38 (95% CI: 1.28,1.49). Controlling for education, caste and living environment and compared to the first (richest) quintile, odds ratio for chewing in the second quintile: 1.43 (95% CI: 1.38,1.48), middle quintile 1.75 (95% CI: 1.68,1.82), fourth quintile: 1.92 (95% CI: 1.84,2.01) and fifth (poorest) quintile: 2.1 (95% CI: 1.99,2.2). Interaction terms in the two tables provide effect estimates for change over the two survey rounds. Among men, significant parameters for interaction terms for smoking are seen by wealth, education (except college educated) and living environment (except small city); and for chewing by wealth, higher education and by residence in towns. The joint test for interaction of fixed terms is significant for smoking by wealth (Joint test: 174.31, $p<0.001$), education (Joint test: 13.31, $p=0.009$) and living environment (Joint test: 13.44,$p=0.003$) and for chewing by wealth (Joint Test:

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15.63,p=0.003), representing robust change over time. Chi-square values for random parameters are significant both at state (Smoking chi2: 12.82, p=0.0003 and Chewing chi2: 12.89, p=0.0003) and local area (Smoking chi2: 650.41, p<0.0001 and Chewing chi2: 801.4, p<0.0001) level showing variation at both levels.

Among women, controlling for education, caste and living environment and compared to those in the first (richest) quintile, the odds ratio of smoking in second quintile: 1.48 (95% CI:1.28,1.71), middle quintile: 1.9 (95%CI:1.64,2.2), fourth quintile: 2.75 (95% CI: 2.37,3.19) and fifth (poorest) quintile: 3.95 (95% CI:3.39,4.6). Controlling for wealth, caste and living environment and compared to those with postgraduate education, odds ratio of chewing among women with college education: 1.84 (95% CI: 1.55,2.19), high school education: 2.19 (95% CI:1.86,2.57), primary schooling: 2.87 (95% CI:2.44,3.4) and no education: 3.85 (95% CI:3.27,4.53). Significant odds ratios for interaction terms are seen for smoking by wealth (Joint test: 19.128,p<0.0001) and for chewing by wealth (Joint Test: 31.96,p<0.0001), education (Joint test: 17.42,p<0.0001) and living environment (Joint test: 157.008,p<0.0001). Chi-square values for random parameters are significant for both state (Smoking chi2: 12.91, p=0.0004 and Chewing chi2: 12.94, p=0.011) and local area (Smoking chi2: 264, p<0.0001 and Chewing Chi2: 839, p<0.0001), showing variation at both levels. Figure 3 presents adjusted probability estimates for smoking and chewing among men and women by wealth and education from multilevel models, which show findings similar to prevalence estimates.

DISCUSSION

In 1994, Lopez et al.[10] proposed the four-stage *Cigarette Epidemic Model* discussing transitions in smoking prevalence, consumption amount and mortality in developed countries. As per the model in stage I, male smoking prevalence is comparatively low and rising (<20%) and female smoking prevalence does not exceed 5% due to sociocultural factors. In stage II, tobacco prevalence among men starts to rise rapidly and peaks around 50-80% with female smoking increasing at a lagged pace behind men. In stage III, prevalence rates for smoking among men start to fall, with both male and female smoking

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converging. Increases are seen for smoking rates among younger compared to older populations. In stage IV, prevalence of smoking begins to decline for both men and women. Mortality attributable to smoking rises to about one-third for all men, with much lower mortality rates seen among women. This model was developed based on empirical data from developed countries and has not been tested in developing countries. However, in 2011 Thun et al.[11] proposed modifications to the model potentially relevant for developing countries and were the first to note that smoking patterns by gender in developing countries distinctly differ from patterns noted in developed countries. India shows a high and complex burden of tobacco consumption, as also reported in tobacco surveillance studies[2,12-13]. This paper uses empirical evidence to show that India is currently between stages II and III of the Cigarette Epidemic model on the basis of estimates of smoking for men, but distinctly differs from the model on the patterns seen for women.

Overall, several dissimilarities are noted in the Indian experience from this model. ***First,*** India's unique tobacco experience comprises a 'double burden' of smoked ***and*** chewed tobacco consumption. Patterns for smoking and chewing seem to follow trajectories that differ by education, living environment and wealth. Further, within smoking, differences potentially exist by SES in the consumption of cigarettes from *bidis,* which most data are unable to distinguish. The quantity and quality of these products may differentially determine the mortality burden attributable to tobacco use in India[14-16]. Assessment of the disease, mortality and cost burden of the tobacco epidemic needs to account for this complexity[14-15].

Second, socioeconomic and sociocultural dynamics play profound roles in impacting tobacco use in India. Differences in tobacco consumption are seen by major SES markers such as wealth, education, living environment and caste. Findings from this analysis indicate a dichotomy between **higher absolute prevalence** by lower caste, wealth and education levels; but **higher relative change in prevalence** over time by higher caste, wealth and education levels. ***No previous study has reported this finding for India***. Urbanization seems to be playing an increasing role in impacting tobacco use for men

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and women. Further analyses by type and amount of tobacco consumed are needed to systematically understand these patterns.

Third, social gradients in tobacco use (overall and by type of tobacco) in India distinctly differ by gender. Despite women's empowerment, large-scale increases in women's smoking as predicted by the Cigarette Epidemic Model are yet to be seen in India[10-11, 17-18]. Aggregate estimates show that women are far behind men in prevalence rates for smoking; and smoking and chewing rates among women, barring a few groups, seem to be declining. The reasons for this could be several. **First,** that Indian sociocultural realities and lower acceptability of smoking among women leads to delays in age of initiation of smoking and higher rates among older compared to younger women (Web Table 1). Women's smoking has been linked to their empowerment, but this may be confined to urban areas and it is possible that on average, smoking continues to remain a social taboo among women. Representation of smoking in the media may also explain the gender patterns in the use of tobacco; smoking has been projected as an expression of masculinity among men and has moralistic connotations for women[19-21]. **Second,** an economic perspective explaining the lower smoking rates among women in India may attribute this statistic to women's unequal participation in the labor market and limited access to personal disposable income. Higher smoking among women in cities may partly indicate greater uptake of smoking by employed women. **Third,** given that data for this analysis comes from a reproductive health survey, it is possible that results for women are an underestimate. Web table 1 indicates that older (above 35 years of age) women are more likely use tobacco. However, patterns in this analysis match findings from other tobacco studies such as the GATS in India (IIPS)[5-6], providing a counter to this argument.

Finally, evidence on the socioeconomic gradient in tobacco use in India needs to be linked to its implications for tobacco-related mortality and morbidity[14-15]. Dikshit et al.[15] provide the first estimates of cancer mortality in India, attributing a major component of age-standardized cancer mortality from lung and oral cancers to high rates of tobacco use in India. Analyses stratifying cancer morbidity and mortality in India by

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SES have not yet been attempted, and the lack of reliable surveillance data for chronic diseases prevents an exhaustive assessment of the impact of tobacco use on Indian current and future chronic disease burden[22].

This study provides a systematic examination of the socioeconomic patterns in tobacco use in India over time. Data in this analysis comes from the NFHS, which is a large, representative and generalizable survey, providing a comparative picture of tobacco patterns over time. The limitations of this analysis are the following. First, data is cross-sectional, hence limiting scope for causal inference. NFHS does not provide detailed data by type or volume of tobacco. Finally, NFHS is a reproductive health survey where women in the ages of 15-49 years are sampled. Men are sampled in the households of the female sample. This introduces the potential for two downward biases. The first pertains to *social desirability bias* particularly related to underestimation of smoking patterns in women's childbearing years. Second, since the sample of men is conditional on the households from which women were sampled, the pool of men sampled may not be representative. Despite these caveats, NFHS (and in general the demographic and health surveys) has proven to be representative and generalizable, and continues to be used in a number of studies related to tobacco[5-6]. In addition, our findings are consistent with estimates from studies using other surveys assessing the burden of tobacco and its drivers in India[2,23]. Tobacco burden in the 'productive' populations (14-50 years) not only represents the current burden of tobacco but may predict future morbidity.

We present empirical evidence that India is experiencing a unique economic and social transition in tobacco consumption, quite distinct from the experience of developed countries that is likely to manifest in a number of morbidities[2,14-15]. In order to ensure policy effectiveness to prevent and reduce the exposure to tobacco, there is a need to systematically monitor and examine the social inequities in tobacco use over time and channel interventions to the social groups that are most vulnerable to these inequalities.

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TABLES, FIGURES AND REFERENCES

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Table 1: Prevalence (%) of tobacco smoking, chewing and dual use (smoking and chewing) by wealth, education and caste/tribe status among men and women in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Caste/ tribe status[1]																		
General	(M) 50,939 (F) 50,526	(M) 21,850 (F) 41,844	22.2 (21.4, 22.9)	28.8 (27.7, 29.9)	30	22.2 (21.4,23 .02)	33.2 (31.8, 34.5)	50	7.4 (6.9,7 .8)	10.8 (10. 0,11 .5)	1.0 (0.9, 1.1)	0.8 (0.55, 1.0)	-20	6.6 (6.1, 7.1)	7.24 (6.6,7. 85)	10	0.24 (0.17, 0.3)	0.2 (0.11,0 .27)
SC	(M) 21,491 (F) 21,045	(M) 11,953 (F) 20,566	31.5 (30.5, 32.5)	39.3 (37.8, 40.9)	25	27.8 (26.6, 29.1)	40.5 (38.8, 42.1)	46	12.1 (11.4, 12.8)	15.8 (14. 7,16 .9)	2.3 (1.9,2. 8)	2.4 (2.05,2 .8)	4	10.9 (10.1,11 .8)	12.1 (11.2,1 2.9)	11	0.5 (0.4,0. 7)	0.4 (0.3,0. 6)
ST	(M) 16,187 (F) 16,520	(M) 8,453 (F) 16,518	30.6 (28.8, 32.3)	36.6 (34.1, 39.1)	20	38.6 (36.9, 40.4)	52.6 (49.9, 55.3)	36	14.5, (13.3, 15.6)	18.6 (16. 7,20 .4)	3.0 (2.5,3. 6)	2.7 (2.04,3 .4)	-10	18.5 (17.0,20 .1)	25.08 (22.8,2 7.4)	36	1.0 (0.7,1. 2)	0.9 (0.6,1. 3)
OBC	(M) 36,381 (F) 36,290	(M) 25,144 (F) 29,561	24.7 (23.9, 25.5)	31.2 (30.2, 32.2)	26	25.4 (24.5, 26.3)	36.2 (35.0, 37.5)	43	9.9 (9.4,1 0.5)	13.1 (12. 3,13 .8)	1.5 (1.3,1. 7)	1.4 (1.2,1. 7)	- 7	7.3 (6.8,7.7)	7.08 (6.6,7. 6)	-3	0.3 (0.26,0 .4)	0.14 (0.09,0 .21)
No caste	(M) 6,466 (F) 6,505	(M) 2,355 (F) 5,653	31.8 (29.4, 34.3)	37.9 (34.2, 41.6)	19	23.3 (20.9, 25.6)	35.5 (31.6, 39.3)	52	10.7 (9.3, 12.1)	13.0 (10. 9,15 .2)	1.4 (0.8,1. 9)	0.9 (0.36,1 .48)	-36	10.3 (9.1,11. 6)	12.8 (10.8,1 4.8)	24	0.4 (0.2,0. 6)	0.31 (0.03,0 .59)
Education Level[2]																		
Post graduat e	(M) 3,432 (F) 1,963	(M) 2,920 (F) 3,526	7.6 (6.5, 8.7)	15.05 (13.0 1,17. 1)	98	12.4 (10.8,14 .1)	18.5 (16.0, 21.1)	49	1.7 (1.2,2 .2)	4.04 (3.0, 5.1)	0.2 (- 0.2, 0.6)	0.02 (- 0.007, 0.05)	-90	1.2 (0.45,1. 9)	0.33 (0.14,0 .5)	-73	0.2 (- 0.17,0. 5)	0.004 (- 0.002, 0.012)
College	(M) 11,340 (F) 6,586	(M) 7,811 (F) 9,424	11.1 (10.2, 11.9)	20.7 (19.2, 22.1)	86	14.9 (13.9,15 .8)	23.9 (22.3, 25.6)	60	3.5 (3.1,3 .9)	6.7 (5.8, 7.6)	0.1 (- 0.01,0. 2)	0.11 (0.03, 0.19)	10	1.3 (0.9,1.6)	1.8 (1.4,2. 2)	39	0.05 (- 0.04,0. 14)	0.04 (- 0.017, 0.1)
High school	(M) 69,996 (F) 46,629	(M) 26,100 (F) 34,338	21.2 (20.7,2 1.8)	24.7 (23.8, .25.5)	17	23.3 (22.7,23 .9)	33.1 (32.0, 34.1)	42	7.8 (7.5, 8.2)	9.9 (9.3, 10.6)	0.2 (0.17, 0.3)	0.07 (0.04, 0.1)	-65	4.2 (3.9, 4.6)	3.4 (3.04,3 .7)	-19	0.1 (0.06,0 .13)	0.04(0. 02,0.0 6)
Primary school	(M) 21,730 (F) 20,604	(M) 12,622 (F) 19,451	32.7 (31.7,3 3.6)	35.6 (34.3, 36.9)	1	30.2 (29.2, 31.2)	41.9 (40.5, 43.4)	39	12.1 (11.4, 12.7)	14.8 (13. 8, 15.7)	0.7 (0.5,0. 8)	0.2 (0.13,0 .3)	-71	9.0 (8.4,9.6)	7.4 (6.8,8. 02)	-18	0.18 (0.13,0 .24)	0.07 (0.03,0 .11)

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Illiterate	(M) 24,966 (F) 55,104	(M) 20,302 (F) 57,403	38.9 (37.9,, 39.9)	43.9 (42.8, 45.2)	13	34.4 (33.2,35 .5)	47.1 (45.7, 48.5)	37	(15.9 (15.1, 16.6)	18.9 (17. 9,19 .9)	2.6 (2.4,,2. 9)	2.3 (2.02,2 .6)	-12	11.9 (11.4, 12.6)	13.3 (12.6, 13.0)	12	0.6 (0.53,0 .72)	0.42 (0.33,0 .51)
Wealth Quintiles																	
Richest	(M) 26,291 (F) 26,177	(M) 13,706 (F) 24,837	11.9 (11.2, 12.5)	19.9 (18.8, 21.1)	63	13.7 (12.8,14 .6)	20.4 (19.0, 21.8)	49	3.3 (2.97, 3.6)	5.8 (5.1, 6.4)	0.2 (0.1,0. 3)	0.14 (0.08,0 .2)	-30	2.2 (1.9,2.5)	2.02 (1.7,2. 3)	-8	0.05 (0.01,0 .07)	0.042 (0.009, 0.07)
Richer	(M) 26,293 (F) 26,177	(M) 13,946 (F) 24,837	19.3 (18.5, 20.04)	25.8 (24.6, 27.1)	37	19.0 (18.1,19 .9)	30.2 (28.7, 31.7)	59	5.6 (5.2,6 .02)	9.3 (8.4, 10.2)	0.46 (0.37,0 .54)	0.37 (0.27,0 .47)	-20	5.4 (4.9,5.9)	4.9 (4.4,5. 4)	-9	0.1 (0.07,0 .18)	0.06 (0.02,0 .09)
Middle	(M) 26,294 (F) 26,174	(M) 14,075 (F) 24,826	25.6 (24.7,2 6.4)	31.4 (30.1, 32.7)	25	22.9 (22.0,23 .9)	34.9 (33.4, 36.3)	52	7.6 (7.2,8 .1)	11.5 (10. 6,12 .3)	1.1 (0.9,1. 3)	0.7 (0.6,0. 9)	-36	7.8 (7.2,8.3)	6.9 (6.4,7. 4)	-11	0.23 (0.16,0 .3)	0.07 (0.04,0 .11)
Poorer	(M) 26,293 (F) 26,179	(M) 14,007 (F) 24,814	30.6 (29.7,3 1.5)	36.5 (35.2, 37.8)	21	28.9 (28.0,29 .9)	39.5 (38.0 3,40. 9)	37	11.6 (10.9, 12.2)	14.5 (13. 6,15 .5)	1.7 (1.5,1. 9)	1.7 (1.4,1. 9)	0	10.9, (10.3,11 .6)	10.5 (9.8,12 .2)	-4	0.4 (0.3,0. 5)	0.24 (0.17,0 .31)
Poorest	(M) 26,293 (F) 26,179	(M) 14,021 (F) 24,828	35.5 (34.4,, 36.5)	40.6, 39.3, 41.9)	13	36.8 (35.7,37 .9)	49.7 (48.2, 51.2)	35	16.7 (15.9, 17.5)	19.4 (18. 4,20 .5)	3.5 (3.1,3. 9)	3.2 (2.8,3. 7)	-9	14.1 (13.3,15 .0)	17.1 (16.03, 18.1)	21	0.9 (0.7,1. 0)	0.7 (0.52,0 .86)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142															

[1]Scheduled castes and scheduled tribes are identified by the Government of India as socially and economically backward and needing protection from social injustice and exploitation. Other backward class is a diverse collection of intermediate castes that were considered low in the traditional caste hierarchy but are clearly above scheduled castes. General is thus a default residual group that enjoys higher status in the caste hierarchy.

[2] Post graduate:15 or more years of education; college: 13-15 years of education; high school: 8-12 years of education; secondary: 5-8 years of education; primary: 0-5 years of education; illiterate: 0 years of education

*Percentage change (**% Δ)** numbers have been rounded to the nearest integer.

*All results for prevalence are survey adjusted and age-standardised. Prevalence results are all in percentages.

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Table 2: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among men and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.37 (1.32,1.43)	1.51 (1.44,1.59)	1.37 (1.31,1.42)	1.36 (1.3,1.41)	1.37 (1.31,1.42)	1.43 (1.38,1.48)	1.33 (1.27,1.4)	1.42 (1.36,1.47)	1.42 (1.36,1.47)	1.41 (1.36,1.47)
Middle	1.71 (1.64,1.78)	1.99 (1.89,2.1)	1.71 (1.64,1.78)	1.68 (1.61,1.75)	1.7 (1.63,1.77)	1.75 (1.68,1.82)	1.63 (1.55,1.72)	1.73 (1.66,1.8)	1.72 (1.65,1.8)	1.72 (1.65,1.79)
Poorer	2.06 (1.97,2.16)	2.51 (2.37,2.65)	2.05 (1.96,2.14)	2.02 (1.93,2.11)	2.04 (1.95,2.14)	1.92 (1.84,2.01)	1.77 (1.67,1.87)	1.89 (1.8,1.97)	1.86 (1.78,1.95)	1.87 (1.79,,1.96)
Poorest	2.33 (2.22,2.46)	2.88 (2.72,3.06)	2.31 (2.19,2.43)	2.29 (2.18,2.41)	2.3 (2.19,2.42)	2.1 (1.99,2.2)	1.93 (1.82,2.05)	2.03 (1.92,2.13)	2.03 (1.932.13)	2.02 (1.93,2.12)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.38 (1.28,1.49)	1.41 (1.31,1.53)	1.34 (1.19,1.5)	1.4 (1.29,1.51)	1.4 (1.3,1.51)	1.26 (1.17,1.36)	1.28 (1.19,1.39)	1.14 (1.02,1.27)	1.29 (1.19,1.39)	1.29 (1.2,1.39)
High School	1.81 (1.69,1.95)	1.91 (1.78,2.05)	2.16 (1.95,2.4)	1.87 (1.74,2.01)	1.87 (1.74,2.01)	1.53 (1.43,1.65)	1.64 (1.53,1.76)	1.46 (1.33,1.61)	1.65 (1.54,1.77)	1.66 (1.54,1.78)
Primary	2.73 (2.54,2.94)	2.81 (2.61,3.04)	3.4 (3.05,3.78)	2.77 (2.57,2.99)	2.77 (2.57,2.99)	1.98 (1.84,2.13)	2.04 (1.9,2.2)	1.84 (1.66,2.04)	2.05 (1.9,2.21)	2.06 (1.91,2.21)
No education	3.18 (2.96,3.43)	3.27 (3.03,3.53)	4.07 (3.66,4.53)	3.19 (2.96,4.34)	3.18 (2.95,3.42)	2.09 (1.94,2.26)	2.06 (1.91,2.22)	1.93 (1.74,2.14)	2.07 (1.92,2.23)	2.08 (1.93,2.24)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.77 (0.72,0.82)	0.81 (0.76,0.87)	0.8 (0.74,0.85)	0.82 (0.75,0.9)	0.79 (0.74,0.84)	0.96 (0.89,1.02)	1.02 (0.96,1.09)	1.02 (0.96,1.09)	1.06 (0.97,1.16)	1.03 (0.97,1.1)
Town	0.78 (0.74,0.82)	0.83(0.79,0 .88)	0.81(0.77,0 .85)	0.88 (0.82,0.95)	0.81 (0.77,0.85)	0.92 (0.87,0.97)	1.01 (0.95,1.06)	1.01 (0.95,1.06)	1.06 (0.98,1.15)	1.01 (0.96,1.07)
Village	0.68 (0.65,0.71)	0.75 (0.71,0.78)	0.73 (0.7,0.77)	0.87 (0.82,0.92)	0.73 (0.7,0.76)	0.76 (0.73,0.79)	0.92 (0.88,0.96)	0.92 (0.88,0.96)	0.93 (0.88,0.99)	0.93 (0.88,0.97)

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Caste/Tribe (Other)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SC	1.16 (1.12,1.2)	1.15 (1.11,1.19)	1.15 (1.11,1.18)	1.15 (1.11,1.19)	1.16 (1.11,1.21)	1.12 (1.08,1.15)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.14)
ST	1.14 (1.09,1.2)	1.13 (1.08, 1.2)	1.14 (1.08,1.18)	1.14 (1.09,1.2)	1.15 (1.09,1.21)	3.02 (2.88,3.15)	1.1 (1.06,1.15)	1.1 (1.05,1.15)	1.1 (1.05,1.15)	1.17 (1.11,1.24)
OBC	1.00 (0.98,1.04)	0.99 (0.97,1.02)	0.99 (0.96,1.02	0.99 (0.97,1.02)	1.03 (0.99,1.07)	1.05 (1.02,1.08)	1.01 (0.97,1.03)	1.002 (0.97,1.03)	1.003 (0.97,1.03)	1.04 (0.99,1.07)
No Caste or missing	1.06 (1.01,1.13)	1.07 (1.01,1.13)	1.07 (1.01,1.13)	1.08 (1.02,1.14)	1.05 (0.98,1.13)	0.97 (0.92,1.03)	1.02 (0.96,1.08)	1.01 (0.96,1.08)	1.02 (0.96,1.08)	0.97 (0.9,1.04)
Survey Year (Yr)		1.74 (1.7,1.88)	1.67 (1.46,1.91)	1.49 (1.4,1.58)	1.24 (1.19,1.3)		1.47 (1.38,1.56)	1.34 (1.17,1.54)	1.69 (1.58,1.8)	1.72 (1.65,1.79)
Yr *Richer		0.78 (0.73,0.84)					1.15 (1.07,1.24)			
Yr*Middle		0.68 (0.63,0.73)					1.13 (1.05,1.22)			
Yr *Poorer		0.60 (0.56,0.65)					1.15 (1.07,1.24)			
Yr *Poorest		0.58 (0.53,0.62)					1.11 (1.03, 1.2)			
Yr *College			1.13 (0.97,1.32)					1.27 (1.1,1.48)		
Yr * High School			0.78 (0.68,0.89)					1.28 (1.11,1.47)		
Yr * Primary			0.66 (0.57,0.77)					1.02 (0.88,,1.18)		
Yr * No education			0.61 (0.53,0.70)					1.01 (0.87,1.17)		
Yr *Small City				0.99 (0.87,1.12)					0.94 (0.82,1.06)	
Yr * Town				0.89 (0.81,0.98)					0.9 (0.82,0.99)	
Yr * Village				0.73 (0.68,0.79)					0.98 (0.91,1.05)	
Yr *SC					0.99 (0.92,1.05)					0.99 (0.93,1.06)
Yr *ST					0.97 (0.9,1.05)					0.84 (0.78,0.91)
Yr*OBC					0.92 (0.87,0.97)					0.92 (0.87,0.97)
Yr*No Caste					1.07 (0.94,1.21)					1.15 (1.02,1.29)

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Fixed Part of the Model										
Joint Chi Test for Interaction (p-value)		174.31 (p<0.001)	13.31 (p=0.009)	13.44 (p=0.003)	0.318 (p=0.98)		15.63 (p=0.003)	8.52 (p=0.074)	2.6 (p=0.46)	1.387 (p=0.85)
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)		12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)
Chi square for Level 2: Local Area (p-value)		650.41 (p<0.001)	655.7 (p<0.001)	654.2 (p<0.001)	660.7 (p<0.001)		801.6 (p<0.001)	802.4 (p<0.001)	802.4 (p<0.001)	801.7 (p<0.001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Table 3: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among women and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.48 (1.28,1.71)	1.82 (1.49,2.22)	1.48 (1.28,1.71)	1.48 (1.28,1.71)	1.49 (1.29,1.72)	1.48 (1.41,1.56)	1.41 (1.32,1.51)	1.48 (1.4,1.55)	1.51 (1.43,1.59)	1.48 (1.41,1.56)
Middle	1.9 (1.64,2.19)	2.63 (2.17,3.19)	1.87 (1.62,2.16)	1.88 (1.62,2.18)	1.9 (1.64,2.19)	1.75 (1.66,1.85)	1.58 (1.47,1.7)	1.75 (1.65,1.84)	1.81 (1.72,1.92)	1.76 (1.66,1.85)
Poorer	2.75 (2.37,3.19)	3.72 (3.07,5.52)	2.8 (2.41,3.25)	2.81 (2.42,3.26)	2.85 (2.45,3.30)	2.14 (2.02,2.27)	1.86 (1.72,2.002)	2.13 (2.01,2.25)	2.2 (2.07,2.32)	2.14 (2.02,2.27)
Poorest	3.95 (3.39,4.6)	4.83 (3.97,5.88)	4.03 (3.46,4.69)	4.05 (3.47,4.72)	4.08 (3.5,4.75)	2.67 (2.5,2.84)	2.14 (1.99,2.32)	2.65 (2.49,2.82)	2.7 (2.54,2.88)	2.7 (2.5,2.84)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.59 (0.91,2.8)	1.61 (0.92,2.82)	0.98 (0.37,2.58)	1.58 (0.9,2.78)	1.57 (0.9,2.75)	1.84 (1.55,2.19)	1.83 (1.54,2.17)	1.1 (0.85,1.42)	1.82 (1.53,2.17)	1.84 (1.55,2.19)
High School	1.78 (1.06,2.99)	1.67 (1.01,,2.82)	1.95 (0.83,4.56)	1.62 (0.96,2.72)	1.61 (0.99,2.7)	2.19 (1.86,2.57)	2.13 (1.82,2.51)	1.47 (1.17,1.85)	2.15 (1.82,2.54)	2.21 (1.88,2.6)
Primary	2.78 (1.66,4.68)	2.62 (1.56,4.41)	3.32 (1.42,7.76)	2.54 (1.51,4.29)	2.52 (1.5,4.24)	2.87 (2.44,3.4)	2.83 (2.4,3.33)	2.03 (1.61,2.56)	2.86 (2.42,3.37)	2.89 (2.45,3.41)
No education	4.78 (2.84,8.04)	4.91 (2.93,8.23)	6.89 (2.53,13.73)	4.72 (2.81,7.93)	4.66 (2.77,7.81)	3.85 (3.27,4.53)	3.75 (3.19,4.42)	2.58 (2.04,3.24)	3.8 (3.22,4.48)	3.85 (3.27,4.53)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.91 (0.75,1.09)	0.98 (0.82, 1.17)	1.01 (0.84,1.21)	0.78 (0.58,1.04)	1.004 (0.84,1.2)	1.23 (1.13,1.32)	1.25 (1.15,1.35)	1.22 (1.13,1.32)	0.97 (0.86,1.1)	1.2 (1.11,1.29)
Town	1.19 (1.03,1.37)	1.2 (1.04,1.38)	1.22 (1.05,1.4)	1.31 (1.06,1.62)	1.23 (1.1,1.41)	1.36 (1.27,1.45)	1.37 (1.29,1.47)	1.36 (1.27,1.45)	0.95 (0.86,1.04)	1.34 (1.25,1.43)
Village	1.4 (1.24,1.59)	1.28 (1.13,1.46)	1.31 (1.16,1.49)	1.37 (1.14,1.66)	1.32 (1.16,1.49)	1.07 (1.01,1.14)	1.09 (1.02,1.16)	1.08 (1.02,1.15)	0.69 (0.64,0.75)	1.07 (1.005,1.13)
Caste/Tribe	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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(Other)										
SC	1.5 (1.39,1.62)	1.55 (1.43,1.67)	1.54 (1.43,1.67)	1.54 (1.43,1.67)	1.4 (1.27,1.55)	1.28 (1.23,1.33)	1.28 (1.23,1.36)	1.28 (1.23,1.33)	1.29 (1.24,1.34)	1.28 (1.22,1.35)
ST	2.04 (1.86,2.24)	2.11 (1.92, 2.3)	2.11 (1.93,2.31)	2.11 (1.93,2.31)	1.99 (1.79,2.23)	1.53 (1.46,1.6)	1.53 (1.46,1.61)	1.53 (1.46,1.61)	1.52 (1.45,1.6)	1.48 (1.39,1.58)
OBC	1.11 (1.03,1.2)	1.17 (1.08,1.26)	1.16 (1.08,1.26)	1.16 (1.08,1.25)	1.13 (1.03,1.24)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.06 (1.02,1.12)
No Caste or missing	0.7 (0.6,0.81)	0.74 (0.64,0.86)	0.72 (0.62,0.85)	0.73 (0.62,0.85)	1.01 (0.85,1.2)	1.02 (0.95,1.09)	1.02 (0.96,1.09)	1.02 (0.95,1.09)	1.01 (0.95,1.08)	0.92 (0.85,1.01)
Survey Year (Yr)		1.004 (0.98,1.03)	0.89 (0.31,2.56)	0.67 (0.55,0.83)	0.57 (0.51,0.63)		0.81 (0.75,0.87)	0.54 (0.4,0.74)	0.52 (0.47,0.56)	1.02 (0.97,1.07)
Yr*Richer		0.66 (0.5,0.87)					1.09 (0.99,1.21)			
Yr*Middle		0.47 (0.36,0.61)					1.21 (1.1,1.34)			
Yr *Poorer		0.56 (0.44,0.72)					1.3 (1.18,1.43)			
Yr *Poorest		0.71 (0.56,0.91)					1.5 (1.37,1.64)			
Yr *College			1.98 (0.6,6.52)					2.26 (1.6,3.21)		
Yr * High School			0.77 (0.26,2.22)					1.94 (1.41,2.67)		
Yr * Primary			0.61 (0.21,1.75)					1.74 (1.27,2.4)		
Yr * No education			0.7 (0.24,2.0)					1.94 (1.41,2.66)		
Yr*Small City				1.44 (0.99,2.07)					1.61 (1.38,1.88)	
Yr * Town				0.89 (0.68,1.16)					1.94 (1.72,2.19)	
Yr * Village				0.92 (0.74,1.15)					2.26 (2.06,2.48)	
Yr *SC					1.29 (1.11,1.51)					0.99 (0.93,1.07)
Yr *ST					1.16 (0.99,1.36)					1.07 (0.98,1.16)
Yr*OBC					1.1 (0.96,1.27)					0.95 (0.89,1.01)
Yr*No Caste					0.45 (0.32,0.63)					1.22 (1.07,1.38)
Fixed Part of the Model										
Overall Chi for Interaction (p-		19.128 (p<0.001)	0.041 (p=0.99)	50.195 (p<0.001)	0.992 (p=0.91)		31.96 (p<0.0001)	17.42 (p=0.001)	157.008 (p<0.0001)	2.665 (p=0.615)

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value)										
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.91 (p=0.011)	12.91 (p=0.011)	12.91 (p=0.004)	12.91 (p=0.011)		12.94 (p=0.011)	12.94 (p=0.011)	12.94 (p=0.004)	12.94 (p=0.011)
Chi square for Level 2: Local Area (p-value)		260.98 (p<0.001)	266.3 (p<0.001)	264.9 (p<0.001)	263.5 (p<0.001)		844.91 (p<0.0001)	839.3 (p<0.0001)	824.92 (p<0.0001)	837.64 (p<0.0001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Web Table 1: Prevalence (%) of tobacco smoking, chewing and dual use (smoking and chewing) by living environment, age, religion and marital status among men and women in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Area of residence[1]																		
Large city	(M) 17,640 (F) 16,081	(M) 19,092 (F) 26,272	17.7 (16.6, 18.9)	27.2 (25.7, 28.8)	54	19.1 (17.4,21.1)	30.3 (28.2, 32.5)	59	6.05 (5.4,6.8)	10.2 (9.2, 11.3)	0.3(0.2, 0.4)	0.4 (0.3,0.6)	33	5.8 (4.9,6.9)	4.9 (4.1,5.9)	-16	0.09 (0.06,0.14)	0.055 (0.03,0.1)
Small city	(M) 8,957 (F) 8,573	(M) 4,723 (F) 9,318	18.3 (16.4,20.2)	28.8 (26.5, 31.2)	57	19.4 (17.1, 22.0)	34.2 (31.1, 37.4)	76	5.8 (4.95, 6.8)	10.9 (9.6, 12.5)	0.3 (0.2,0.5)	0.5 (0.35,0.7)	67	5.9 (4.8,7.1)	6.6 (5.5,8.1)	12	0.06 (0.03,0.14)	0.09 (0.04,0.2)
Town	(M) 18,837 (F) 18,803	(M) 12,078 (F) 21,256	19.9 (18.6,21.2)	30.3 (28.4, 32.2)	52	20.6 (18.7,22.5)	31.1 (28.6, 33.7)	51	6.3 (5.6,7.1)	10.5 (9.4, 11.7)	0.6 (0.5,0.8)	0.6 (0.4,0.8)	0	6.7 (5.8,7.8)	7.2 (6.1,8.4)	8	0.2 (0.15,0.3)	0.1 (0.07,0.2)
Village	(M) 86,030 (F) 87,429	(M) 33,862 (F) 67,296	28.9 (28.2,29.6)	35.2 (34.2, 36.2)	22	28.2 (27.4,28.9)	40.9 (39.8, 41.9)	45	11.4 (10.9, 11.8)	15.02 (14.3,15.7)	2.04 (1.85,2.24)	1.98 (1.75,2.24)	-3	9.8 (9.3,10.3)	11.3 (10.6,11.9)	15	0.5 (0.43,0.6)	0.4 (0.3,0.5)
Age-groups																		
15-24	(M) 50,266 (F) 52,299	(M) 25,511 (F) 46,688	8.6 (8.2, 9.1)	19.2 (18.4, 20.1)	123	14.3 (13.7, 14.9)	30.3 (29.27,31.4)	112	3.5 (3.3,3.8)	9.45 (8.9, 10.1)	0.4 (0.31,0.45)	0.3 (0.21,0.36)	-25	3.1 (2.8,3.3)	4.4 (3.99,4.7)	42	0.098 (0.07,0.14)	0.08 (0.05,0.13)
25-34	(M) 38,650 (F) 40,764	(M) 20,794 (F) 38,441	29.1 (28.3, 29.9)	36.3 (35.2, 37.4)	25	29.9 (29.1, 30.7)	43.1 (41.9, 44.3)	44	11.5 (10.9, 12.0)	16.0 (15.2,16.8)	1.4 (1.26,1.62)	1.3 (1.1,1.56)	-7	9.0 (8.5,9.5)	10.1 (9.45,10.7)	12	0.33 (0.27,0.4)	0.23 (0.2,0.3)
35-49	(M) 42,548 (F) 37,823	(M) 23,450 (F) 39,013	43.4 (42.5, 44.2)	44.1 (42.9, 45.2)	1.6	35.3 (34.4, 36.2)	40.2 (39.02,41.3)	14	15.7 (15.1, 16.3)	15.2 (14.4,16.01)	3.4 (3.1,3.8)	3.2 (2.84,3.57)	-6	16.5 (15.8,17.3)	15.7 (14.9,16.4)	-5	0.9 (0.76,1.02)	0.6 (0.5,0.7)
Marital Status																		
Currently married	(M) 77,233 (F) 95,398	(M) 40,529 (F) 87,754	36.9 (36.2,37.6)	40.6 (39.7, 41.5)	10	33.7 (32.9, 34.4)	42.9 (41.9, 43.9)	27	13.9 (13.5, 14.4)	15.9 (15.3,16.6)	1.8 (1.6, 1.94)	1.8 (1.6,2.02)	0	9.8 (9.3,10.3)	10.9 (10.4,11.5)	11	0.43 (0.37,0.5)	0.3 (0.26,0.4)

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Single	(M) 52,443 (F) 29,623	(M) 28,377 (F) 30,606	7.6 (7.3, 8.04)	18.9 (18.2, 19.7)	14 9	12.5 (11.9,12 .9)	27.4 (26.4, 28.4)	11 9	2.9 (2.7,3 .2)	8.6 (8.1, 9.2)	0.3 (0.22,0 .4)	0.09 (0.06,0 .14)	-70	1.9 (1.8,2.2)	2.8 (2.5,3. 2)	47	0.12 (0.08,0 .18)	0.03 (0.01,0 .06)
Widowe d	(M) 1,070 (F) 4,038	(M) 415 (F) 3,909	48.7 (45.1,5 2.3)	50.1 (43.9, 56.3)	2.8	41.6 (38.0,45 .3)	59.5 (53.2, 65.6)	43	19.5 (16.8, 22.5)	23.7 (18. 7,29 .6)	4.7 (3.86, 5.6)	3.5 (2.78,4 .3)	-26	21.3 (19.7,22 .9)	18.5 (16.9,2 0.2)	-13	1.4 (1.05,1 .89)	0.9 (0.6,1. 4)
Divorce d/ separat ed	(M) 718 (F) 1,827	(M) 434 (F) 1,873	41.7 (37.2,4 6.4)	46.6 (39.9, 53.3)	12	33.4 (29.01, 38.1)	55.9 (49.0 3,62. 7)	67	15.7 (12.5, 19.5)	25.2 (19. 7,31 .6)	2.5 (1.8,3. 6)	1.6 (1.01,2 .6)	-36	18.1 (15.9,20 .6)	18.6 (16.4, 21.01)	3	0.31 (0.13,0 .75)	0.6 (0.3,1. 2)
***Religion*[2]**																		
Hindu	(M) 100,339 (F) 99,430	(M) 51,174 (F) 89,888	26.1 (25.5,2 6.7)	33.01 (32.2, 33.8)	27	26.6 (26.0, 27.3)	38.2 (37.3, 39.1)	44	10.2 (9.8,1 0.5)	13.7 (13. 2,14 .3)	1.5 (1.4,1. 7)	1.5 (1.35,1 .7)	0	8.8 (8.3,9.2)	9.6 (9.1,10 .2)	9	0.37 (0.31,0 .43)	0.25 (0.2,0. 3)
Muslim	(M) 16,278 (F) 16,215	(M) 9,145 (F) 16,731	28.3 (26.7,2 9.9)	36.2 (34.3, 38.2)	28	23.4 (21.7,25 .1)	37.4 (35.0 2,39. 8)	60	9.5 (8.7,1 0.5)	13.1 (11. 9,14 .5)	1.9 (1.6,2. 3)	1.73 (1.25,2 .4)	-9	9.1 (8.3,9.9)	9.9 (8.9,10 .9)	9	0.5 (0.37,0 .7)	0.4 (0.3,0. 7)
Christia n	(M) 8,055 (F) 8,547	(M) 6,250 (F) 10,974	28.2 (25.9,3 0.5)	33.1 (29.9, 36.4)	17	17.5 (15.1, 20.1)	29.1 (25.0 1,33. 5)	66	8.2 (6.9,9 .6)	12.7 (10. 4,15 .5)	2.4 (1.7,3. 3)	1.3 (0.98,1 .62)	-46	9.9 (8.4,11. 6)	10.7 (9.1,12 .5)	8	0.98 (0.72,1 .33)	0.6 (0.5,0. 7)
Others	(M) 6,792 (F) 6,694	(M) 3,186 (F) 6,549	11.1 (9.5,12 .8)	16.2 (14.2, 18.4)	46	19.3 (17.1,21 .7)	26.0 (23.1, 29.2)	35	4.4 (3.4,5 .6)	6.5 (5.2, 8.0)	0.6 (0.4, 0.9)	0.4 (0.2,0. 65)	-33	7.5 (5.8,9.6)	7.6 (6.2,9. 4)	1	0.27 (0.13,0 .55)	0.2 (0.1,0. 6)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142																

[1]Large city: urban population ≥1 million; Small city: 100000-1 million; Town: ≤100000 million

[2]Others include Sikh, Buddhist, Jain, Jewish, Zoroastrian and Others

*Percentage change (**% Δ)** numbers have been rounded to the nearest integer. Estimates are not age-standardized

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Figure 1: Percentage change in smoking among men and women by education level and wealth quintiles

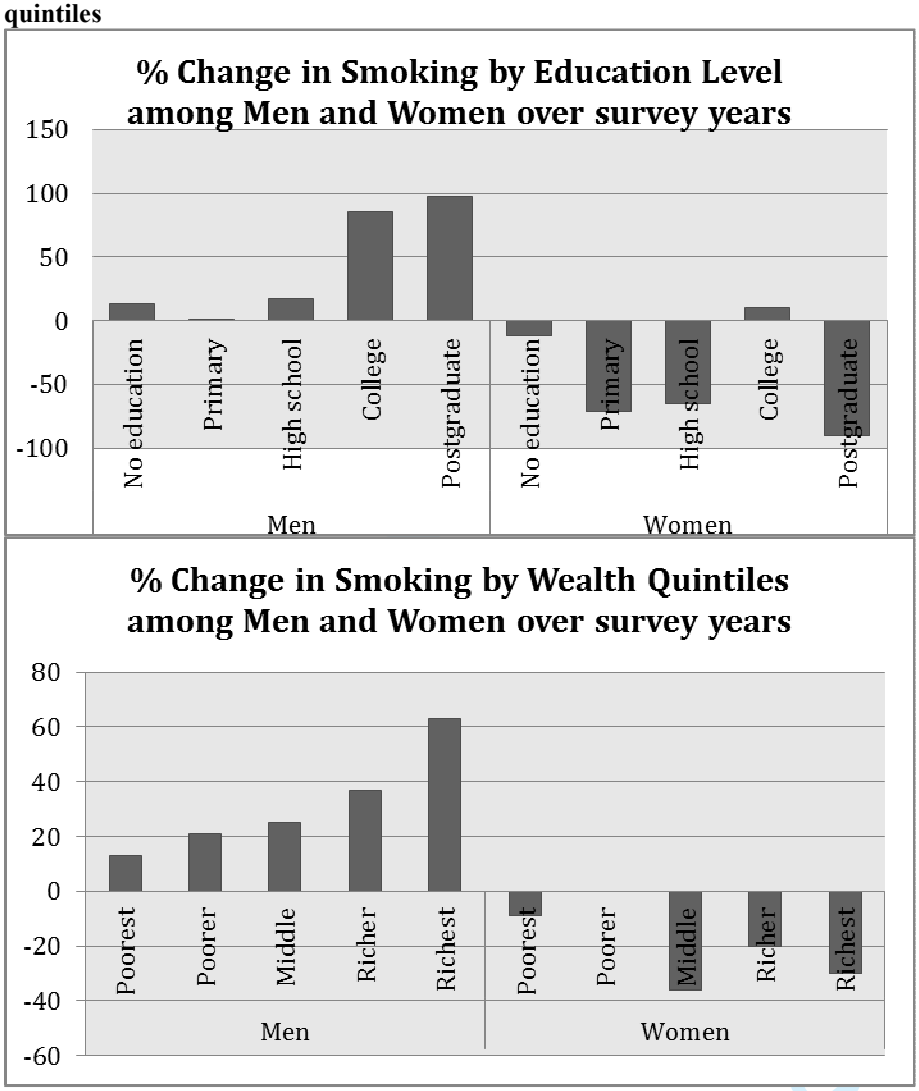

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Figure 2: Percentage change in chewing among men and women by education level and wealth quintiles

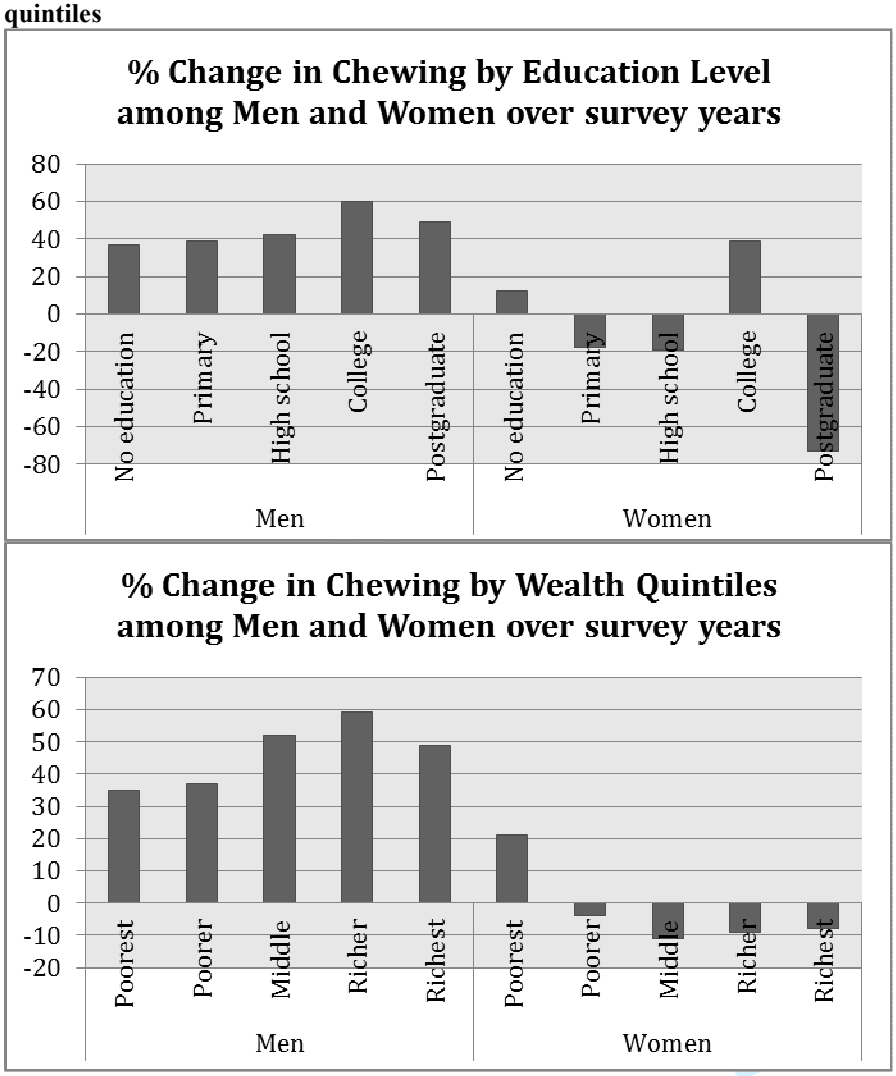

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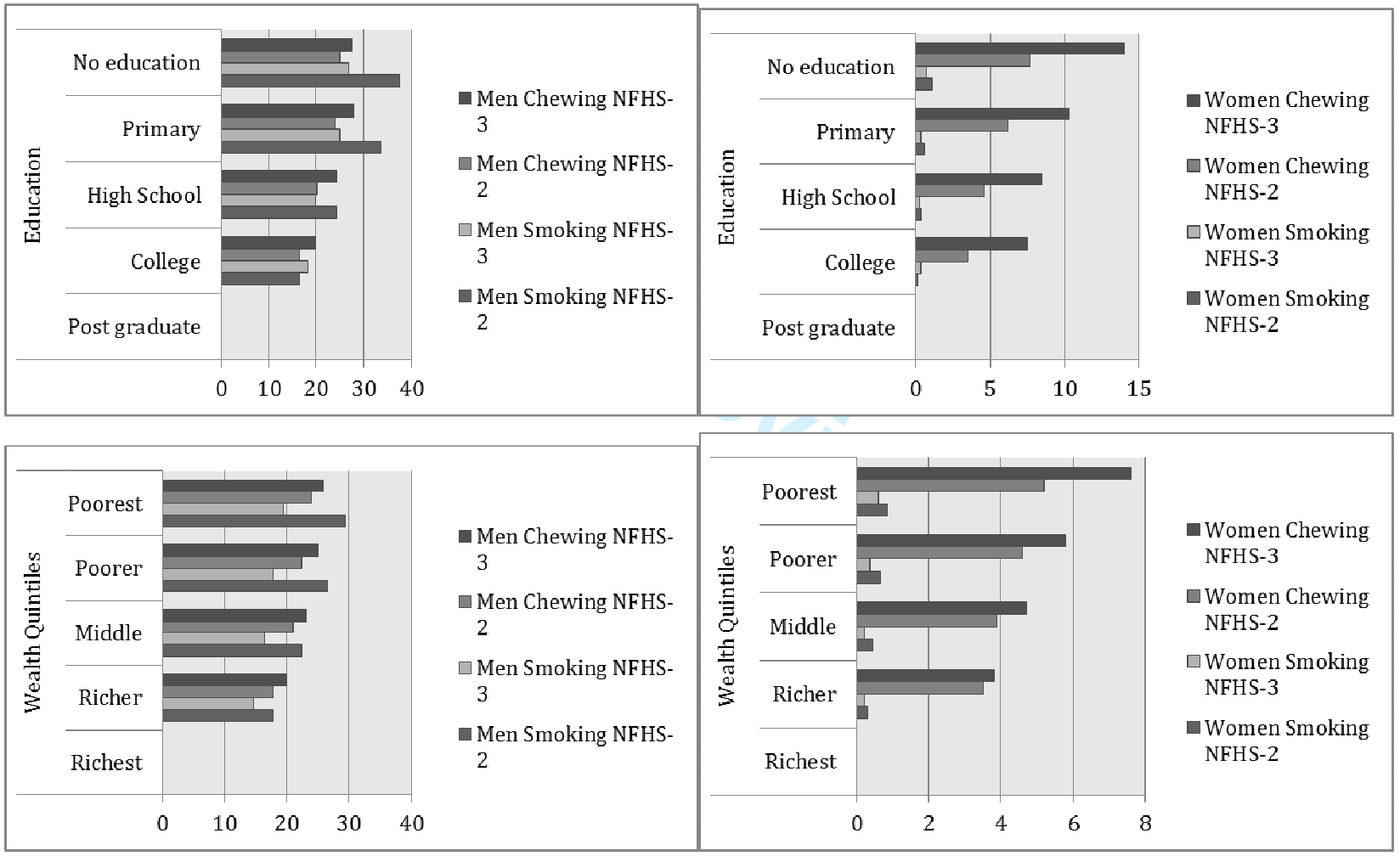
Figure 3: Probability of smoking and chewing among men and women by education and wealth



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Are sSocioeconomic disparities ~~patterns~~ in tobacco consumption increasing ~~over time~~ in India? A repeated cross-sectional multilevel analysis~~: Examining trends from NFHS-2 and 3 in light of the Cigarette Epidemic Model~~

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ABSTRACT: (298~~250~~ words)

Objectives: India bears a significant portion of the global tobacco burden with high prevalence of tobacco among men (47%) and women (14%). This study examines the socioeconomic patterning of tobacco use and identifies the changing gender and socioeconomic dynamics in light of the *Cigarette Epidemic Model*. ~~Smoking, chewing and dual use (smoking and chewing) in India show socioeconomic and spatial gradients among both men and women.~~

Design: Population-based c~~C~~ross-sectional s~~S~~urveys, NFHS -2 and 3, India

Setting & participants: 131,464 men and 130,886 women (NFHS-2) and 69,755 men and 124,142 women (NFHS -3) ~~in India~~ ages 15-49 years.

Outcomes & methods: Outcomes include smoking (cigarettes, *bidis* and pipes/cigar), chewing tobacco (*paan masala*, *gutkha* or other chewed forms of tobacco) and dual use examined by education, wealth living environment and caste/tribe status. ~~Survey-weighted age s~~Standardized prevalence and percentage change were estimated. ~~Pooled relative percentage change over time in smoking, chewing tobacco and Dual Use of tobacco.~~ m~~M~~ulti-level models estimate the effect of socioeconomic covariates on the log odds of tobacco used by gender, estimating fixed and random parameters. ~~with state, local area and individual as analytical levels were used to estimate probability of smoking and chewing, and significance of the trend.~~

Findings: Among men (2005-6), SES gradients in smoking (Illiterate: 44% vs. Postgraduates: 15%) and chewing (Illiterate: 47% vs. Postgraduate:19%) were observed. Similar SES gradients observed by education, living environment and caste. Chewed tobacco prevalence among women showed inverse SES gradients comparing the illiterate (7.4%) vs. postgraduate (0.33%), and poorest (17%) vs. richest (2%) quintiles. However, change estimates showed greater percentage rises in smoking and chewing respectively by higher SES groups among men – postgraduates (98%) and richest (49%) compared to those with high schooling only (17%) and poorest (35%). Among women, higher educated showed larger declines - 90% (postgraduates) vs. 12% (illiterates). Younger men (15-24 years) showed increasing tobacco use (Smoking: 123% and Chewing:112%).

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Older women (35-49 years) show higher prevalence 3.2% compared to 0.3% (15-24 years) for smoking.

~~a) increases in tobacco consumption among men with sharper inequalities in smoking compared to chewing; higher risks for the less educated, poorer, rural and lower caste populations, b) greater change in risk and percentage increases among high educated, urban, richer groups, previously unreported, c) low and declining smoking risks and unclear patterns in chewing among women, d) significant increases in smoking and chewing prevalence among younger men, and in chewing prevalence among younger women.~~

Conclusions: Indian tobacco use patterns show significant diversions from ~~Our results add qualitatively to the propositions of~~ the *Cigarette Epidemic Model* ~~showing significant diversions in the patterns in India compared to developed countries —~~ from gender and socioeconomic perspectives. ~~Given the twin burden of smoking and chewing and their unique challenges, we recommend~~ Sseparate analysies by ~~tobacco~~ type is needed to further ~~to~~ understand social determinants of tobacco use ~~the unique drivers of smoking and chewing~~ in India.

Article Summary

Article Focus

- India bears a significant burden of tobacco consumption, with high prevalence of smoking and chewing among men & women.
- ~~, and p~~Previous studies have established a unique social and spatial gradient in tobacco use. However, no studies have yet reported estimates for changing patterns in tobacco use prevalence or relative risk over time.
- ~~consumption.~~
- ~~No studies have provided estimates and inferences on changing trends in tobacco consumption over time, either through prevalence or relative risks.~~

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- This study estimates socioeconomic patterns ~~trends~~ and examines the changing gender and socioeconomic dynamics of tobacco use ~~consumption~~ in light of the *Cigarette Epidemic Model*.

Key Messages

- Among men, higher prevalence of smoking and chewing for less educated, poorer, rural and lower caste. Sharp and rising inequalities by survey year, but percentage change shows increases are greater among higher SES groups – higher education, urban, richer populations, previously unreported.
- Low and declining risks of smoking and chewing among women. Higher rates of chewing compared to smoking. Increase in smoking with urbanization for women. Greater declines over time for higher educated women.
- Significant changing trend by wealth, education and living environment in smoking among men and in chewing among women. Increases in smoking prevalence among younger men (15-24 years) and chewing among younger women (15-24 years).
- ~~Sharper and rising inequalities for smoking compared to chewing among men, versus low and declining risks for women.~~
- ~~Higher risks of smoking and chewing among men for the less educated, poorer, rural and lower caste populations, but greater increases in risks among the high educated, urban, richer groups, previously unreported.~~
- ~~significant increases in smoking and chewing prevalence among younger men, and in chewing prevalence among younger women.~~

Strengths & limitations

1. First systematic examination of socioeconomic patterns ~~trends~~ in tobacco use ~~consumption~~ in India, highlighting SES gradients in use and risks among vulnerable populations.
2. Large sample, representative and generalizable surveus providing repeated and comparable estimates over time. ~~and linking it to a previously developed~~

~~1. model to understand tobacco consumption transition.~~

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~~2. Estimates for relative risk, age standardised prevalence and percentage change over time, highlighting vulnerable groups.~~

3. Limitations: a) cross-sectional data, limiting scope for causal inference, b) lack of data by tobacco ~~include inability to differentiate between~~ type ~~of cigarette and estimate~~or the volume of ~~consumption.~~ use, c) data from a reproductive health survey may suffer from social desirability bias.

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INTRODUCTION

Global estimates indicate that one in ten adult deaths can be attributed to tobacco consumption, leading to approximately 5 million global deaths per year[1-4]. Of these, 2.4 million deaths occur in developing countries. India bears a significant portion of this global tobacco burden[~~2~~ 3-4]. Consumption of both smoked and smoke-less (chewed and inhaled) forms of tobacco is highly prevalent among men (47%) and women (14%)[54]. However, previous studies have indicated that tobacco use, like other n~~N~~on-c~~C~~ommunicable d~~D~~isease risk factors, is unequally distributed across different social determinants in India – education, caste and wealth – among both men and women[1,~~4,~~5-7,~~6~~], indicating a distinct ‘“~~“~~economic and spatial distribution’” in tobacco use[6~~5~~]. No studies have yet systematically examined patterns~~trends~~ and changes in the prevalence of tobacco consumption in India by socioeconomic factors over time.

In this study, we aim to ~~This research paper~~ provide~~s~~ estimates and inferences on the changing gradient of tobacco consumption in India, analysing prevalence and odds ratio patterns from the National Family Health Surveys[~~7~~ 8-9]. We discuss our findings in light of the Cigarette Epidemic Model[~~9~~ 10-11] and examine what populations show higher and lower prevalence of tobacco consumption over time.

METHODS

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Data was analysed from two rounds of the Indian National Family Health Surveys (NFHS 2 &3) conducted during ~~in~~ 1998-9 and 2005-6. The NFHS is a nationally representative cross-sectional survey that is collected and managed by the Indian Institute of Population Sciences (IIPS) in Mumbai, India. ~~(NFHS 2 & 3)~~ These surveys provide vital sources of information on demographic, health and socioeconomic behaviour of Indian households. Data from men and women in the age group of 15-49 years was used from both survey rounds to ensure comparability. Data is representative of all Indian states (except the small Union Territories), hence covering almost ~~was analysed and survey weighted age standardized prevalence estimates together with percentage change were estimated. Analysis was restricted to men and women in the age group 15-49 years for comparability. NFHS data covers~~ 99% of the country's ~~India's~~ population. The surveys were collected using multistage cluster random sampling techniques. Rural and urban areas are sampled separately and a uniform sample design was followed in each state; states and PSUs are considered as levels. Individual questionnaires for men and women were used to interview usual residents of the household or visitors who stayed in the house the night before. Further ~~and is representative of all states. d~~Details on sample design, including sampling framework and survey implementation, ~~are~~ are provided in the basic survey reports by IIPS[~~7~~ 8-9].

Outcomes of interest ~~Dependent variables in the analyses~~ included **smoking** (cigarettes, *bidis*[1] and pipes/cigar), **chewing tobacco** (*paan masala*[2], *gutkha*[3] or other chewed forms of tobacco) and **dual use** (consuming both smoked and smoke-less forms) of tobacco. NFHS-3 provides details on the different types of smoked and smokeless tobacco products, but this information was unavailable in NFHS-2. The main covariates of interest were ~~Independent variables in the analysis include~~ age ~~categories~~, marital status and education ~~level~~ at the individual level, and household wealth, area of residence (urban/rural), religion and caste/tribe status at the household level (*Variable definitions are provided in Table 1*). Survey-weighted age-standardised prevalence estimates of

[1] *Bidis* are local inexpensive cigarettes that are thinner and contain tobacco flakes rolled inside *tendu* leaves. Bidis are often smoked by poorer populations.
[2] *Paan Masala* is a powdered preparation of betel leaves combined with cured tobacco and/or areca nut, which has stimulating properties.
[3] *Gutkha* is a savoury or sweet preparation containing areca nut, tobacco, catechu, paraffin and slaked lime.

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smoking, chewing and dual use of tobacco along with percentage change were calculated. Pooled m~~M~~ulti-level models with state, local area and individual as analytical levels were used to estimate the effect of wealth, education, living environment and caste on the log odds ~~and probability~~ of smoking and chewing ~~by education and wealth~~ among men and women. Regression models are adjusted for age, religion and marital status. Survey year was used in the interaction terms to estimate a time trend in socioeconomic determinants of tobacco. Tests for trend include~~ing~~ joint tests for significance of fixed parameters~~time trends~~ and significance of random parameters. ~~effects were estimated.~~ Model estimates were maximum likelihood-based using the Iterative Generalized Least-Squares (IGLS) algorithm as implemented within the MLwin software programme (version 2.23)~~and controlled for age, marital status and religion~~.

RESULTS

Data used in this analysis covers 131,464 men and 130,886 women residing in 92,486 households in NFHS-2 and 69,755 men and 124,142 women residing in 109,041 households in NFHS-3, with an overall response rate of 96% for NFHS-2 and 98% for NFHS-3 (Table 1). ~~Change in p~~Prevalence~~ (%)~~ of smoking, chewing and dual ~~u~~se of tobacco over two survey rounds are presented by the three primary markers of socioeconomic status - ~~by~~ education, wealth and caste ~~(is shown in~~ table 1) along with ~~, and figures 1-3 show the~~ percentage change estimates. Estimates by living environment, marital status, age and religion are presented in the appendix (Web Table 1). ~~in and probability of smoking and chewing by wealth and education among men and women. Additional results on the multilevel models and tests of significance for trends are presented in web tables 1-2, while web table 3 presents the prevalence of smoking and chewing by age, residence, religion and marital status.~~

Among men, the prevalence of tobacco use (smoking, chewing and dual use) ~~of tobacco are~~is seen to ~~unanimously~~ increase across all socioeconomic groups. For instance, smoking rises from 35.5% to 40.6% in the fifth (poorest) quintile, 30.6% to 36.5% in the

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fourth quintile, 25.6 to 31.4% in the middle quintile, 19.3% to 25.8% in the second quintile and 11.9% to 19.9% in the first (richest) quintile (table 1). Chewed tobacco use increased from 34.4% to 47.1% among the illiterate populations, 30.2% to 41.9% among those with primary schooling only, 23.3% to 33.1% among those with high school education, 14.9% to 23.9% among those with college education and 12.4% to 18.5% among those with postgraduate degree. Higher ~~While the relative~~ prevalence of tobacco use among men in each survey round is seen for ~~is higher among~~ socioeconomically disadvantaged groups – with less educated, lower wealth, living in rural areas or lower caste showing an inverse SES gradient; however, greater ~~higher~~ proportional increases in prevalence over time are ~~is~~ seen among ~~social groups with~~ higher SES groups. For instance, higher absolute smoking prevalence in NFHS 3 is seen among men in lower wealth quintiles compared to those in higher wealth quintiles (41% for fifth (poorest) quintile and 37% for fourth quintile, compared to 20% in first (richest) quintile and 26% in second quintile); higher percentage increases in smoking are recorded among first (~~E.g. change in smoking prevalence among men in the~~ richest) quintile (~~is~~ 63%) and second quintile (37%) compared to the fourth quintile (21%) and fifth (~~while that in the~~ poorest) quintile (~~is~~ 13%). Similar trend is seen for education with a 98% increase in prevalence among those with postgraduate education and 13% increase in prevalence among those with no education over the two survey rounds. Sharper inequalities with higher inter-group differences are seen for smoking compared to chewing. Prevalence of chewing among men in the richest quintile and with postgraduate education each increased by 49%, while that for the poorest increased by 35% and for those with no education increased by 37%.

Socioeconomic patterns for tobacco use among women differ distinctly. Overall p~~; similarly smoking prevalence among those with post graduate level of education increases by 98% and those with no education increases by 13%. Sharper inequalities with greater inter-group differences are seen in smoking compared to chewing. Prevalence of chewing among men in the richest quintile and with post graduate education increased by 49%, while that for the poorest increased by 35% and for the illiterate increased by 37%. P~~revalence rates of ~~trends~~ tobacco use among women are

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~~were less clear with overall rates staying~~ significantly lower than ~~compared to~~ men. In 2005-06, prevalence of smoking and chewing among women with no education was 2.3% and 13.3% respectively, while the same for men was 43.9% and 47.1% respectively (table 1). Women in most SES categories showed a declining trend for tobacco use, and only scheduled caste women and those with college education showed small increases in smoking and chewing. Higher and more consistent declines in prevalence are seen for education, compared to wealth and caste/tribe status. For instance, women with postgraduate education noted a 90% decrease in smoking and a 73% decrease in chewing (table 1). Women in the first (richest) quintile showed a decline of 30% for smoking and 8% for chewing (table 1). Results by area of residence (Web Table 1) show an increase in risks for tobacco use with urbanization among both men and women, except in the prevalence of chewed tobacco among women. Figures 1-2 show the percentage change in smoking and chewing by education and wealth for men and women reflecting findings from table 1.

Tables 2-3 present results from pooled multilevel models showing odds ratios for smoking and chewing by education, wealth, living environment and caste, along with interactions with survey year. Gradients in odds ratios (95% CI) are seen by all four markers of SES among men and women for smoking and chewing with sharper inequalities seen for education and wealth, compared to other markers. Controlling for wealth, caste and living environment and compared to those with postgraduate education, the odds ratio of smoking for men with no education: 3.18 (95% CI: 2.96,3.43), with primary education: 2.73 (95% CI: 2.54,2.94), with high school education: 1.81 (95% CI: 1.69,1.85) and with college education: 1.38 (95% CI: 1.28,1.49). Controlling for education, caste and living environment and compared to the first (richest) quintile, odds ratio for chewing in the second quintile: 1.43 (95% CI: 1.38,1.48), middle quintile 1.75 (95% CI: 1.68,1.82), fourth quintile: 1.92 (95% CI: 1.84,2.01) and fifth (poorest) quintile: 2.1 (95% CI: 1.99,2.2). Interaction terms in the two tables provide effect estimates for change over the two survey rounds. Among men, significant parameters for interaction terms for smoking are seen by wealth, education (except college educated) and living environment (except small city); and for chewing by wealth, higher education and by

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residence in towns. The joint test for interaction of fixed terms is significant for smoking by wealth (Joint test: 174.31, p<0.001), education (Joint test:13.31, p=0.009) and living environment (Joint test: 13.44,p=0.003) and for chewing by wealth (Joint Test: 15.63,p=0.003), representing robust change over time. Chi-square values for random parameters are significant both at state (Smoking chi2: 12.82, p=0.0003 and Chewing chi2: 12.89, p=0.0003) and local area (Smoking chi2: 650.41, p<0.0001 and Chewing chi2: 801.4, p<0.0001) level showing variation at both levels.

Among women, controlling for education, caste and living environment and compared to those in the first (richest) quintile, the odds ratio of smoking in second quintile: 1.48 (95% CI: 1.28,1.71), middle quintile: 1.9 (95%CI: 1.64,2.2), fourth quintile: 2.75 (95% CI: 2.37,3.19) and fifth (poorest) quintile: 3.95 (95% CI: 3.39,4.6). Controlling for wealth, caste and living environment and compared to those with postgraduate education, odds ratio of chewing among women with college education: 1.84 (95% CI: 1.55,2.19), high school education: 2.19 (95% CI: 1.86,2.57), primary schooling: 2.87 (95% CI: 2.44,3.4) and no education: 3.85 (95% CI: 3.27,4.53). Significant odds ratios for interaction terms are seen for smoking by wealth (Joint test: 19.128,p<0.0001) and for chewing by wealth (Joint Test: 31.96,p<0.0001), education (Joint test: 17.42,p<0.0001) and living environment (Joint test: 157.008,p<0.0001). Chi-square values for random parameters are significant for both state (Smoking chi2: 12.91, p=0.0004 and Chewing chi2: 12.94, p=0.011) and local area (Smoking chi2: 264, p<0.0001 and Chewing Chi2: 839, p<0.0001), showing variation at both levels. Figure 3 presents adjusted probability estimates for smoking and chewing among men and women by wealth and education from multilevel models, which show findings similar to prevalence estimates.~~; women in most social groups showed a declining trend for smoking and only scheduled caste women and those with college education showed small increases in smoking and chewing. All prevalence estimates were age standardized. Adjusted probability estimates for smoking and chewing were calculated from multi-level models (figure 3) and probability trends are seen to resonate with prevalence estimates. Tests for trend over time for smoking among men are significant for wealth, education and residence, while for chewing are significant for wealth only (web table 1). Tests for trend over time for~~

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~~smoking among women are significant for wealth and residence, while for chewing significant trend is seen for wealth, education and residence (web table 2). Random effects estimates are seen to be significant at both local area and state level, with higher variation at local area level.~~

DISCUSSION

In 1994, Lopez et al.[10~~9~~] proposed the four-stage *Cigarette Epidemic Model* ~~that~~ discussinged ~~the~~ transitions in ~~of~~ smoking prevalence, consumption amount and mortality in developed countries. As per the model i~~ in four stages. I~~n stage I, male smoking prevalence is comparatively low ~~(<15%)~~ and rising (≤20%) and ~~–~~female smoking prevalence does not exceed 5% due to sociocultural factors~~ does not exceed 5%~~. I~~; i~~n stage II, tobacco~~male~~ prevalence among men starts to ~~-~~rise rapidly and peaks~~s~~ around ~~to~~ 50-80% with f~~and f~~emale smoking increasinge~~s~~ at a lagged pace behind men. In stage III, prevalence rates for ~~of~~ smoking among men start to fall, with both male and female smoking converging. Increases are seen for smoking rates among ~~and women stabilizes at 40% and 35% respectively, and~~ younger compared to older populations. ~~are seen to smoke more than older populations.~~ In sStage IV, prevalence of smoking begins to ~~gradually~~ decline~~s~~ for~~among~~ both men and women. M~~, but the effects of previous stages are seen in high m~~ortality attributable to smoking rises to about one-third for all men, with much lower mortality rates seen among women. This model was developed based on empirical data from developed countries and has not been tested in developing countries. However, i~~ In~~ 2011~~,~~ Thun et al.[11~~0~~] proposed ~~a~~ modifications to the~~is~~ model potentially relevant for developing countries and were the first to note that smoking patterns by gender in developing countries ~~where smoking patterns among men and women~~ distinctly differ from patterns noted in developed countries. India shows a high and

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complex burden of tobacco consumption, as also reported in tobacco surveillance studies[2,12-13]. This paper uses empirical evidence to show that

~~Our results show that~~ India is currently ~~somewhere~~ between stages II and III of the Cigarette Epidemic model on the basis of estimates of smoking for men, ~~for the smoking rates seen for men,~~ but distinctly differs from the model on the patterns ~~in the prevalence rates~~ seen for women.

~~We note several distinctions in the Indian scenario from the propositions of this model.~~ Overall, several dissimilarities are noted in the Indian experience from this model. ***First,*** India's unique tobacco experience comprises a 'double burden of ~~the burden of tobacco consumption in India follows two separate trajectories for~~ smoked ***and*** chewed tobacco consumption. Patterns for smoking and chewing seem to follow trajectories that differ by education, living environment and wealth. Further, within smoking, differences potentially exist by SES in the consumption of cigarettes from *bidis,* which most data are unable to distinguish. The quantity and quality of these products may differentially determine the mortality burden attributable to tobacco use in India[14-16]. Assessment of the disease, mortality and cost burden of the tobacco epidemic needs to account for this complexity[14-15]. ~~ing and chewing~~

~~, and even within smoking, differences may be seen in the consumption of cigarettes and *bidis* that are combined in most analyses.~~ ***Second,*** ~~a unique~~ socioeconomic and sociocultural dynamics play profound roles in impacting tobacco use in India. Differences in tobacco consumption are seen by major SES markers such as ~~spatial gradient (not reported in the model) is seen in India by the diverse axes~~ wealth, education, living environment and caste. Findings from this analysis indicate a dichotomy between ~~, and prevalence results indicates a dichotomy in the understanding of this gradient. We find~~ **higher absolute prevalence** by ~~rates among socioeconomically disadvantaged groups (~~lower caste, wealth and education levels~~)~~ but **higher relative change in prevalence** over time ~~percentage increases among the socioeconomically advantaged groups (~~by higher caste, wealth and education levels~~).~~ ***No previous ~~other~~ study has reported this finding for India.*** Urbanization seems to be playing an increasing

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role in impacting tobacco use for men and women. ~~We also recommend that~~Further analyses by type and amount of tobacco consumed are needed to systematically understand these patterns.

~~be examined systematically to understand the direction of these trends.~~ ***Third***, social gradients in tobacco use (overall and by type of tobacco) in India distinctly differ by gender. D~~d~~espite women's empowerment ~~in India~~, large-scale increases in women's smoking as predicted by the Cigarette Epidemic Model are yet to be seen in India[10-11, 17-18]. ~~, as seen in the developed countries[11].~~ Aggregate estimates show that women are far behind men in prevalence rates for smoking; and smoking and chewing rates among women, barring a few groups, seem ~~are seen~~ to be declining. Aggregate estimates show that women are far behind men in prevalence rates for smoking; and smoking and chewing rates among women, barring a few groups, seem to be declining. The reasons for this could be several. **First,** that Indian sociocultural realities and lower acceptability of smoking among women leads to delays in age of initiation of smoking and higher rates among older compared to younger women (Web Table 1). Women's smoking has been linked to their empowerment, but this may be confined to urban areas and it is possible that on average, smoking continues to remain a social taboo among women. Representation of smoking in the media may also explain the gender patterns in the use of tobacco; smoking has been projected as an expression of masculinity among men and has moralistic connotations for women[19-21]. **Second,** an economic perspective explaining the lower smoking rates among women in India may attribute this statistic to women's unequal participation in the labor market and limited access to personal disposable income. Higher smoking among women in cities may partly indicate greater uptake of smoking by employed women. **Third,** given that data for this analysis comes from a reproductive health survey, it is possible that results for women are an underestimate. Web table 1 indicates that older (above 35 years of age) women are more likely use tobacco. However, patterns in this analysis match findings from other tobacco studies such as the GATS in India (IIPS)[5-6], providing a counter to this argument.

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Finally, evidence on the socioeconomic gradient in tobacco use in India needs to be linked to its implications for tobacco-related mortality and morbidity[14-15]. Dikshit et al.[15] provide the first estimates of cancer mortality in India, attributing a major component of age-standardized cancer mortality from lung and oral cancers to high rates of tobacco use in India. Analyses stratifying cancer morbidity and mortality in India by SES have not yet been attempted, and the lack of reliable surveillance data for chronic diseases prevents an exhaustive assessment of the impact of tobacco use on Indian current and future chronic disease burden[22].

~~a missing component in understanding the burden of tobacco in India needs to come from cause specific or cancer mortality studies[12]. Currently, only ecological analyses of these are possible due to lack of surveillance data in India[13], and hence a systematic examination of mortality attributable to tobacco consumption will assist in understanding where India is vis-a-vis this model.~~

This study provides a~~is the first~~ systematic examination of the ~~trends in~~ socioeconomic patterns in ~~distributions of~~ tobacco use in India over time~~consumption in India~~. Data in this ~~from this~~ analysis comes from the NFHS, which is a large, ~~is~~ representative and generalizable survey, providing a comparative picture of tobacco patterns over time. T~~to the Indian population. However, t~~he limitations of this analysis are the following. First, ~~study include that~~ data is cross-sectional, hence limiting scope for causal inference. NFHS does not provide detailed data by ~~and categories~~type or volume of tobacco. Finally, NFHS is a reproductive health survey where women in the ages of 15-49 years are sampled. Men are sampled in the households of the female sample. This introduces the potential for two downward biases. The first pertains to *social desirability bias* particularly related to underestimation of smoking patterns in women's childbearing years. Second, since the sample of men is conditional on the households from which women were sampled, the pool of men sampled may not be representative. ~~consumed are not available for NFHS -2.~~ Despite these caveats, NFHS (and in general the demographic and health surveys) has proven to be representative and generalizable and continues to be used in a number of studies related to tobacco and other health outcomes[5-6]. In addition, our findings are consistent with estimates from studies using other surveys

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assessing the burden of tobacco and its drivers in India[2,23]. Tobacco burden in the 'productive' populations (14-50 years) not only represents the current burden of tobacco but may predict future morbidity.

We present empirical evidence ~~we believe~~ that India is experiencing a unique economic and social transition in tobacco consumption, quite distinct from the experience of developed countries that is likely to manifest in a number of morbidities[2,14-15]. ~~that is likely to manifest in a number of health inequalities including tobacco consumption.~~ In order to ensure policy effectiveness to prevent and reduce the exposure to tobacco, ~~over time,~~ there is a need to systematically monitor and examine the social inequities in tobacco ~~consumption~~ use over time and channel interventions to the social groups that are most vulnerable to these inequalities.

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Table 1: ~~Frequency and p~~Prevalence (%) of tobacco smoking, chewing and dual use (smoking and chewing) by wealth, education and caste/tribe status among men and women in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Caste/ tribe status																		
General	(M) 50,939 (F) 50,526	(M) 21,850 (F) 41,844	22.2 (21.4, 22.9)	28.8 (27.7, 29.9)	30	22.2 (21.4,23 .02)	33.2 (31.8, 34.5)	50	7.4 (6.9,7 .8)	10.8 (10. 0,11 .5)	1.0 (0.9, 1.1)	0.8 (0.55, 1.0)	-20	6.6 (6.1, 7.1)	7.24 (6.6,7. 85)	10	0.24 (0.17, 0.3)	0.2 (0.11,0 .27)
SC	(M) 21,491 (F) 21,045	(M) 11,953 (F) 20,566	31.5 (30.5, 32.5)	39.3 (37.8, 40.9)	25	27.8 (26.6, 29.1)	40.5 (38.8, 42.1)	46	12.1 (11.4, 12.8)	15.8 (14. 7,16 .9)	2.3 (1.9,2. 8)	2.4 (2.05,2 .8)	4	10.9 (10.1,11 .8)	12.1 (11.2,1 2.9)	11	0.5 (0.4,0. 7)	0.4 (0.3,0. 6)
ST	(M) 16,187 (F) 16,520	(M) 8,453 (F) 16,518	30.6 (28.8, 32.3)	36.6 (34.1, 39.1)	20	38.6 (36.9, 40.4)	52.6 (49.9, 55.3)	36	14.5, (13.3, 15.6)	18.6 (16. 7,20 .4)	3.0 (2.5,3. 6)	2.7 (2.04,3 .4)	-10	18.5 (17.0,20 .1)	25.08 (22.8,2 7.4)	36	1.0 (0.7,1. 2)	0.9 (0.6,1. 3)
OBC	(M) 36,381 (F) 36,290	(M) 25,144 (F) 29,561	24.7 (23.9, 25.5)	31.2 (30.2, 32.2)	26	25.4 (24.5, 26.3)	36.2 (35.0, 37.5)	43	9.9 (9.4,1 0.5)	13.1 (12. 3,13 .8)	1.5 (1.3,1. 7)	1.4 (1.2,1. 7)	- 7	7.3 (6.8,7.7)	7.08 (6.6,7. 6)	-3	0.3 (0.26,0 .4)	0.14 (0.09,0 .21)
No caste	(M) 6,466 (F) 6,505	(M) 2,355 (F) 5,653	31.8 (29.4, 34.3)	37.9 (34.2, 41.6)	19	23.3 (20.9, 25.6)	35.5 (31.6, 39.3)	52	10.7 (9.3, 12.1)	13.0 (10. 9,15 .2)	1.4 (0.8,1. 9)	0.9 (0.36,1 .48)	-36	10.3 (9.1,11. 6)	12.8 (10.8,1 4.8)	24	0.4 (0.2,0. 6)	0.31 (0.03,0 .59)
Education Level																		
Post graduate	(M) 3,432 (F) 1,963	(M) 2,920 (F) 3,526	7.6 (6.5,, 8.7)	15.05 (13.0 1,17. 1)	98	12.4 (10.8,14 .1)	18.5 (16.0, 21.1)	49	1.7 (1.2,2 .2)	4.04 (3.0, 5.1)	0.2 (- 0.2, 0.6)	0.02 (- 0.007, 0.05)	-90	1.2 (0.45,1. 9)	0.33 (0.14,0 .5)	-73	0.2 (- 0.17,0. 5)	0.004 (- 0.002, 0.012)
College	(M) 11,340 (F) 6,586	(M) 7,811 (F) 9,424	11.1 (10.2, 11.9)	20.7 (19.2, 22.1)	86	14.9 (13.9,15 .8)	23.9 (22.3, 25.6)	60	3.5 (3.1,3 .9)	6.7 (5.8, 7.6)	0.1 (- 0.01,0. 2)	0.11 (0.03, 0.19)	10	1.3 (0.9,1.6)	1.8 (1.4,2. 2)	39	0.05 (- 0.04,0. 14)	0.04 (- 0.017, 0.1)
High school	(M) 69,996 (F) 46,629	(M) 26,100 (F) 34,338	21.2 (20.7,2 1.8)	24.7 (23.8, .25.5)	17	23.3 (22.7,23 .9)	33.1 (32.0, 34.1)	42	7.8 (7.5, 8.2)	9.9 (9.3, 10.6)	0.2 (0.17, 0.3)	0.07 (0.04, 0.1)	-65	4.2 (3.9, 4.6)	3.4 (3.04,3 .7)	-19	0.1 (0.06,0 .13)	0.04(0. 02,0.0 6)
Primary school	(M) 21,730 (F) 20,604	(M) 12,622 (F) 19,451	32.7 (31.7,3 3.6)	35.6 (34.3, 36.9)	1	30.2 (29.2, 31.2)	41.9 (40.5, 43.4)	39	12.1 (11.4, 12.7)	14.8 (13. 8, 15.7)	0.7 (0.5,0. 8)	0.2 (0.13,0 .3)	-71	9.0 (8.4,9.6)	7.4 (6.8,8. 02)	-18	0.18 (0.13,0 .24)	0.07 (0.03,0 .11)

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Illiterate	(M) 24,966 (F) 55,104	(M) 20,302 (F) 57,403	38.9 (37.9,, 39.9)	43.9 (42.8, 45.2)	13	34.4 (33.2,35 .5)	47.1 (45.7, 48.5)	37	(15.9 (15.1, 16.6)	18.9 (17. 9,19 .9)	2.6 (2.4,,2. 9)	2.3 (2.02,2 .6)	-12	11.9 (11.4, 12.6)	13.3 (12.6, 13.0)	12	0.6 (0.53,0 .72)	0.42 (0.33,0 .51)
Wealth Quintiles																		
Richest	(M) 26,291 (F) 26,177	(M) 13,706 (F) 24,837	11.9 (11.2, 12.5)	19.9 (18.8, 21.1)	63	13.7 (12.8,14 .6)	20.4 (19.0, 21.8)	49	3.3 (2.97, 3.6)	5.8 (5.1, 6.4)	0.2 (0.1,0. 3)	0.14 (0.08,0 .2)	-30	2.2 (1.9,2.5)	2.02 (1.7,2. 3)	-8	0.05 (0.01,0 .07)	0.042 (0.009, 0.07)
Richer	(M) 26,293 (F) 26,177	(M) 13,946 (F) 24,837	19.3 (18.5, 20.04)	25.8 (24.6, 27.1)	37	19.0 (18.1,19 .9)	30.2 (28.7, 31.7)	59	5.6 (5.2,6 .02)	9.3 (8.4, 10.2)	0.46 (0.37,0 .54)	0.37 (0.27,0 .47)	-20	5.4 (4.9,5.9)	4.9 (4.4,5. 4)	-9	0.1 (0.07,0 .18)	0.06 (0.02,0 .09)
Middle	(M) 26,294 (F) 26,174	(M) 14,075 (F) 24,826	25.6 (24.7,2 6.4)	31.4 (30.1, 32.7)	25	22.9 (22.0,23 .9)	34.9 (33.4, 36.3)	52	7.6 (7.2,8 .1)	11.5 (10. 6,12 .3)	1.1 (0.9,1. 3)	0.7 (0.6,0. 9)	-36	7.8 (7.2,8.3)	6.9 (6.4,7. 4)	-11	0.23 (0.16,0 .3)	0.07 (0.04,0 .11)
Poorer	(M) 26,293 (F) 26,179	(M) 14,007 (F) 24,814	30.6 (29.7,3 1.5)	36.5 (35.2, 37.8)	21	28.9 (28.0,29 .9)	39.5 (38.0 3,40. 9)	37	11.6 (10.9, 12.2)	14.5 (13. 6,15 .5)	1.7 (1.5,1. 9)	1.7 (1.4,1. 9)	0	10.9, (10.3,11 .6)	10.5 (9.8,12 .2)	-4	0.4 (0.3,0. 5)	0.24 (0.17,0 .31)
Poorest	(M) 26,293 (F) 26,179	(M) 14,021 (F) 24,828	35.5 (34.4,, 36.5)	40.6, 39.3, 41.9)	13	36.8 (35.7,37 .9)	49.7 (48.2, 51.2)	35	16.7 (15.9, 17.5)	19.4 (18. 4,20 .5)	3.5 (3.1,3. 9)	3.2 (2.8,3. 7)	-9	14.1 (13.3,15 .0)	17.1 (16.03, 18.1)	21	0.9 (0.7,1. 0)	0.7 (0.52,0 .86)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142																

[1]~~Large city: urban population ≥1 million; Small city: 100000-1 million; Town: ≤100000 million~~

[12]Scheduled castes and scheduled tribes are identified by the Government of India as socially and economically backward and needing protection from social injustice and exploitation. Other backward class is a diverse collection of intermediate castes that were considered low in the traditional caste hierarchy but are clearly above scheduled castes. General is thus a default residual group that enjoys higher status in the caste hierarchy.

[3]~~Others include Sikh, Buddhist, Jain, Jewish, Zoroastrian and Others~~

[24] Post graduate:15 or more years of education; college: 13-15 years of education; high school: 8-12 years of education; secondary: 5-8 years of education; primary: 0-5 years of education; illiterate: 0 years of education

*Percentage change (**% Δ**) numbers have been rounded to the nearest integer.

*All results for prevalence are survey adjusted and age-standardised. Prevalence results are all in percentages.

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~~**Web Tables:**~~

Table 2~~1~~: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among men and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.37 (1.32,1.43)	1.51 (1.44,1.59)	1.37 (1.31,1.42)	1.36 (1.3,1.41)	1.37 (1.31,1.42)	1.43 (1.38,1.48)	1.33 (1.27,1.4)	1.42 (1.36,1.47)	1.42 (1.36,1.47)	1.41 (1.36,1.47)
Middle	1.71 (1.64,1.78)	1.99 (1.89,2.1)	1.71 (1.64,1.78)	1.68 (1.61,1.75)	1.7 (1.63,1.77)	1.75 (1.68,1.82)	1.63 (1.55,1.72)	1.73 (1.66,1.8)	1.72 (1.65,1.8)	1.72 (1.65,1.79)
Poorer	2.06 (1.97,2.16)	2.51 (2.37,2.65)	2.05 (1.96,2.14)	2.02 (1.93,2.11)	2.04 (1.95,2.14)	1.92 (1.84,2.01)	1.77 (1.67,1.87)	1.89 (1.8,1.97)	1.86 (1.78,1.95)	1.87 (1.79,,1.96)
Poorest	2.33 (2.22,2.46)	2.88 (2.72,3.06)	2.31 (2.19,2.43)	2.29 (2.18,2.41)	2.3 (2.19,2.42)	2.1 (1.99,2.2)	1.93 (1.82,2.05)	2.03 (1.92,2.13)	2.03 (1.932.13)	2.02 (1.93,2.12)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.38 (1.28,1.49)	1.41 (1.31,1.53)	1.34 (1.19,1.5)	1.4 (1.29,1.51)	1.4 (1.3,1.51)	1.26 (1.17,1.36)	1.28 (1.19,1.39)	1.14 (1.02,1.27)	1.29 (1.19,1.39)	1.29 (1.2,1.39)
High School	1.81 (1.69,1.95)	1.91 (1.78,2.05)	2.16 (1.95,2.4)	1.87 (1.74,2.01)	1.87 (1.74,2.01)	1.53 (1.43,1.65)	1.64 (1.53,1.76)	1.46 (1.33,1.61)	1.65 (1.54,1.77)	1.66 (1.54,1.78)
Primary	2.73 (2.54,2.94)	2.81 (2.61,3.04)	3.4 (3.05,3.78)	2.77 (2.57,2.99)	2.77 (2.57,2.99)	1.98 (1.84,2.13)	2.04 (1.9,2.2)	1.84 (1.66,2.04)	2.05 (1.9,2.21)	2.06 (1.91,2.21)
No education	3.18 (2.96,3.43)	3.27 (3.03,3.53)	4.07 (3.66,4.53)	3.19 (2.96,4.34)	3.18 (2.95,3.42)	2.09 (1.94,2.26)	2.06 (1.91,2.22)	1.93 (1.74,2.14)	2.07 (1.92,2.23)	2.08 (1.93,2.24)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.77	0.81	0.8	0.82 (0.75,0.9)	0.79	0.96	1.02	1.02	1.06	1.03

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	(0.72,0.82)	(0.76,0.87)	(0.74,0.85)		(0.74,0.84)	(0.89,1.02)	(0.96,1.09)	(0.96,1.09)	(0.97,1.16)	(0.97,1.1)
Town	0.78 (0.74,0.82)	0.83(0.79,0 .88)	0.81(0.77,0 .85)	0.88 (0.82,0.95)	0.81 (0.77,0.85)	0.92 (0.87,0.97)	1.01 (0.95,1.06)	1.01 (0.95,1.06)	1.06 (0.98,1.15)	1.01 (0.96,1.07)
Village	0.68 (0.65,0.71)	0.75 (0.71,0.78)	0.73 (0.7,0.77)	0.87 (0.82,0.92)	0.73 (0.7,0.76)	0.76 (0.73,0.79)	0.92 (0.88,0.96)	0.92 (0.88,0.96)	0.93 (0.88,0.99)	0.93 (0.88,0.97)
Caste/Tribe (Other)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SC	1.16 (1.12,1.2)	1.15 (1.11,1.19)	1.15 (1.11,1.18)	1.15 (1.11,1.19)	1.16 (1.11,1.21)	1.12 (1.08,1.15)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.14)
ST	1.14 (1.09,1.2)	1.13 (1.08, 1.2)	1.14 (1.08,1.18)	1.14 (1.09,1.2)	1.15 (1.09,1.21)	3.02 (2.88,3.15)	1.1 (1.06,1.15)	1.1 (1.05,1.15)	1.1 (1.05,1.15)	1.17 (1.11,1.24)
OBC	1.00 (0.98,1.04)	0.99 (0.97,1.02)	0.99 (0.96,1.02	0.99 (0.97,1.02)	1.03 (0.99,1.07)	1.05 (1.02,1.08)	1.01 (0.97,1.03)	1.002 (0.97,1.03)	1.003 (0.97,1.03)	1.04 (0.99,1.07)
No Caste or missing	1.06 (1.01,1.13)	1.07 (1.01,1.13)	1.07 (1.01,1.13)	1.08 (1.02,1.14)	1.05 (0.98,1.13)	0.97 (0.92,1.03)	1.02 (0.96,1.08)	1.01 (0.96,1.08)	1.02 (0.96,1.08)	0.97 (0.9,1.04)
Survey Year (Yr)		1.74 (1.7,1.88)	1.67 (1.46,1.91)	1.49 (1.4,1.58)	1.24 (1.19,1.3)		1.47 (1.38,1.56)	1.34 (1.17,1.54)	1.69 (1.58,1.8)	1.72 (1.65,1.79)
Yr *Richer		0.78 (0.73,0.84)					1.15 (1.07,1.24)			
Yr*Middle		0.68 (0.63,0.73)					1.13 (1.05,1.22)			
Yr *Poorer		0.60 (0.56,0.65)					1.15 (1.07,1.24)			
Yr *Poorest		0.58 (0.53,0.62)					1.11 (1.03, 1.2)			
Yr *College			1.13 (0.97,1.32)					1.27 (1.1,1.48)		
Yr * High School			0.78 (0.68,0.89)					1.28 (1.11,1.47)		
Yr * Primary			0.66 (0.57,0.77)					1.02 (0.88,,1.18)		
Yr * No education			0.61 (0.53,0.70)					1.01 (0.87,1.17)		
Yr *Small City				0.99 (0.87,1.12)					0.94 (0.82,1.06)	
Yr * Town				0.89 (0.81,0.98)					0.9 (0.82,0.99)	
Yr * Village				0.73 (0.68,0.79)					0.98 (0.91,1.05)	
Yr *SC					0.99 (0.92,1.05)					0.99 (0.93,1.06)

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Yr *ST					0.97 (0.9,1.05)					0.84 (0.78,0.91)
Yr*OBC					0.92 (0.87,0.97)					0.92 (0.87,0.97)
Yr*No Caste					1.07 (0.94,1.21)					1.15 (1.02,1.29)
Fixed Part of the Model										
Joint Chi Test for Interaction (p-value)		174.31 (p<0.001)	13.31 (p=0.009)	13.44 (p=0.003)	0.318 (p=0.98)		15.63 (p=0.003)	8.52 (p=0.074)	2.6 (p=0.46)	1.387 (p=0.85)
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)		12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)
Chi square for Level 2: Local Area (p-value)		650.41 (p<0.001)	655.7 (p<0.001)	654.2 (p<0.001)	660.7 (p<0.001)		801.6 (p<0.001)	802.4 (p<0.001)	802.4 (p<0.001)	801.7 (p<0.001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Table 32: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among women and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.48 (1.28,1.71)	1.82 (1.49,2.22)	1.48 (1.28,1.71)	1.48 (1.28,1.71)	1.49 (1.29,1.72)	1.48 (1.41,1.56)	1.41 (1.32,1.51)	1.48 (1.4,1.55)	1.51 (1.43,1.59)	1.48 (1.41,1.56)
Middle	1.9 (1.64,2.19)	2.63 (2.17,3.19)	1.87 (1.62,2.16)	1.88 (1.62,2.18)	1.9 (1.64,2.19)	1.75 (1.66,1.85)	1.58 (1.47,1.7)	1.75 (1.65,1.84)	1.81 (1.72,1.92)	1.76 (1.66,1.85)
Poorer	2.75 (2.37,3.19)	3.72 (3.07,5.52)	2.8 (2.41,3.25)	2.81 (2.42,3.26)	2.85 (2.45,3.30)	2.14 (2.02,2.27)	1.86 (1.72,2.002)	2.13 (2.01,2.25)	2.2 (2.07,2.32)	2.14 (2.02,2.27)
Poorest	3.95 (3.39,4.6)	4.83 (3.97,5.88)	4.03 (3.46,4.69)	4.05 (3.47,4.72)	4.08 (3.5,4.75)	2.67 (2.5,2.84)	2.14 (1.99,2.32)	2.65 (2.49,2.82)	2.7 (2.54,2.88)	2.7 (2.5,2.84)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.59 (0.91,2.8)	1.61 (0.92,2.82)	0.98 (0.37,2.58)	1.58 (0.9,2.78)	1.57 (0.9,2.75)	1.84 (1.55,2.19)	1.83 (1.54,2.17)	1.1 (0.85,1.42)	1.82 (1.53,2.17)	1.84 (1.55,2.19)
High School	1.78 (1.06,2.99)	1.67 (1.01,,2.82)	1.95 (0.83,4.56)	1.62 (0.96,2.72)	1.61 (0.99,2.7)	2.19 (1.86,2.57)	2.13 (1.82,2.51)	1.47 (1.17,1.85)	2.15 (1.82,2.54)	2.21 (1.88,2.6)
Primary	2.78 (1.66,4.68)	2.62 (1.56,4.41)	3.32 (1.42,7.76)	2.54 (1.51,4.29)	2.52 (1.5,4.24)	2.87 (2.44,3.4)	2.83 (2.4,3.33)	2.03 (1.61,2.56)	2.86 (2.42,3.37)	2.89 (2.45,3.41)
No education	4.78 (2.84,8.04)	4.91 (2.93,8.23)	6.89 (2.53,13.73)	4.72 (2.81,7.93)	4.66 (2.77,7.81)	3.85 (3.27,4.53)	3.75 (3.19,4.42)	2.58 (2.04,3.24)	3.8 (3.22,4.48)	3.85 (3.27,4.53)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.91 (0.75,1.09)	0.98 (0.82, 1.17)	1.01 (0.84,1.21)	0.78 (0.58,1.04)	1.004 (0.84,1.2)	1.23 (1.13,1.32)	1.25 (1.15,1.35)	1.22 (1.13,1.32)	0.97 (0.86,1.1)	1.2 (1.11,1.29)
Town	1.19 (1.03,1.37)	1.2 (1.04,1.38)	1.22 (1.05,1.4)	1.31 (1.06,1.62)	1.23 (1.1,1.41)	1.36 (1.27,1.45)	1.37 (1.29,1.47)	1.36 (1.27,1.45)	0.95 (0.86,1.04)	1.34 (1.25,1.43)

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Village	1.4 (1.24,1.59)	1.28 (1.13,1.46)	1.31 (1.16,1.49)	1.37 (1.14,1.66)	1.32 (1.16,1.49)	1.07 (1.01,1.14)	1.09 (1.02,1.16)	1.08 (1.02,1.15)	0.69 (0.64,0.75)	1.07 (1.005,1.13)
Caste/Tribe (Other)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SC	1.5 (1.39,1.62)	1.55 (1.43,1.67)	1.54 (1.43,1.67)	1.54 (1.43,1.67)	1.4 (1.27,1.55)	1.28 (1.23,1.33)	1.28 (1.23,1.36)	1.28 (1.23,1.33)	1.29 (1.24,1.34)	1.28 (1.22,1.35)
ST	2.04 (1.86,2.24)	2.11 (1.92, 2.3)	2.11 (1.93,2.31)	2.11 (1.93,2.31)	1.99 (1.79,2.23)	1.53 (1.46,1.6)	1.53 (1.46,1.61)	1.53 (1.46,1.61)	1.52 (1.45,1.6)	1.48 (1.39,1.58)
OBC	1.11 (1.03,1.2)	1.17 (1.08,1.26)	1.16 (1.08,1.26)	1.16 (1.08,1.25)	1.13 (1.03,1.24)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.06 (1.02,1.12)
No Caste or missing	0.7 (0.6,0.81)	0.74 (0.64,0.86)	0.72 (0.62,0.85)	0.73 (0.62,0.85)	1.01 (0.85,1.2)	1.02 (0.95,1.09)	1.02 (0.96,1.09)	1.02 (0.95,1.09)	1.01 (0.95,1.08)	0.92 (0.85,1.01)
Survey Year (Yr)		1.004 (0.98,1.03)	0.89 (0.31,2.56)	0.67 (0.55,0.83)	0.57 (0.51,0.63)		0.81 (0.75,0.87)	0.54 (0.4,0.74)	0.52 (0.47,0.56)	1.02 (0.97,1.07)
Yr*Richer		0.66 (0.5,0.87)					1.09 (0.99,1.21)			
Yr*Middle		0.47 (0.36,0.61)					1.21 (1.1,1.34)			
Yr *Poorer		0.56 (0.44,0.72)					1.3 (1.18,1.43)			
Yr *Poorest		0.71 (0.56,0.91)					1.5 (1.37,1.64)			
Yr *College			1.98 (0.6,6.52)					2.26 (1.6,3.21)		
Yr * High School			0.77 (0.26,2.22)					1.94 (1.41,2.67)		
Yr * Primary			0.61 (0.21,1.75)					1.74 (1.27,2.4)		
Yr * No education			0.7 (0.24,2.0)					1.94 (1.41,2.66)		
Yr*Small City				1.44 (0.99,2.07)					1.61 (1.38,1.88)	
Yr * Town				0.89 (0.68,1.16)					1.94 (1.72,2.19)	
Yr * Village				0.92 (0.74,1.15)					2.26 (2.06,2.48)	
Yr *SC					1.29 (1.11,1.51)					0.99 (0.93,1.07)
Yr *ST					1.16 (0.99,1.36)					1.07 (0.98,1.16)
Yr*OBC					1.1 (0.96,1.27)					0.95 (0.89,1.01)
Yr*No Caste					0.45					1.22

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					(0.32,0.63)					(1.07,1.38)
Fixed Part of the Model										
Overall Chi for Interaction (p-value)		19.128 (p<0.001)	0.041 (p=0.99)	50.195 (p<0.001)	0.992 (p=0.91)		31.96 (p<0.0001)	17.42 (p=0.001)	157.008 (p<0.0001)	2.665 (p=0.615)
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.91 (p=0.011)	12.91 (p=0.011)	12.91 (p=0.004)	12.91 (p=0.011)		12.94 (p=0.011)	12.94 (p=0.011)	12.94 (p=0.004)	12.94 (p=0.011)
Chi square for Level 2: Local Area (p-value)		260.98 (p<0.001)	266.3 (p<0.001)	264.9 (p<0.001)	263.5 (p<0.001)		844.91 (p<0.0001)	839.3 (p<0.0001)	824.92 (p<0.0001)	837.64 (p<0.0001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Web Table 13: ~~Frequency and p~~Prevalence (%) of tobacco smoking, chewing and dual use (smoking and chewing) by living environment, age, religion and marital status among men and women in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Area of residence[1]																		
Large city	(M) 17,640 (F) 16,081	(M) 19,092 (F) 26,272	17.7 (16.6, 18.9)	27.2 (25.7, 28.8)	54	19.1 (17.4,21 .1)	30.3 (28.2, 32.5)	59	6.05 (5.4,6 .8)	10.2 (9.2, 11.3)	0.3(0.2 , 0.4)	0.4 (0.3,0. 6)	33	5.8 (4.9,6.9)	4.9 (4.1,5. 9)	-16	0.09 (0.06,0 .14)	0.055 (0.03,0 .1)
Small city	(M) 8,957 (F) 8,573	(M) 4,723 (F) 9,318	18.3 (16.4,2 0.2)	28.8 (26.5, 31.2)	57	19.4 (17.1, 22.0)	34.2 (31.1, 37.4)	76	5.8 (4.95, 6.8)	10.9 (9.6, 12.5)	0.3 (0.2,0. 5)	0.5 (0.35,0 .7)	67	5.9 (4.8,7.1)	6.6 (5.5,8. 1)	12	0.06 (0.03,0 .14)	0.09 (0.04,0 .2)
Town	(M) 18,837 (F) 18,803	(M) 12,078 (F) 21,256	19.9 (18.6,2 1.2)	30.3 (28.4, 32.2)	52	20.6 (18.7,22 .5)	31.1 (28.6, 33.7)	51	6.3 (5.6,7 .1)	10.5 (9.4, 11.7)	0.6 (0.5,0. 8)	0.6 (0.4,0. 8)	0	6.7 (5.8,7.8)	7.2 (6.1,8. 4)	8	0.2 (0.15,0 .3)	0.1 (0.07,0 .2)
Village	(M) 86,030 (F) 87,429	(M) 33,862 (F) 67,296	28.9 (28.2,2 9.6)	35.2 (34.2, 36.2)	22	28.2 (27.4,28 .9)	40.9 (39.8, 41.9)	45	11.4 (10.9, 11.8)	15.0 2 (14. 3,15 .7)	2.04 (1.85,2 .24)	1.98 (1.75,2 .24)	-3	9.8 (9.3,10. 3)	11.3 (10.6,1 1.9)	15	0.5 (0.43,0 .6)	0.4 (0.3,0. 5)
Age-groups																		
15-24	(M) 50,266 (F) 52,299	(M) 25,511 (F) 46,688	8.6 (8.2, 9.1)	19.2 (18.4, 20.1)	12 3	14.3 (13.7, 14.9)	30.3 (29.2 7,31. 4)	11 2	3.5 (3.3,3 .8)	9.45 (8.9, 10.1)	0.4 (0.31,0 .45)	0.3 (0.21,0 .36)	-25	3.1 (2.8,3.3)	4.4 (3.99,4 .7)	42	0.098 (0.07,0 .14)	0.08 (0.05,0 .13)
25-34	(M) 38,650 (F) 40,764	(M) 20,794 (F) 38,441	29.1 (28.3, 29.9)	36.3 (35.2, 37.4)	25	29.9 (29.1, 30.7)	43.1 (41.9, 44.3)	44	11.5 (10.9, 12.0)	16.0 (15. 2,16 .8)	1.4 (1.26,1 .62)	1.3 (1.1,1. 56)	-7	9.0 (8.5,9.5)	10.1 (9.45,1 0.7)	12	0.33 (0.27,0 .4)	0.23 (0.2,0. 3)
35-49	(M) 42,548 (F) 37,823	(M) 23,450 (F) 39,013	43.4 (42.5, 44.2)	44.1 (42.9, 45.2)	1.6	35.3 (34.4, 36.2)	40.2 (39.0 2,41. 3)	14	15.7 (15.1, 16.3)	15.2 (14. 4,16 .01)	3.4 (3.1,3. 8)	3.2 (2.84,3 .57)	-6	16.5 (15.8,17 .3)	15.7 (14.9,1 6.4)	-5	0.9 (0.76,1 .02)	0.6 (0.5,0. 7)
Marital Status																		

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Currently married	(M) 77,233 (F) 95,398	(M) 40,529 (F) 87,754	36.9 (36.2,37.6)	40.6 (39.7, 41.5)	10	33.7 (32.9, 34.4)	42.9 (41.9, 43.9)	27	13.9 (13.5, 14.4)	15.9 (15.3,16.6)	1.8 (1.6, 1.94)	1.8 (1.6,2.02)	0	9.8 (9.3,10.3)	10.9 (10.4,11.5)	11	0.43 (0.37,0.5)	0.3 (0.26,0.4)
Single	(M) 52,443 (F) 29,623	(M) 28,377 (F) 30,606	7.6 (7.3, 8.04)	18.9 (18.2, 19.7)	149	12.5 (11.9,12.9)	27.4 (26.4, 28.4)	119	2.9 (2.7,3.2)	8.6 (8.1, 9.2)	0.3 (0.22,0.4)	0.09 (0.06,0.14)	-70	1.9 (1.8,2.2)	2.8 (2.5,3.2)	47	0.12 (0.08,0.18)	0.03 (0.01,0.06)
Widowed	(M) 1,070 (F) 4,038	(M) 415 (F) 3,909	48.7 (45.1,52.3)	50.1 (43.9, 56.3)	2.8	41.6 (38.0,45.3)	59.5 (53.2, 65.6)	43	19.5 (16.8, 22.5)	23.7 (18.7,29.6)	4.7 (3.86, 5.6)	3.5 (2.78,4.3)	-26	21.3 (19.7,22.9)	18.5 (16.9,20.2)	-13	1.4 (1.05,1.89)	0.9 (0.6,1.4)
Divorced/ separated	(M) 718 (F) 1,827	(M) 434 (F) 1,873	41.7 (37.2,46.4)	46.6 (39.9, 53.3)	12	33.4 (29.01, 38.1)	55.9 (49.03,62.7)	67	15.7 (12.5, 19.5)	25.2 (19.7,31.6)	2.5 (1.8,3.6)	1.6 (1.01,2.6)	-36	18.1 (15.9,20.6)	18.6 (16.4, 21.01)	3	0.31 (0.13,0.75)	0.6 (0.3,1.2)
Religion[2]																		
Hindu	(M) 100,339 (F) 99,430	(M) 51,174 (F) 89,888	26.1 (25.5,26.7)	33.01 (32.2, 33.8)	27	26.6 (26.0, 27.3)	38.2 (37.3, 39.1)	44	10.2 (9.8,10.5)	13.7 (13.2,14.3)	1.5 (1.4,1.7)	1.5 (1.35,1.7)	0	8.8 (8.3,9.2)	9.6 (9.1,10.2)	9	0.37 (0.31,0.43)	0.25 (0.2,0.3)
Muslim	(M) 16,278 (F) 16,215	(M) 9,145 (F) 16,731	28.3 (26.7,29.9)	36.2 (34.3, 38.2)	28	23.4 (21.7,25.1)	37.4 (35.02,39.8)	60	9.5 (8.7,10.5)	13.1 (11.9,14.5)	1.9 (1.6,2.3)	1.73 (1.25,2.4)	-9	9.1 (8.3,9.9)	9.9 (8.9,10.9)	9	0.5 (0.37,0.7)	0.4 (0.3,0.7)
Christian	(M) 8,055 (F) 8,547	(M) 6,250 (F) 10,974	28.2 (25.9,30.5)	33.1 (29.9, 36.4)	17	17.5 (15.1, 20.1)	29.1 (25.01,33.5)	66	8.2 (6.9,9.6)	12.7 (10.4,15.5)	2.4 (1.7,3.3)	1.3 (0.98,1.62)	-46	9.9 (8.4,11.6)	10.7 (9.1,12.5)	8	0.98 (0.72,1.33)	0.6 (0.5,0.7)
Others	(M) 6,792 (F) 6,694	(M) 3,186 (F) 6,549	11.1 (9.5,12.8)	16.2 (14.2, 18.4)	46	19.3 (17.1,21.7)	26.0 (23.1, 29.2)	35	4.4 (3.4,5.6)	6.5 (5.2, 8.0)	0.6 (0.4, 0.9)	0.4 (0.2,0.65)	-33	7.5 (5.8,9.6)	7.6 (6.2,9.4)	1	0.27 (0.13,0.55)	0.2 (0.1,0.6)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142																

[1]Large city: urban population ≥1 million; Small city: 100000-1 million; Town: ≤100000 million

[2]~~Scheduled castes and scheduled tribes are identified by the Government of India as socially and economically backward and needing protection from social injustice and exploitation. Other backward class is a diverse collection of intermediate castes that were considered low in the traditional caste hierarchy but are clearly above scheduled castes. General is thus a default residual group that enjoys higher status in the caste hierarchy.~~

[23]Others include Sikh, Buddhist, Jain, Jewish, Zoroastrian and Others

[4]~~Post graduate:15 or more years of education; college: 13-15 years of education; high school: 8-12 years of education; secondary: 5-8 years of education; primary: 0-5 years of education; illiterate: 0 years of education~~

*Percentage change (**% Δ)** numbers have been rounded to the nearest integer. Estimates are not age-standardized

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Figure 1: Percentage change in smoking among men and women by education level and wealth quintiles

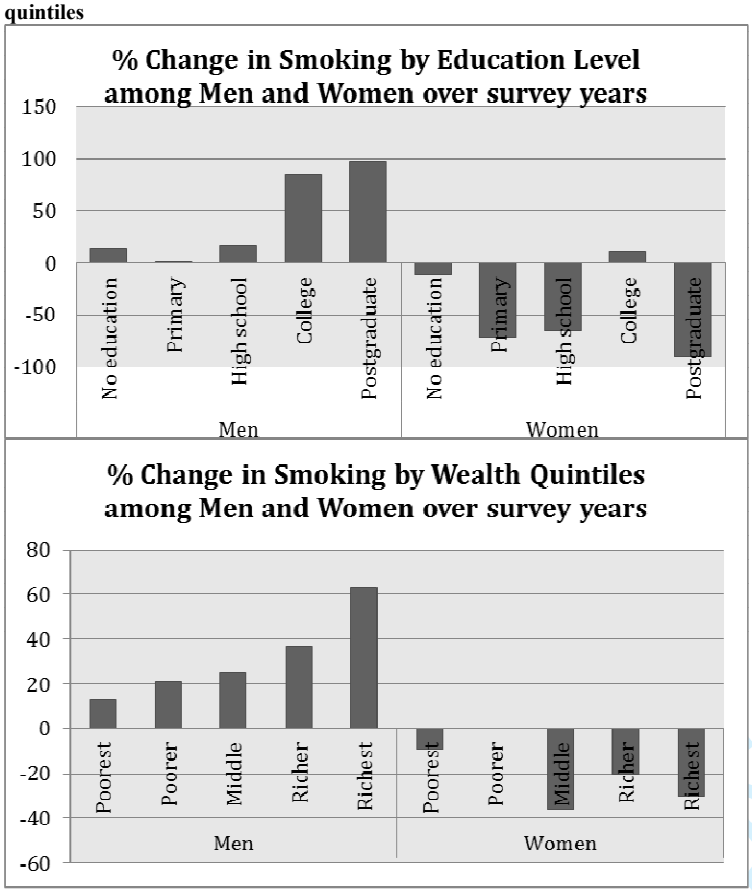

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Figure 2: Percentage change in chewing among men and women by education level and wealth quintiles

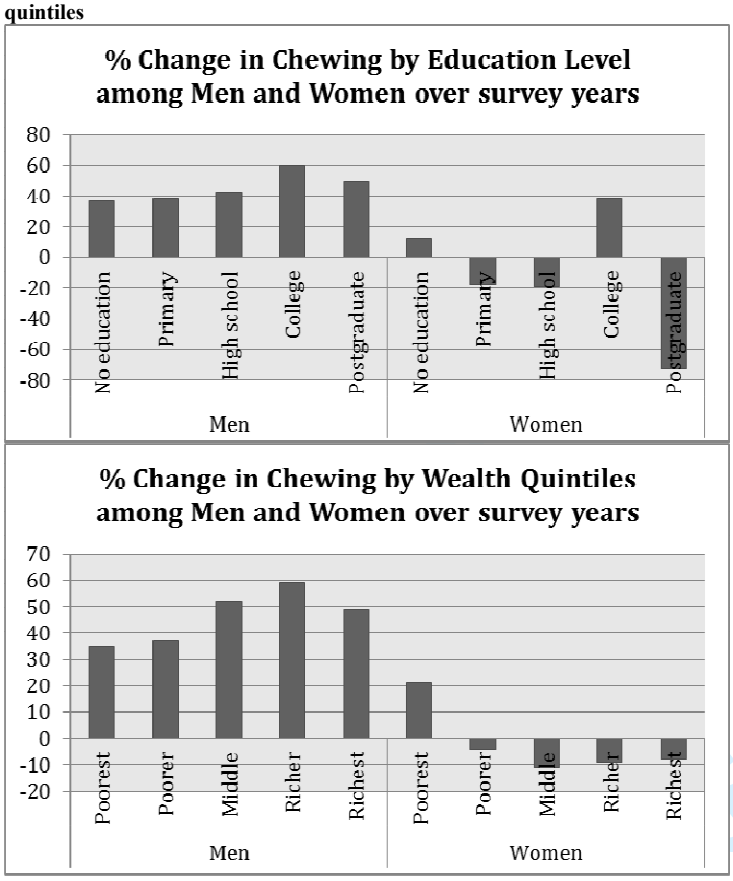

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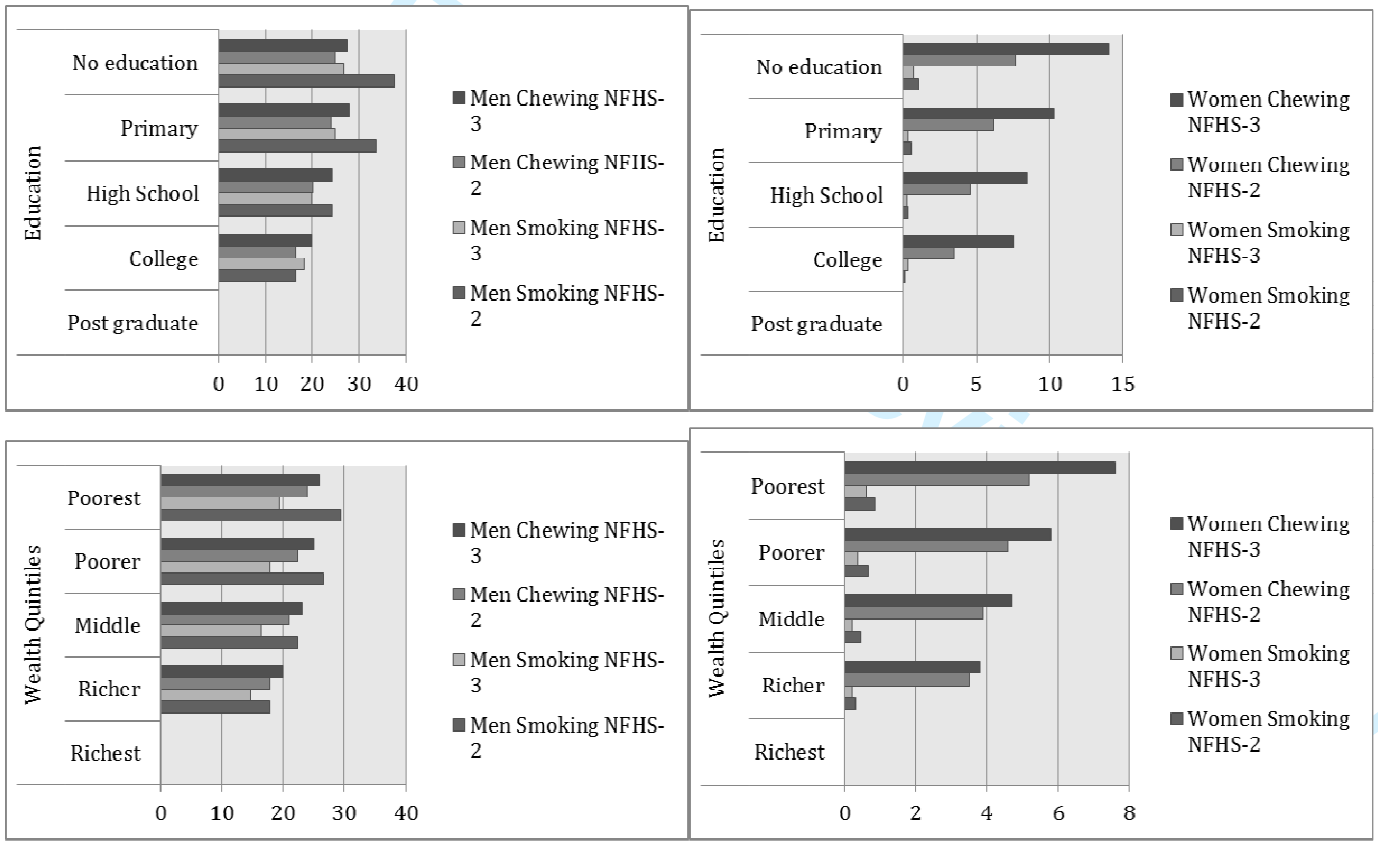
Figure 3: Probability of smoking and chewing among men and women by education and wealth



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Are socioeconomic disparities in tobacco consumption increasing in India? A repeated cross-sectional multilevel analysis

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ABSTRACT: (291 words)

Objectives: India bears a significant portion of the global tobacco burden with high prevalence of tobacco use. This study examines the socioeconomic patterning of tobacco use and identifies the changing gender and socioeconomic dynamics in light of the *Cigarette Epidemic Model.*

Design: Secondary analyses of second and third National Family Health Survey (NFHS) data.

Setting & participants: Data were analysed from 201,219 men and 255,028 women over two survey rounds.

Outcomes & methods: Outcomes included **smoking** (cigarettes, *bidis* and pipes/cigar), **chewed tobacco** (*paan masala, gutkha* and others) and **dual use,** examined by education, wealth, living environment and caste. Standardized prevalence and percentage change were estimated. Pooled multilevel models estimated the effect of socioeconomic covariates on the log odds of tobacco use by gender, along with fixed and random parameters.

Findings: Among men (2005-6), gradients in smoking by education (illiterate: 44% vs. postgraduates: 15%) and chewing (illiterate: 47% vs. postgraduate: 19%) were observed. Inverse gradients were also observed by wealth, living environment and caste. Chewed tobacco use by women showed inverse SES gradients comparing the illiterate (7.4%) vs. postgraduate (0.33%), and poorest (17%) vs. richest (2%) quintiles. However, proportional increases in smoking were higher among more educated (postgraduates (98%) vs. high schooling only (17%)) and chewing among richer (richest quintile (49%) vs. poorest quintile (35%)). Among women, higher educated showed larger declines for smoking - 90% (postgraduates) vs. 12% (illiterates). Younger men (15-24 years) showed increasing tobacco use (smoking: 123% and chewing: 112%). Older women (35-49 years) show higher prevalence of smoking (3.2%) compared to younger women (0.3%).

Conclusions: Indian tobacco use patterns show significant diversions from the *Cigarette Epidemic Model*– from gender and socioeconomic perspectives. Separate analysis by type is needed to further understand social determinants of tobacco use in India.

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Article Summary

Article Focus

- India bears a significant burden of tobacco consumption, with high prevalence of smoking and chewing among men & women.
- Previous studies have established a unique social and spatial gradient in tobacco use. However, no studies have yet reported estimates for changing patterns in tobacco use prevalence or relative risk over time.
- This study estimates socioeconomic patterns and examines the changing gender and socioeconomic dynamics of tobacco use in light of the *Cigarette Epidemic Model.*

Key Messages

- Among men, higher prevalence of smoking and chewing for less educated, poorer, rural and lower caste. Sharp and rising inequalities by survey year, but percentage change shows increases are greater among higher SES groups – higher education, urban, richer populations, previously unreported.
- Low and declining risks of smoking and chewing among women. Higher rates of chewing compared to smoking. Increase in smoking with urbanization for women. Greater declines over time for higher educated women.
- Significant changing trend by wealth, education and living environment in smoking among men and in chewing among women. Increases in smoking prevalence among younger men (15-24 years) and chewing among younger women (15-24 years).

Strengths & limitations

- First systematic examination of socioeconomic patterns in tobacco use in India, highlighting SES gradients in use and risks among vulnerable populations.
- Large sample, representative and generalizable surveys providing repeated and comparable estimates over time.
- Limitations: a) cross-sectional data, limiting scope for causal inference, b) lack of data by tobacco type or volume of use, c) data from a reproductive health survey may suffer from social desirability bias.

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INTRODUCTION

Global estimates indicate that one in ten adult deaths can be attributed to tobacco consumption, leading to approximately 5 million global deaths per year[1-4]. Of these, 2.4 million deaths occur in developing countries. India bears a significant portion of this global tobacco burden[3-4]. Consumption of both smoked and smoke-less (chewed and inhaled) forms of tobacco is highly prevalent among men (47%) and women (14%)[5]. However, previous studies have indicated that tobacco use, like other non-communicable disease risk factors, is unequally distributed across different social determinants in India – education, caste and wealth – among both men and women[1,5-7], indicating a distinct 'economic and spatial distribution' in tobacco use[6]. No studies have yet systematically examined patterns and changes in the prevalence of tobacco consumption in India by socioeconomic factors over time.

In this study, we aim to provide estimates and inferences on the changing gradient of tobacco consumption in India, analysing prevalence and odds ratio patterns from the National Family Health Surveys[8-9]. We discuss our findings in light of the Cigarette Epidemic Model[10-11] and examine what populations show higher and lower prevalence of tobacco consumption over time.

METHODS

Data were analysed from two rounds of the Indian National Family Health Survey (NFHS 2 and 3) conducted during 1998-99 and 2005-06 respectively. NFHS is a nationally representative cross-sectional survey that is collected and managed by the Indian Institute of Population Sciences (IIPS) in Mumbai, India. These surveys provide vital sources of information on demographic, health and socioeconomic behaviour of Indian households. Data from men and women in the age group of 15-49 years were used from both survey rounds to ensure comparability. Data are representative of all Indian states (except the small Union Territories), hence covering almost 99 per cent of the

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country's population. The surveys were collected using multistage cluster random sampling techniques. Rural and urban areas were sampled separately and a uniform sample design was followed in each state; states and PSUs are considered as levels. Individual questionnaires for men and women were used to interview usual residents of the household or visitors who stayed in the house the night before. Further details on sample design, including sampling framework and sample implementation, are provided in the basic survey reports by IIPS [8-9].

Outcomes of interest included **smoking** (cigarettes, *bidis*[1] and pipes/cigar), **chewing tobacco** (*paan masala*[2], *gutkha*[3] or other chewed forms of tobacco) and **dual use** (consuming both smoked and chewed forms) of tobacco. NFHS-3 provides details on the different types of smoked and chewed tobacco products, but this information was unavailable in NFHS-2. The main covariates of interest were age, marital status and education at the individual level, and household wealth, area of residence (urban/rural), religion and caste/tribe status at the household level (*Variable definitions are provided in Table 1*). Survey-weighted age-standardised prevalence estimates of smoking, chewing and dual use of tobacco along with percentage change were calculated. Pooled multi-level models with state, local area and individual as analytical levels were used to estimate the effect of wealth, education, living environment and caste on the log odds of smoking and chewing among men and women. Regression models were adjusted for age, religion and marital status. Survey year was used in the interaction terms to estimate a time trend in socioeconomic determinants of tobacco. Tests for trend included joint tests for significance of fixed parameters and significance tests for random parameters. Model estimates were maximum likelihood-based using the Iterative Generalized Least-Squares (IGLS) algorithm as implemented within the MLwin software programme (version 2.23).

RESULTS

Data used in this analysis covered 131,464 men and 130,886 women residing in 92,486 households in NFHS-2 and 69,755 men and 124,142 women residing in 109,041

[1] *Bidis* are local inexpensive cigarettes, that are thinner and contain tobacco flakes rolled inside tendu leaves. Bidis are often smoked by poorer populations.
[2] *Paan Masala* is a powdered preparation of betel leaves combined with cured tobacco and/or areca nut, which has stimulating properties
[3] *Gutkha* is a savoury or sweet preparation containing areca nut, tobacco, catechu, paraffin and slaked lime.

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households in NFHS-3, with an overall response rate of 96% for NFHS-2 and 98% for NFHS-3. Prevalence (%) of smoking, chewing and dual use of tobacco over two survey rounds are presented by the three primary markers of socioeconomic status (SES) - education, wealth and caste (Table 1) along with percentage change estimates. Estimates by living environment, marital status, age and religion are presented in the appendix (Web Table 1). Among men, the prevalence of tobacco use (smoking, chewing and dual use) was seen to increase across all socioeconomic groups. For instance, smoking has risen from 35.5% to 40.6% in the fifth (poorest) quintile, 30.6% to 36.5% in the fourth quintile, 25.6 to 31.4% in the middle quintile, 19.3% to 25.8% in the second quintile and 11.9% to 19.9% in the first (richest) quintile (table 1). Chewed tobacco use increased from 34.4% to 47.1% among the illiterate populations, 30.2% to 41.9% among those with primary schooling only, 23.3% to 33.1% among those with high school education, 14.9% to 23.9% among those with college education and 12.4% to 18.5% among those with postgraduate degree. Higher prevalence of tobacco use among men in each survey round was seen for socioeconomically disadvantaged groups – with less educated, lower wealth, rural residence or lower caste showing an inverse SES gradient; however, greater proportional increases in prevalence over time were seen among higher SES groups. For instance, higher absolute smoking prevalence in NFHS-3 was seen among men in lower wealth quintiles compared to those in higher wealth quintiles (41% for fifth (poorest) quintile and 37% for fourth quintile, compared to 20% in first (richest) quintile and 26% in second quintile); higher percentage increases in smoking were recorded among first (richest) quintile (63%) and second quintile (37%) compared to fourth quintile (21%) and fifth (poorest) quintile (13%). Similar trend was seen for education with a 98% increase in prevalence among those with postgraduate education and 13% increase in prevalence among those with no education over the two survey rounds. Sharper inequalities with higher inter-group differences were seen for smoking compared to chewing. Prevalence of chewing among men in the richest quintile and with postgraduate education each increased by 49%, while that for the poorest increased by 35% and for those with no education increased by 37%.

Socioeconomic patterns for tobacco use among women differed distinctly. Overall prevalence rates of tobacco use among women were significantly lower than men. In

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2005-06, prevalence of smoking and chewing among women with no education was 2.3% and 13.3% respectively, while the same for men was 43.9% and 47.1% respectively (Table 1). Women in most SES categories showed a declining trend for tobacco use, and only scheduled caste women and those with college education showed small increases in smoking and chewing. Higher and more consistent declines in prevalence were seen for education, compared to wealth and caste. For instance, women with postgraduate education noted a 90% decrease in smoking and a 73% decrease in chewing (Table 1). Women in the first (richest) quintile showed a decline of 30% for smoking and 8% for chewing (Table 1). Results by area of residence (Web Table 1) showed an increase in risks for tobacco use with urbanization among both men and women, except in the prevalence of chewed tobacco among women. Figures 1-2 show the percentage change in smoking and chewing by education and wealth for men and women reflecting findings from table 1.

Tables 2-3 present results from pooled multilevel models showing odds ratios for smoking and chewing by education, wealth, living environment and caste, along with interactions with survey year. Gradients in odds ratios (95% CI) are seen by all four markers of SES among men and women for smoking and chewing with sharper inequalities seen for education and wealth, compared to other markers. Controlling for wealth, caste and living environment and compared to those with postgraduate education, the odds ratio of smoking for men with no education: 3.18 (95% CI: 2.96,3.43), with primary education: 2.73 (95% CI: 2.54,2.94), with high school education: 1.81 (95% CI: 1.69,1.85) and with college education: 1.38 (95% CI: 1.28,1.49). Controlling for education, caste and living environment and compared to the first (richest) quintile, odds ratio for chewing in the second quintile: 1.43 (95% CI: 1.38,1.48), middle quintile: 1.75 (95% CI: 1.68,1.82), fourth quintile: 1.92 (95% CI: 1.84,2.01) and fifth (poorest) quintile: 2.1 (95% CI: 1.99,2.2). Interaction terms in the two tables provide effect estimates for change over the two survey rounds. Among men, significant parameters for interaction terms for smoking are seen by wealth, education (except college educated) and living environment (except small city); and for chewing by wealth, higher education and by residence in towns. The joint test for interaction of fixed terms is significant for smoking

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by wealth (Joint test: 174.31, p<0.001), education (Joint test: 13.31, p=0.009) and living environment (Joint test: 13.44,p=0.003) and for chewing by wealth (Joint Test: 15.63,p=0.003), representing robust change over time. Chi-square values for random parameters are significant both at state (Smoking chi2: 12.82, p=0.0003 and Chewing chi2: 12.89, p=0.0003) and local area (Smoking chi2: 650.41, p<0.0001 and Chewing chi2: 801.4, p<0.0001) level showing variation at both levels.

Among women, controlling for education, caste and living environment and compared to those in the first (richest) quintile, the odds ratio of smoking in second quintile: 1.48 (95% CI:1.28,1.71), middle quintile: 1.9 (95%CI:1.64,2.2), fourth quintile: 2.75 (95% CI: 2.37,3.19) and fifth (poorest) quintile: 3.95 (95% CI:3.39,4.6). Controlling for wealth, caste and living environment and compared to those with postgraduate education, odds ratio of chewing among women with college education: 1.84 (95% CI: 1.55,2.19), high school education: 2.19 (95% CI:1.86,2.57), primary schooling: 2.87 (95% CI:2.44,3.4) and no education: 3.85 (95% CI:3.27,4.53). Significant odds ratios for interaction terms are seen for smoking by wealth (Joint test: 19.128,p<0.0001) and for chewing by wealth (Joint Test: 31.96,p<0.0001), education (Joint test: 17.42,p<0.0001) and living environment (Joint test: 157.008,p<0.0001). Chi-square values for random parameters are significant for both state (Smoking chi2: 12.91, p=0.0004 and Chewing chi2: 12.94, p=0.011) and local area (Smoking chi2: 264, p<0.0001 and Chewing Chi2: 839, p<0.0001), showing variation at both levels. Figure 3 presents adjusted probability estimates for smoking and chewing among men and women by wealth and education from multilevel models, which show findings similar to prevalence estimates.

DISCUSSION

In 1994, Lopez et al.[10] proposed the four-stage *Cigarette Epidemic Model* discussing transitions in smoking prevalence, consumption amount and mortality in developed countries. As per the model in stage I, male smoking prevalence is comparatively low and rising (<20%) and female smoking prevalence does not exceed 5% due to sociocultural factors. In stage II, tobacco prevalence among men starts to rise rapidly and peaks around

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50-80% with female smoking increasing at a lagged pace behind men. In stage III, prevalence rates for smoking among men start to fall, with both male and female smoking converging. Increases are seen for smoking rates among younger compared to older populations. In stage IV, prevalence of smoking begins to decline for both men and women. Mortality attributable to smoking rises to about one-third for all men, with much lower mortality rates seen among women. This model was developed based on empirical data from developed countries and has not been tested in developing countries. However, in 2011 Thun et al.[11] proposed modifications to the model potentially relevant for developing countries and were the first to note that smoking patterns by gender in developing countries distinctly differ from patterns noted in developed countries. India shows a high and complex burden of tobacco consumption, as also reported in tobacco surveillance studies[2,12-13]. This paper uses empirical evidence to show that India is currently between stages II and III of the Cigarette Epidemic model on the basis of estimates of smoking for men, but distinctly differs from the model on the patterns seen for women.

Overall, several dissimilarities are noted in the Indian experience from this model. ***First,*** India's unique tobacco experience comprises a 'double burden' of smoked ***and*** chewed tobacco consumption. Patterns for smoking and chewing seem to follow trajectories that differ by education, living environment and wealth. Further, within smoking, differences potentially exist by SES in the consumption of cigarettes from *bidis,* which most data are unable to distinguish. The quantity and quality of these products may differentially determine the mortality burden attributable to tobacco use in India[14-16]. Assessment of the disease, mortality and cost burden of the tobacco epidemic needs to account for this complexity[14-15].

Second, socioeconomic and sociocultural dynamics play profound roles in impacting tobacco use in India. Differences in tobacco consumption are seen by major SES markers such as wealth, education, living environment and caste. Findings from this analysis indicate a dichotomy between **higher absolute prevalence** by lower caste, wealth and education levels; but **higher relative change in prevalence** over time by higher caste,

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wealth and education levels. ***No previous study has reported this finding for India***. Urbanization seems to be playing an increasing role in impacting tobacco use for men and women. Further analyses by type and amount of tobacco consumed are needed to systematically understand these patterns.

Third, social gradients in tobacco use (overall and by type of tobacco) in India distinctly differ by gender. Despite women's empowerment, large-scale increases in women's smoking as predicted by the Cigarette Epidemic Model are yet to be seen in India[10-11, 17-18]. Aggregate estimates show that women are far behind men in prevalence rates for smoking; and smoking and chewing rates among women, barring a few groups, seem to be declining. The reasons for this could be several. **First,** that Indian sociocultural realities and lower acceptability of smoking among women lead to delays in age of initiation of smoking and higher rates among older compared to younger women (Web Table 1). Women's smoking has been linked to their empowerment, but this may be confined to urban areas and it is possible that on average, smoking continues to remain a social taboo among women. Representation of smoking in the media may also explain the gender patterns in the use of tobacco; smoking has been projected as an expression of masculinity among men and has moralistic connotations for women[19-21]. **Second,** an economic perspective explaining the lower smoking rates among women in India may attribute this statistic to women's unequal participation in the labor market and limited access to personal disposable income. Higher smoking among women in cities may partly indicate greater uptake of smoking by employed women. **Third,** given that data for this analysis come from a reproductive health survey, it is possible that results for women are an underestimate. Web table 1 indicates that older (above 35 years of age) women are more likely use tobacco. However, patterns in this analysis match findings from other tobacco studies such as the GATS in India (IIPS)[5-6], providing a counter to this argument.

Finally, evidence on the socioeconomic gradient in tobacco use in India needs to be linked to its implications for tobacco-related mortality and morbidity[14-15]. Dikshit et al.[15] provide the first estimates of cancer mortality in India, attributing a major

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component of age-standardized cancer mortality from lung and oral cancers to high rates of tobacco use in India. Analyses stratifying cancer morbidity and mortality in India by SES have not yet been attempted, and the lack of reliable surveillance data for chronic diseases prevent exhaustive assessments of the impact of tobacco use on Indian current and future chronic disease burden[22].

This study provides a systematic examination of the socioeconomic patterns in tobacco use in India over time. Data in this analysis come from the NFHS, which is a large, representative and generalizable survey, providing a comparative picture of tobacco patterns over time. The limitations of this analysis are the following. First, the surveys are cross-sectional, hence limiting scope for causal inference. NFHS does not provide detailed data by type or volume of tobacco. Finally, NFHS is a reproductive health survey where women in the ages of 15-49 years are sampled. Men are sampled in the households of the female sample. This introduces the potential for two downward biases. The first pertains to *social desirability bias* particularly related to underestimation of smoking patterns in women's childbearing years. Second, since the sample of men is conditional on the households from which women were sampled, the pool of men sampled may not be representative. Despite these caveats, NFHS (and in general the demographic and health surveys) has proven to be representative and generalizable, and continues to be used in a number of studies related to tobacco[5-6]. In addition, our findings are consistent with estimates from studies using other surveys assessing the burden of tobacco and its drivers in India[2,23]. Tobacco burden in the 'productive' populations (14-50 years) not only represents the current burden of tobacco but may predict future morbidity.

We present empirical evidence that India is experiencing a unique economic and social transition in tobacco consumption, quite distinct from the experience of developed countries that is likely to manifest in a number of morbidities[2,14-15]. In order to ensure policy effectiveness to prevent and reduce the exposure to tobacco, there is a need to systematically monitor and examine the social inequities in tobacco use over time and channel interventions to the social groups that are most vulnerable to these inequalities.

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TABLES, FIGURES AND REFERENCES

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Table 1: Prevalence (%) of tobacco smoking, chewing and dual use (smoking and chewing) by wealth, education and caste/tribe status among men and women in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Caste/ tribe status[1]																		
General	(M) 50,939 (F) 50,526	(M) 21,850 (F) 41,844	22.2 (21.4, 22.9)	28.8 (27.7, 29.9)	30	22.2 (21.4,23 .02)	33.2 (31.8, 34.5)	50	7.4 (6.9,7 .8)	10.8 (10. 0,11 .5)	1.0 (0.9, 1.1)	0.8 (0.55, 1.0)	-20	6.6 (6.1, 7.1)	7.24 (6.6,7. 85)	10	0.24 (0.17, 0.3)	0.2 (0.11,0 .27)
SC	(M) 21,491 (F) 21,045	(M) 11,953 (F) 20,566	31.5 (30.5, 32.5)	39.3 (37.8, 40.9)	25	27.8 (26.6, 29.1)	40.5 (38.8, 42.1)	46	12.1 (11.4, 12.8)	15.8 (14. 7,16 .9)	2.3 (1.9,2. 8)	2.4 (2.05,2 .8)	4	10.9 (10.1,11 .8)	12.1 (11.2,1 2.9)	11	0.5 (0.4,0. 7)	0.4 (0.3,0. 6)
ST	(M) 16,187 (F) 16,520	(M) 8,453 (F) 16,518	30.6 (28.8, 32.3)	36.6 (34.1, 39.1)	20	38.6 (36.9, 40.4)	52.6 (49.9, 55.3)	36	14.5, (13.3, 15.6)	18.6 (16. 7,20 .4)	3.0 (2.5,3. 6)	2.7 (2.04,3 .4)	-10	18.5 (17.0,20 .1)	25.08 (22.8,2 7.4)	36	1.0 (0.7,1. 2)	0.9 (0.6,1. 3)
OBC	(M) 36,381 (F) 36,290	(M) 25,144 (F) 29,561	24.7 (23.9, 25.5)	31.2 (30.2, 32.2)	26	25.4 (24.5, 26.3)	36.2 (35.0, 37.5)	43	9.9 (9.4,1 0.5)	13.1 (12. 3,13 .8)	1.5 (1.3,1. 7)	1.4 (1.2,1. 7)	- 7	7.3 (6.8,7.7)	7.08 (6.6,7. 6)	-3	0.3 (0.26,0 .4)	0.14 (0.09,0 .21)
No caste	(M) 6,466 (F) 6,505	(M) 2,355 (F) 5,653	31.8 (29.4, 34.3)	37.9 (34.2, 41.6)	19	23.3 (20.9, 25.6)	35.5 (31.6, 39.3)	52	10.7 (9.3, 12.1)	13.0 (10. 9,15 .2)	1.4 (0.8,1. 9)	0.9 (0.36,1 .48)	-36	10.3 (9.1,11. 6)	12.8 (10.8,1 4.8)	24	0.4 (0.2,0. 6)	0.31 (0.03,0 .59)
Education Level[2]																		
Post graduat e	(M) 3,432 (F) 1,963	(M) 2,920 (F) 3,526	7.6 (6.5, 8.7)	15.05 (13.0 1,17. 1)	98	12.4 (10.8,14 .1)	18.5 (16.0, 21.1)	49	1.7 (1.2,2 .2)	4.04 (3.0, 5.1)	0.2 (- 0.2, 0.6)	0.02 (- 0.007, 0.05)	-90	1.2 (0.45,1. 9)	0.33 (0.14,0 .5)	-73	0.2 (- 0.17,0. 5)	0.004 (- 0.002, 0.012)
College	(M) 11,340 (F) 6,586	(M) 7,811 (F) 9,424	11.1 (10.2, 11.9)	20.7 (19.2, 22.1)	86	14.9 (13.9,15 .8)	23.9 (22.3, 25.6)	60	3.5 (3.1,3 .9)	6.7 (5.8, 7.6)	0.1 (- 0.01,0. 2)	0.11 (0.03, 0.19)	10	1.3 (0.9,1.6)	1.8 (1.4,2. 2)	39	0.05 (- 0.04,0. 14)	0.04 (- 0.017, 0.1)
High school	(M) 69,996 (F) 46,629	(M) 26,100 (F) 34,338	21.2 (20.7,2 1.8)	24.7 (23.8, .25.5)	17	23.3 (22.7,23 .9)	33.1 (32.0, 34.1)	42	7.8 (7.5, 8.2)	9.9 (9.3, 10.6)	0.2 (0.17, 0.3)	0.07 (0.04, 0.1)	-65	4.2 (3.9, 4.6)	3.4 (3.04,3 .7)	-19	0.1 (0.06,0 .13)	0.04(0. 02,0.0 6)
Primary school	(M) 21,730 (F) 20,604	(M) 12,622 (F) 19,451	32.7 (31.7,3 3.6)	35.6 (34.3, 36.9)	1	30.2 (29.2, 31.2)	41.9 (40.5, 43.4)	39	12.1 (11.4, 12.7)	14.8 (13. 8, 15.7)	0.7 (0.5,0. 8)	0.2 (0.13,0 .3)	-71	9.0 (8.4,9.6)	7.4 (6.8,8. 02)	-18	0.18 (0.13,0 .24)	0.07 (0.03,0 .11)

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Illiterate	(M) 24,966 (F) 55,104	(M) 20,302 (F) 57,403	38.9 (37.9,, 39.9)	43.9 (42.8, 45.2)	13	34.4 (33.2,35 .5)	47.1 (45.7, 48.5)	37	(15.9 (15.1, 16.6)	18.9 (17. 9,19 .9)	2.6 (2.4,,2. 9)	2.3 (2.02,2 .6)	-12	11.9 (11.4, 12.6)	13.3 (12.6, 13.0)	12	0.6 (0.53,0 .72)	0.42 (0.33,0 .51)
Wealth Quintiles																	
Richest	(M) 26,291 (F) 26,177	(M) 13,706 (F) 24,837	11.9 (11.2, 12.5)	19.9 (18.8, 21.1)	63	13.7 (12.8,14 .6)	20.4 (19.0, 21.8)	49	3.3 (2.97, 3.6)	5.8 (5.1, 6.4)	0.2 (0.1,0. 3)	0.14 (0.08,0 .2)	-30	2.2 (1.9,2.5)	2.02 (1.7,2. 3)	-8	0.05 (0.01,0 .07)	0.042 (0.009, 0.07)
Richer	(M) 26,293 (F) 26,177	(M) 13,946 (F) 24,837	19.3 (18.5, 20.04)	25.8 (24.6, 27.1)	37	19.0 (18.1,19 .9)	30.2 (28.7, 31.7)	59	5.6 (5.2,6 .02)	9.3 (8.4, 10.2)	0.46 (0.37,0 .54)	0.37 (0.27,0 .47)	-20	5.4 (4.9,5.9)	4.9 (4.4,5. 4)	-9	0.1 (0.07,0 .18)	0.06 (0.02,0 .09)
Middle	(M) 26,294 (F) 26,174	(M) 14,075 (F) 24,826	25.6 (24.7,2 6.4)	31.4 (30.1, 32.7)	25	22.9 (22.0,23 .9)	34.9 (33.4, 36.3)	52	7.6 (7.2,8 .1)	11.5 (10. 6,12 .3)	1.1 (0.9,1. 3)	0.7 (0.6,0. 9)	-36	7.8 (7.2,8.3)	6.9 (6.4,7. 4)	-11	0.23 (0.16,0 .3)	0.07 (0.04,0 .11)
Poorer	(M) 26,293 (F) 26,179	(M) 14,007 (F) 24,814	30.6 (29.7,3 1.5)	36.5 (35.2, 37.8)	21	28.9 (28.0,29 .9)	39.5 (38.0 3,40. 9)	37	11.6 (10.9, 12.2)	14.5 (13. 6,15 .5)	1.7 (1.5,1. 9)	1.7 (1.4,1. 9)	0	10.9, (10.3,11 .6)	10.5 (9.8,12 .2)	-4	0.4 (0.3,0. 5)	0.24 (0.17,0 .31)
Poorest	(M) 26,293 (F) 26,179	(M) 14,021 (F) 24,828	35.5 (34.4,, 36.5)	40.6, 39.3, 41.9)	13	36.8 (35.7,37 .9)	49.7 (48.2, 51.2)	35	16.7 (15.9, 17.5)	19.4 (18. 4,20 .5)	3.5 (3.1,3. 9)	3.2 (2.8,3. 7)	-9	14.1 (13.3,15 .0)	17.1 (16.03, 18.1)	21	0.9 (0.7,1. 0)	0.7 (0.52,0 .86)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142															

[1]Scheduled castes and scheduled tribes are identified by the Government of India as socially and economically backward and needing protection from social injustice and exploitation. Other backward class is a diverse collection of intermediate castes that were considered low in the traditional caste hierarchy but are clearly above scheduled castes. General is thus a default residual group that enjoys higher status in the caste hierarchy.

[2] Post graduate:15 or more years of education; college: 13-15 years of education; high school: 8-12 years of education; secondary: 5-8 years of education; primary: 0-5 years of education; illiterate: 0 years of education

*Percentage change (**% Δ)** numbers have been rounded to the nearest integer.

*All results for prevalence are survey adjusted and age-standardised. Prevalence results are all in percentages.

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Table 2: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among men and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.37 (1.32,1.43)	1.51 (1.44,1.59)	1.37 (1.31,1.42)	1.36 (1.3,1.41)	1.37 (1.31,1.42)	1.43 (1.38,1.48)	1.33 (1.27,1.4)	1.42 (1.36,1.47)	1.42 (1.36,1.47)	1.41 (1.36,1.47)
Middle	1.71 (1.64,1.78)	1.99 (1.89,2.1)	1.71 (1.64,1.78)	1.68 (1.61,1.75)	1.7 (1.63,1.77)	1.75 (1.68,1.82)	1.63 (1.55,1.72)	1.73 (1.66,1.8)	1.72 (1.65,1.8)	1.72 (1.65,1.79)
Poorer	2.06 (1.97,2.16)	2.51 (2.37,2.65)	2.05 (1.96,2.14)	2.02 (1.93,2.11)	2.04 (1.95,2.14)	1.92 (1.84,2.01)	1.77 (1.67,1.87)	1.89 (1.8,1.97)	1.86 (1.78,1.95)	1.87 (1.79,,1.96)
Poorest	2.33 (2.22,2.46)	2.88 (2.72,3.06)	2.31 (2.19,2.43)	2.29 (2.18,2.41)	2.3 (2.19,2.42)	2.1 (1.99,2.2)	1.93 (1.82,2.05)	2.03 (1.92,2.13)	2.03 (1.932.13)	2.02 (1.93,2.12)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.38 (1.28,1.49)	1.41 (1.31,1.53)	1.34 (1.19,1.5)	1.4 (1.29,1.51)	1.4 (1.3,1.51)	1.26 (1.17,1.36)	1.28 (1.19,1.39)	1.14 (1.02,1.27)	1.29 (1.19,1.39)	1.29 (1.2,1.39)
High School	1.81 (1.69,1.95)	1.91 (1.78,2.05)	2.16 (1.95,2.4)	1.87 (1.74,2.01)	1.87 (1.74,2.01)	1.53 (1.43,1.65)	1.64 (1.53,1.76)	1.46 (1.33,1.61)	1.65 (1.54,1.77)	1.66 (1.54,1.78)
Primary	2.73 (2.54,2.94)	2.81 (2.61,3.04)	3.4 (3.05,3.78)	2.77 (2.57,2.99)	2.77 (2.57,2.99)	1.98 (1.84,2.13)	2.04 (1.9,2.2)	1.84 (1.66,2.04)	2.05 (1.9,2.21)	2.06 (1.91,2.21)
No education	3.18 (2.96,3.43)	3.27 (3.03,3.53)	4.07 (3.66,4.53)	3.19 (2.96,4.34)	3.18 (2.95,3.42)	2.09 (1.94,2.26)	2.06 (1.91,2.22)	1.93 (1.74,2.14)	2.07 (1.92,2.23)	2.08 (1.93,2.24)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.77 (0.72,0.82)	0.81 (0.76,0.87)	0.8 (0.74,0.85)	0.82 (0.75,0.9)	0.79 (0.74,0.84)	0.96 (0.89,1.02)	1.02 (0.96,1.09)	1.02 (0.96,1.09)	1.06 (0.97,1.16)	1.03 (0.97,1.1)
Town	0.78 (0.74,0.82)	0.83(0.79,0 .88)	0.81(0.77,0 .85)	0.88 (0.82,0.95)	0.81 (0.77,0.85)	0.92 (0.87,0.97)	1.01 (0.95,1.06)	1.01 (0.95,1.06)	1.06 (0.98,1.15)	1.01 (0.96,1.07)
Village	0.68 (0.65,0.71)	0.75 (0.71,0.78)	0.73 (0.7,0.77)	0.87 (0.82,0.92)	0.73 (0.7,0.76)	0.76 (0.73,0.79)	0.92 (0.88,0.96)	0.92 (0.88,0.96)	0.93 (0.88,0.99)	0.93 (0.88,0.97)

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Caste/Tribe (Other)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SC	1.16 (1.12,1.2)	1.15 (1.11,1.19)	1.15 (1.11,1.18)	1.15 (1.11,1.19)	1.16 (1.11,1.21)	1.12 (1.08,1.15)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.14)
ST	1.14 (1.09,1.2)	1.13 (1.08, 1.2)	1.14 (1.08,1.18)	1.14 (1.09,1.2)	1.15 (1.09,1.21)	3.02 (2.88,3.15)	1.1 (1.06,1.15)	1.1 (1.05,1.15)	1.1 (1.05,1.15)	1.17 (1.11,1.24)
OBC	1.00 (0.98,1.04)	0.99 (0.97,1.02)	0.99 (0.96,1.02	0.99 (0.97,1.02)	1.03 (0.99,1.07)	1.05 (1.02,1.08)	1.01 (0.97,1.03)	1.002 (0.97,1.03)	1.003 (0.97,1.03)	1.04 (0.99,1.07)
No Caste or missing	1.06 (1.01,1.13)	1.07 (1.01,1.13)	1.07 (1.01,1.13)	1.08 (1.02,1.14)	1.05 (0.98,1.13)	0.97 (0.92,1.03)	1.02 (0.96,1.08)	1.01 (0.96,1.08)	1.02 (0.96,1.08)	0.97 (0.9,1.04)
Survey Year (Yr)		1.74 (1.7,1.88)	1.67 (1.46,1.91)	1.49 (1.4,1.58)	1.24 (1.19,1.3)		1.47 (1.38,1.56)	1.34 (1.17,1.54)	1.69 (1.58,1.8)	1.72 (1.65,1.79)
Yr *Richer		0.78 (0.73,0.84)					1.15 (1.07,1.24)			
Yr*Middle		0.68 (0.63,0.73)					1.13 (1.05,1.22)			
Yr *Poorer		0.60 (0.56,0.65)					1.15 (1.07,1.24)			
Yr *Poorest		0.58 (0.53,0.62)					1.11 (1.03, 1.2)			
Yr *College			1.13 (0.97,1.32)					1.27 (1.1,1.48)		
Yr * High School			0.78 (0.68,0.89)					1.28 (1.11,1.47)		
Yr * Primary			0.66 (0.57,0.77)					1.02 (0.88,,1.18)		
Yr * No education			0.61 (0.53,0.70)					1.01 (0.87,1.17)		
Yr *Small City				0.99 (0.87,1.12)					0.94 (0.82,1.06)	
Yr * Town				0.89 (0.81,0.98)					0.9 (0.82,0.99)	
Yr * Village				0.73 (0.68,0.79)					0.98 (0.91,1.05)	
Yr *SC					0.99 (0.92,1.05)					0.99 (0.93,1.06)
Yr *ST					0.97 (0.9,1.05)					0.84 (0.78,0.91)
Yr*OBC					0.92 (0.87,0.97)					0.92 (0.87,0.97)
Yr*No Caste					1.07 (0.94,1.21)					1.15 (1.02,1.29)

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Fixed Part of the Model										
Joint Chi Test for Interaction (p-value)		174.31 (p<0.001)	13.31 (p=0.009)	13.44 (p=0.003)	0.318 (p=0.98)		15.63 (p=0.003)	8.52 (p=0.074)	2.6 (p=0.46)	1.387 (p=0.85)
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)		12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)
Chi square for Level 2: Local Area (p-value)		650.41 (p<0.001)	655.7 (p<0.001)	654.2 (p<0.001)	660.7 (p<0.001)		801.6 (p<0.001)	802.4 (p<0.001)	802.4 (p<0.001)	801.7 (p<0.001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Table 3: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among women and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.48 (1.28,1.71)	1.82 (1.49,2.22)	1.48 (1.28,1.71)	1.48 (1.28,1.71)	1.49 (1.29,1.72)	1.48 (1.41,1.56)	1.41 (1.32,1.51)	1.48 (1.4,1.55)	1.51 (1.43,1.59)	1.48 (1.41,1.56)
Middle	1.9 (1.64,2.19)	2.63 (2.17,3.19)	1.87 (1.62,2.16)	1.88 (1.62,2.18)	1.9 (1.64,2.19)	1.75 (1.66,1.85)	1.58 (1.47,1.7)	1.75 (1.65,1.84)	1.81 (1.72,1.92)	1.76 (1.66,1.85)
Poorer	2.75 (2.37,3.19)	3.72 (3.07,5.52)	2.8 (2.41,3.25)	2.81 (2.42,3.26)	2.85 (2.45,3.30)	2.14 (2.02,2.27)	1.86 (1.72,2.002)	2.13 (2.01,2.25)	2.2 (2.07,2.32)	2.14 (2.02,2.27)
Poorest	3.95 (3.39,4.6)	4.83 (3.97,5.88)	4.03 (3.46,4.69)	4.05 (3.47,4.72)	4.08 (3.5,4.75)	2.67 (2.5,2.84)	2.14 (1.99,2.32)	2.65 (2.49,2.82)	2.7 (2.54,2.88)	2.7 (2.5,2.84)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.59 (0.91,2.8)	1.61 (0.92,2.82)	0.98 (0.37,2.58)	1.58 (0.9,2.78)	1.57 (0.9,2.75)	1.84 (1.55,2.19)	1.83 (1.54,2.17)	1.1 (0.85,1.42)	1.82 (1.53,2.17)	1.84 (1.55,2.19)
High School	1.78 (1.06,2.99)	1.67 (1.01,,2.82)	1.95 (0.83,4.56)	1.62 (0.96,2.72)	1.61 (0.99,2.7)	2.19 (1.86,2.57)	2.13 (1.82,2.51)	1.47 (1.17,1.85)	2.15 (1.82,2.54)	2.21 (1.88,2.6)
Primary	2.78 (1.66,4.68)	2.62 (1.56,4.41)	3.32 (1.42,7.76)	2.54 (1.51,4.29)	2.52 (1.5,4.24)	2.87 (2.44,3.4)	2.83 (2.4,3.33)	2.03 (1.61,2.56)	2.86 (2.42,3.37)	2.89 (2.45,3.41)
No education	4.78 (2.84,8.04)	4.91 (2.93,8.23)	6.89 (2.53,13.73)	4.72 (2.81,7.93)	4.66 (2.77,7.81)	3.85 (3.27,4.53)	3.75 (3.19,4.42)	2.58 (2.04,3.24)	3.8 (3.22,4.48)	3.85 (3.27,4.53)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.91 (0.75,1.09)	0.98 (0.82, 1.17)	1.01 (0.84,1.21)	0.78 (0.58,1.04)	1.004 (0.84,1.2)	1.23 (1.13,1.32)	1.25 (1.15,1.35)	1.22 (1.13,1.32)	0.97 (0.86,1.1)	1.2 (1.11,1.29)
Town	1.19 (1.03,1.37)	1.2 (1.04,1.38)	1.22 (1.05,1.4)	1.31 (1.06,1.62)	1.23 (1.1,1.41)	1.36 (1.27,1.45)	1.37 (1.29,1.47)	1.36 (1.27,1.45)	0.95 (0.86,1.04)	1.34 (1.25,1.43)
Village	1.4 (1.24,1.59)	1.28 (1.13,1.46)	1.31 (1.16,1.49)	1.37 (1.14,1.66)	1.32 (1.16,1.49)	1.07 (1.01,1.14)	1.09 (1.02,1.16)	1.08 (1.02,1.15)	0.69 (0.64,0.75)	1.07 (1.005,1.13)
Caste/Tribe	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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(Other)										
SC	1.5 (1.39,1.62)	1.55 (1.43,1.67)	1.54 (1.43,1.67)	1.54 (1.43,1.67)	1.4 (1.27,1.55)	1.28 (1.23,1.33)	1.28 (1.23,1.36)	1.28 (1.23,1.33)	1.29 (1.24,1.34)	1.28 (1.22,1.35)
ST	2.04 (1.86,2.24)	2.11 (1.92, 2.3)	2.11 (1.93,2.31)	2.11 (1.93,2.31)	1.99 (1.79,2.23)	1.53 (1.46,1.6)	1.53 (1.46,1.61)	1.53 (1.46,1.61)	1.52 (1.45,1.6)	1.48 (1.39,1.58)
OBC	1.11 (1.03,1.2)	1.17 (1.08,1.26)	1.16 (1.08,1.26)	1.16 (1.08,1.25)	1.13 (1.03,1.24)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.06 (1.02,1.12)
No Caste or missing	0.7 (0.6,0.81)	0.74 (0.64,0.86)	0.72 (0.62,0.85)	0.73 (0.62,0.85)	1.01 (0.85,1.2)	1.02 (0.95,1.09)	1.02 (0.96,1.09)	1.02 (0.95,1.09)	1.01 (0.95,1.08)	0.92 (0.85,1.01)
Survey Year (Yr)		1.004 (0.98,1.03)	0.89 (0.31,2.56)	0.67 (0.55,0.83)	0.57 (0.51,0.63)		0.81 (0.75,0.87)	0.54 (0.4,0.74)	0.52 (0.47,0.56)	1.02 (0.97,1.07)
Yr*Richer		0.66 (0.5,0.87)					1.09 (0.99,1.21)			
Yr*Middle		0.47 (0.36,0.61)					1.21 (1.1,1.34)			
Yr *Poorer		0.56 (0.44,0.72)					1.3 (1.18,1.43)			
Yr *Poorest		0.71 (0.56,0.91)					1.5 (1.37,1.64)			
Yr *College			1.98 (0.6,6.52)					2.26 (1.6,3.21)		
Yr * High School			0.77 (0.26,2.22)					1.94 (1.41,2.67)		
Yr * Primary			0.61 (0.21,1.75)					1.74 (1.27,2.4)		
Yr * No education			0.7 (0.24,2.0)					1.94 (1.41,2.66)		
Yr*Small City				1.44 (0.99,2.07)					1.61 (1.38,1.88)	
Yr * Town				0.89 (0.68,1.16)					1.94 (1.72,2.19)	
Yr * Village				0.92 (0.74,1.15)					2.26 (2.06,2.48)	
Yr *SC					1.29 (1.11,1.51)					0.99 (0.93,1.07)
Yr *ST					1.16 (0.99,1.36)					1.07 (0.98,1.16)
Yr*OBC					1.1 (0.96,1.27)					0.95 (0.89,1.01)
Yr*No Caste					0.45 (0.32,0.63)					1.22 (1.07,1.38)
Fixed Part of the Model										
Overall Chi for Interaction (p-		19.128 (p<0.001)	0.041 (p=0.99)	50.195 (p<0.001)	0.992 (p=0.91)		31.96 (p<0.0001)	17.42 (p=0.001)	157.008 (p<0.0001)	2.665 (p=0.615)

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value)										
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.91 (p=0.011)	12.91 (p=0.011)	12.91 (p=0.004)	12.91 (p=0.011)		12.94 (p=0.011)	12.94 (p=0.011)	12.94 (p=0.004)	12.94 (p=0.011)
Chi square for Level 2: Local Area (p-value)		260.98 (p<0.001)	266.3 (p<0.001)	264.9 (p<0.001)	263.5 (p<0.001)		844.91 (p<0.0001)	839.3 (p<0.0001)	824.92 (p<0.0001)	837.64 (p<0.0001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Data Sharing Statement: Open source dataset.

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Are socioeconomic disparities in tobacco consumption increasing in India? A repeated cross-sectional multilevel analysis

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ABSTRACT: (291~~298~~ words)

Objectives: India bears a significant portion of the global tobacco burden with high prevalence of tobacco ~~tobacco~~ use ~~among men and women~~. This study examines the socioeconomic patterning of tobacco use and identifies the changing gender and socioeconomic dynamics in light of the *Cigarette Epidemic Model.*

Design: ~~Population based cross sectional surveys,~~ Secondary analyses of second and third National Family Health Survey (NFHS) data~~NFHS- 2 and 3, India~~.

Setting & participants: Data were analysed from 201,219~~131,464~~ men and 255,028~~130,886~~ women over survey rounds. ~~(NFHS-2) and 69,755 men and 124,142 women (NFHS- 3) - ages 15-49 years.~~

Outcomes & methods: Outcomes included **smoking** (cigarettes, *bidis* and pipes/cigar), ~~chewing~~ **chewed tobacco** (*paan masala, gutkha* ~~or other chewed forms of tobacco~~and others) and **dual use**, examined by education, wealth, living environment and caste~~/tribe~~. Standardized prevalence and percentage change were estimated. Pooled multilevel models estimated the effect of socioeconomic covariates on the log odds of tobacco use by gender, ~~estimating~~ along with fixed and random parameters.

Findings: Among men (2005-6), ~~SES~~ gradients in smoking by education (i~~I~~lliterate: 44% vs. p~~P~~ostgraduates: 15%) and chewing (i~~I~~lliterate: 47% vs. p~~P~~ostgraduate: 19%) were observed. Inverse ~~Similar g~~gradients were also observed by ~~education~~wealth, living environment and caste. Chewed tobacco ~~prevalence~~ use ~~among~~ by women showed inverse SES gradients comparing the illiterate (7.4%) vs. postgraduate (0.33%), and poorest (17%) vs. richest (2%) quintiles. However, proportional increases in smoking were higher among more educated (postgraduates (98%) vs. high schooling only (17%)) and chewing among richer (richest quintile (49%) vs. poorest quintile (35%)). ~~change estimates showed greater percentage rises in smoking and chewing respectively by higher SES groups among men - postgraduates (98%) and richest (49%) compared to those with high schooling only (17%) and poorest (35%).~~ Among women, higher educated showed larger declines for smoking - 90% (postgraduates) vs. 12% (illiterates). Younger men (15-24 years) showed increasing tobacco use (Smoking: 123% and Chewing: 112%). Older

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women (35-49 years) show higher prevalence of smoking (3.2%) compared to younger~~0.3% (15-24 years)~~ 0.3%)~~for smoking~~.

Conclusions: Indian tobacco use patterns show significant diversions from the *Cigarette Epidemic Model*– from gender and socioeconomic perspectives. Separate analysis by type is needed to further understand social determinants of tobacco use in India.

Article Summary

Article Focus

- India bears a significant burden of tobacco consumption, with high prevalence of smoking and chewing among men & women.
- Previous studies have established a unique social and spatial gradient in tobacco use. However, no studies have yet reported estimates for changing patterns in tobacco use prevalence or relative risk over time.
- This study estimates socioeconomic patterns and examines the changing gender and socioeconomic dynamics of tobacco use in light of the *Cigarette Epidemic Model.*

Key Messages

- Among men, higher prevalence of smoking and chewing for less educated, poorer, rural and lower caste. Sharp and rising inequalities by survey year, but percentage change shows increases are greater among higher SES groups – higher education, urban, richer populations, previously unreported.
- Low and declining risks of smoking and chewing among women. Higher rates of chewing compared to smoking. Increase in smoking with urbanization for women. Greater declines over time for higher educated women.
- Significant changing trend by wealth, education and living environment in smoking among men and in chewing among women. Increases in smoking prevalence among younger men (15-24 years) and chewing among younger women (15-24 years).

Strengths & limitations

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- First systematic examination of socioeconomic patterns in tobacco use in India, highlighting SES gradients in use and risks among vulnerable populations.
- Large sample, representative and generalizable surveys providing repeated and comparable estimates over time.
- Limitations: a) cross-sectional data, limiting scope for causal inference, b) lack of data by tobacco type or volume of use, c) data from a reproductive health survey may suffer from social desirability bias.

INTRODUCTION

Global estimates indicate that one in ten adult deaths can be attributed to tobacco consumption, leading to approximately 5 million global deaths per year[1-4]. Of these, 2.4 million deaths occur in developing countries. India bears a significant portion of this global tobacco burden[3-4]. Consumption of both smoked and smoke-less (chewed and inhaled) forms of tobacco is highly prevalent among men (47%) and women (14%)[5]. However, previous studies have indicated that tobacco use, like other non-communicable disease risk factors, is unequally distributed across different social determinants in India – education, caste and wealth – among both men and women[1,5-7], indicating a distinct 'economic and spatial distribution' in tobacco use[6]. No studies have yet systematically examined patterns and changes in the prevalence of tobacco consumption in India by socioeconomic factors over time.

In this study, we aim to provide estimates and inferences on the changing gradient of tobacco consumption in India, analysing prevalence and odds ratio patterns from the National Family Health Surveys[8-9]. We discuss our findings in light of the Cigarette Epidemic Model[10-11] and examine what populations show higher and lower prevalence of tobacco consumption over time.

METHODS

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Data wereas analysed from two rounds of the Indian National Family Health Survey (NFHS 2 and& 3) conducted during 1998-99 and 2005-06 respectively. The NFHS is a nationally representative cross-sectional survey that is collected and managed by the Indian Institute of Population Sciences (IIPS) in Mumbai, India. These surveys provide vital sources of information on demographic, health and socioeconomic behaviour of Indian households. Data from men and women in the age group of 15-49 years wereas used from both survey rounds to ensure comparability. Data areis representative of all Indian states (except the small Union Territories), hence covering almost 99 per cent of the country's population. The surveys were collected using multistage cluster random sampling techniques. Rural and urban areas wereare sampled separately and a uniform sample design was followed in each state; states and PSUs are considered as levels. Individual questionnaires for men and women were used to interview usual residents of the household or visitors who stayed in the house the night before. Further details on sample design, including sampling framework and sample implementation, are provided in the basic survey reports by IIPS [8-9].

Outcomes of interest included **smoking** (cigarettes, *bidis*[1] and pipes/cigar), **chewing tobacco** (*paan masala*[2], *gutkha*[3] or other chewed forms of tobacco) and **dual use** (consuming both smoked and chewedsmoke less forms) of tobacco. NFHS-3 provides details on the different types of smoked and chewedsmokeless tobacco products, but this information was unavailable in NFHS-2. The main covariates of interest were age, marital status and education at the individual level, and household wealth, area of residence (urban/rural), religion and caste/tribe status at the household level (*Variable definitions are provided in Table 1*). Survey-weighted age-standardised prevalence estimates of smoking, chewing and dual use of tobacco along with percentage change were calculated. Pooled multi-level models with state, local area and individual as analytical levels were used to estimate the effect of wealth, education, living environment and caste on the log odds of smoking and chewing among men and women. Regression models wereare adjusted for age, religion and marital status. Survey year was used in the

[1] *Bidis* are local inexpensive cigarettes, that are thinner and contain tobacco flakes rolled inside tendu leaves. Bidis are often smoked by poorer populations.
[2] *Paan Masala* is a powdered preparation of betel leaves combined with cured tobacco and/or areca nut, which has stimulating properties
[3] *Gutkha* is a savoury or sweet preparation containing areca nut, tobacco, catechu, paraffin and slaked lime.

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interaction terms to estimate a time trend in socioeconomic determinants of tobacco. Tests for trend included joint tests for significance of fixed parameters and significance tests for random parameters. Model estimates were maximum likelihood-based using the Iterative Generalized Least-Squares (IGLS) algorithm as implemented within the MLwin software programme (version 2.23).

RESULTS

Data used in this analysis coverededs 131,464 men and 130,886 women residing in 92,486 households in NFHS-2 and 69,755 men and 124,142 women residing in 109,041 households in NFHS-3, with an overall response rate of 96% for NFHS-2 and 98% for NFHS-3. Prevalence (%) of smoking, chewing and dual use of tobacco over two survey rounds are presented by the three primary markers of socioeconomic status (SES) - education, wealth and caste (Ttable 1) along with percentage change estimates. Estimates by living environment, marital status, age and religion are presented in the appendix (Web Table 1). Among men, the prevalence of tobacco use (smoking, chewing and dual use) wasis seen to increase across all socioeconomic groups. For instance, smoking has risenrises from 35.5% to 40.6% in the fifth (poorest) quintile, 30.6% to 36.5% in the fourth quintile, 25.6 to 31.4% in the middle quintile, 19.3% to 25.8% in the second quintile and 11.9% to 19.9% in the first (richest) quintile (table 1). Chewed tobacco use increased from 34.4% to 47.1% among the illiterate populations, 30.2% to 41.9% among those with primary schooling only, 23.3% to 33.1% among those with high school education, 14.9% to 23.9% among those with college education and 12.4% to 18.5% among those with postgraduate degree. Higher prevalence of tobacco use among men in each survey round wasis seen for socioeconomically disadvantaged groups – with less educated, lower wealth, living in rural residence areas or lower caste showing an inverse SES gradient; however, greater proportional increases in prevalence over time wereare seen among higher SES groups. For instance, higher absolute smoking prevalence in NFHS-3 wasis seen among men in lower wealth quintiles compared to those in higher wealth quintiles (41% for fifth (poorest) quintile and 37% for fourth quintile, compared to 20% in first (richest) quintile and 26% in second quintile); higher percentage increases in smoking wereare recorded among first (richest) quintile (63%) and second quintile (37%)

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compared to fourth quintile (21%) and fifth (poorest) quintile (13%). Similar trend was~~is~~ seen for education with a 98% increase in prevalence among those with postgraduate education and 13% increase in prevalence among those with no education over the two survey rounds. Sharper inequalities with higher inter-group differences were~~are~~ seen for smoking compared to chewing. Prevalence of chewing among men in the richest quintile and with postgraduate education each increased by 49%, while that for the poorest increased by 35% and for those with no education increased by 37%.

Socioeconomic patterns for tobacco use among women differed distinctly. Overall prevalence rates of tobacco use among women were~~are~~ significantly lower than men. In 2005-06, prevalence of smoking and chewing among women with no education was 2.3% and 13.3% respectively, while the same for men was 43.9% and 47.1% respectively (T~~t~~able 1). Women in most SES categories showed a declining trend for tobacco use, and only scheduled caste women and those with college education showed small increases in smoking and chewing. Higher and more consistent declines in prevalence were~~are~~ seen for education, compared to wealth and caste~~/tribe status~~. For instance, women with postgraduate education noted a 90% decrease in smoking and a 73% decrease in chewing (table 1). Women in the first (richest) quintile showed a decline of 30% for smoking and 8% for chewing (T~~t~~able 1). Results by area of residence (Web Table 1) showed an increase in risks for tobacco use with urbanization among both men and women, except in the prevalence of chewed tobacco among women. Figures 1-2 show the percentage change in smoking and chewing by education and wealth for men and women reflecting findings from table 1.

Tables 2-3 present results from pooled multilevel models showing odds ratios for smoking and chewing by education, wealth, living environment and caste, along with interactions with survey year. Gradients in odds ratios (95% CI) are seen by all four markers of SES among men and women for smoking and chewing with sharper inequalities seen for education and wealth, compared to other markers. Controlling for wealth, caste and living environment and compared to those with postgraduate education, the odds ratio of smoking for men with no education: 3.18 (95% CI: 2.96,3.43), with primary education: 2.73 (95% CI: 2.54,2.94), with high school education: 1.81 (95% CI:

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1.69,1.85) and with college education: 1.38 (95% CI: 1.28,1.49). Controlling for education, caste and living environment and compared to the first (richest) quintile, odds ratio for chewing in the second quintile: 1.43 (95% CI: 1.38,1.48), middle quintile 1.75 (95% CI: 1.68,1.82), fourth quintile: 1.92 (95% CI: 1.84,2.01) and fifth (poorest) quintile: 2.1 (95% CI: 1.99,2.2). Interaction terms in the two tables provide effect estimates for change over the two survey rounds. Among men, significant parameters for interaction terms for smoking are seen by wealth, education (except college educated) and living environment (except small city); and for chewing by wealth, higher education and by residence in towns. The joint test for interaction of fixed terms is significant for smoking by wealth (Joint test: 174.31, p<0.001), education (Joint test: 13.31, p=0.009) and living environment (Joint test: 13.44,p=0.003) and for chewing by wealth (Joint Test: 15.63,p=0.003), representing robust change over time. Chi-square values for random parameters are significant both at state (Smoking chi2: 12.82, p=0.0003 and Chewing chi2: 12.89, p=0.0003) and local area (Smoking chi2: 650.41, p<0.0001 and Chewing chi2: 801.4, p<0.0001) level showing variation at both levels.

Among women, controlling for education, caste and living environment and compared to those in the first (richest) quintile, the odds ratio of smoking in second quintile: 1.48 (95% CI:1.28,1.71), middle quintile: 1.9 (95%CI:1.64,2.2), fourth quintile: 2.75 (95% CI: 2.37,3.19) and fifth (poorest) quintile: 3.95 (95% CI:3.39,4.6). Controlling for wealth, caste and living environment and compared to those with postgraduate education, odds ratio of chewing among women with college education: 1.84 (95% CI: 1.55,2.19), high school education: 2.19 (95% CI:1.86,2.57), primary schooling: 2.87 (95% CI:2.44,3.4) and no education: 3.85 (95% CI:3.27,4.53). Significant odds ratios for interaction terms are seen for smoking by wealth (Joint test: 19.128,p<0.0001) and for chewing by wealth (Joint Test: 31.96,p<0.0001), education (Joint test: 17.42,p<0.0001) and living environment (Joint test: 157.008,p<0.0001). Chi-square values for random parameters are significant for both state (Smoking chi2: 12.91, p=0.0004 and Chewing chi2: 12.94, p=0.011) and local area (Smoking chi2: 264, p<0.0001 and Chewing Chi2: 839, p<0.0001), showing variation at both levels. Figure 3 presents adjusted probability

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estimates for smoking and chewing among men and women by wealth and education from multilevel models, which show findings similar to prevalence estimates.

DISCUSSION

In 1994, Lopez et al.[10] proposed the four-stage *Cigarette Epidemic Model* discussing transitions in smoking prevalence, consumption amount and mortality in developed countries. As per the model in stage I, male smoking prevalence is comparatively low and rising (<20%) and female smoking prevalence does not exceed 5% due to sociocultural factors. In stage II, tobacco prevalence among men starts to rise rapidly and peaks around 50-80% with female smoking increasing at a lagged pace behind men. In stage III, prevalence rates for smoking among men start to fall, with both male and female smoking converging. Increases are seen for smoking rates among younger compared to older populations. In stage IV, prevalence of smoking begins to decline for both men and women. Mortality attributable to smoking rises to about one-third for all men, with much lower mortality rates seen among women. This model was developed based on empirical data from developed countries and has not been tested in developing countries. However, in 2011 Thun et al.[11] proposed modifications to the model potentially relevant for developing countries and were the first to note that smoking patterns by gender in developing countries distinctly differ from patterns noted in developed countries. India shows a high and complex burden of tobacco consumption, as also reported in tobacco surveillance studies[2,12-13]. This paper uses empirical evidence to show that India is currently between stages II and III of the Cigarette Epidemic model on the basis of estimates of smoking for men, but distinctly differs from the model on the patterns seen for women.

Overall, several dissimilarities are noted in the Indian experience from this model. ***First,*** India's unique tobacco experience comprises a 'double burden' of smoked ***and*** chewed tobacco consumption. Patterns for smoking and chewing seem to follow trajectories that differ by education, living environment and wealth. Further, within smoking, differences potentially exist by SES in the consumption of cigarettes from *bidis,* which most data are

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unable to distinguish. The quantity and quality of these products may differentially determine the mortality burden attributable to tobacco use in India[14-16]. Assessment of the disease, mortality and cost burden of the tobacco epidemic needs to account for this complexity[14-15].

Second, socioeconomic and sociocultural dynamics play profound roles in impacting tobacco use in India. Differences in tobacco consumption are seen by major SES markers such as wealth, education, living environment and caste. Findings from this analysis indicate a dichotomy between **higher absolute prevalence** by lower caste, wealth and education levels; but **higher relative change in prevalence** over time by higher caste, wealth and education levels. ***No previous study has reported this finding for India***. Urbanization seems to be playing an increasing role in impacting tobacco use for men and women. Further analyses by type and amount of tobacco consumed are needed to systematically understand these patterns.

Third, social gradients in tobacco use (overall and by type of tobacco) in India distinctly differ by gender. Despite women's empowerment, large-scale increases in women's smoking as predicted by the Cigarette Epidemic Model are yet to be seen in India[10-11, 17-18]. Aggregate estimates show that women are far behind men in prevalence rates for smoking; and smoking and chewing rates among women, barring a few groups, seem to be declining. The reasons for this could be several. **First,** that Indian sociocultural realities and lower acceptability of smoking among women leads to delays in age of initiation of smoking and higher rates among older compared to younger women (Web Table 1). Women's smoking has been linked to their empowerment, but this may be confined to urban areas and it is possible that on average, smoking continues to remain a social taboo among women. Representation of smoking in the media may also explain the gender patterns in the use of tobacco; smoking has been projected as an expression of masculinity among men and has moralistic connotations for women[19-21]. **Second,** an economic perspective explaining the lower smoking rates among women in India may attribute this statistic to women's unequal participation in the labor market and limited access to personal disposable income. Higher smoking among women in cities may partly

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indicate greater uptake of smoking by employed women. **Third,** given that data for this analysis comes from a reproductive health survey, it is possible that results for women are an underestimate. Web table 1 indicates that older (above 35 years of age) women are more likely use tobacco. However, patterns in this analysis match findings from other tobacco studies such as the GATS in India (IIPS)[5-6], providing a counter to this argument.

Finally, evidence on the socioeconomic gradient in tobacco use in India needs to be linked to its implications for tobacco-related mortality and morbidity[14-15]. Dikshit et al.[15] provide the first estimates of cancer mortality in India, attributing a major component of age-standardized cancer mortality from lung and oral cancers to high rates of tobacco use in India. Analyses stratifying cancer morbidity and mortality in India by SES have not yet been attempted, and the lack of reliable surveillance data for chronic diseases prevents an exhaustive assessments of the impact of tobacco use on Indian current and future chronic disease burden[22].

This study provides a systematic examination of the socioeconomic patterns in tobacco use in India over time. Data in this analysis comes from the NFHS, which is a large, representative and generalizable survey, providing a comparative picture of tobacco patterns over time. The limitations of this analysis are the following. First, the surveysdata areis cross-sectional, hence limiting scope for causal inference. NFHS does not provide detailed data by type or volume of tobacco. Finally, NFHS is a reproductive health survey where women in the ages of 15-49 years are sampled. Men are sampled in the households of the female sample. This introduces the potential for two downward biases. The first pertains to *social desirability bias* particularly related to underestimation of smoking patterns in women's childbearing years. Second, since the sample of men is conditional on the households from which women were sampled, the pool of men sampled may not be representative. Despite these caveats, NFHS (and in general the demographic and health surveys) has proven to be representative and generalizable, and continues to be used in a number of studies related to tobacco[5-6]. In addition, our findings are consistent with estimates from studies using other surveys assessing the

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burden of tobacco and its drivers in India[2,23]. Tobacco burden in the 'productive' populations (14-50 years) not only represents the current burden of tobacco but may predict future morbidity.

We present empirical evidence that India is experiencing a unique economic and social transition in tobacco consumption, quite distinct from the experience of developed countries that is likely to manifest in a number of morbidities[2,14-15]. In order to ensure policy effectiveness to prevent and reduce the exposure to tobacco, there is a need to systematically monitor and examine the social inequities in tobacco use over time and channel interventions to the social groups that are most vulnerable to these inequalities.

TABLES, FIGURES AND REFERENCES

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Table 1: Prevalence (%) of tobacco smoking, chewing and dual use (smoking and chewing) by wealth, education and caste/tribe status among men and women in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Caste/ tribe status[1]																		
General	(M) 50,939 (F) 50,526	(M) 21,850 (F) 41,844	22.2 (21.4, 22.9)	28.8 (27.7, 29.9)	30	22.2 (21.4,23 .02)	33.2 (31.8, 34.5)	50	7.4 (6.9,7 .8)	10.8 (10. 0,11 .5)	1.0 (0.9, 1.1)	0.8 (0.55, 1.0)	-20	6.6 (6.1, 7.1)	7.24 (6.6,7. 85)	10	0.24 (0.17, 0.3)	0.2 (0.11,0 .27)
SC	(M) 21,491 (F) 21,045	(M) 11,953 (F) 20,566	31.5 (30.5, 32.5)	39.3 (37.8, 40.9)	25	27.8 (26.6, 29.1)	40.5 (38.8, 42.1)	46	12.1 (11.4, 12.8)	15.8 (14. 7,16 .9)	2.3 (1.9,2. 8)	2.4 (2.05,2 .8)	4	10.9 (10.1,11 .8)	12.1 (11.2,1 2.9)	11	0.5 (0.4,0. 7)	0.4 (0.3,0. 6)
ST	(M) 16,187 (F) 16,520	(M) 8,453 (F) 16,518	30.6 (28.8, 32.3)	36.6 (34.1, 39.1)	20	38.6 (36.9, 40.4)	52.6 (49.9, 55.3)	36	14.5, (13.3, 15.6)	18.6 (16. 7,20 .4)	3.0 (2.5,3. 6)	2.7 (2.04,3 .4)	-10	18.5 (17.0,20 .1)	25.08 (22.8,2 7.4)	36	1.0 (0.7,1. 2)	0.9 (0.6,1. 3)
OBC	(M) 36,381 (F) 36,290	(M) 25,144 (F) 29,561	24.7 (23.9, 25.5)	31.2 (30.2, 32.2)	26	25.4 (24.5, 26.3)	36.2 (35.0, 37.5)	43	9.9 (9.4,1 0.5)	13.1 (12. 3,13 .8)	1.5 (1.3,1. 7)	1.4 (1.2,1. 7)	- 7	7.3 (6.8,7.7)	7.08 (6.6,7. 6)	-3	0.3 (0.26,0 .4)	0.14 (0.09,0 .21)
No caste	(M) 6,466 (F) 6,505	(M) 2,355 (F) 5,653	31.8 (29.4, 34.3)	37.9 (34.2, 41.6)	19	23.3 (20.9, 25.6)	35.5 (31.6, 39.3)	52	10.7 (9.3, 12.1)	13.0 (10. 9,15 .2)	1.4 (0.8,1. 9)	0.9 (0.36,1 .48)	-36	10.3 (9.1,11. 6)	12.8 (10.8,1 4.8)	24	0.4 (0.2,0. 6)	0.31 (0.03,0 .59)
Education Level[2]																		
Post graduat e	(M) 3,432 (F) 1,963	(M) 2,920 (F) 3,526	7.6 (6.5, 8.7)	15.05 (13.0 1,17. 1)	98	12.4 (10.8,14 .1)	18.5 (16.0, 21.1)	49	1.7 (1.2,2 .2)	4.04 (3.0, 5.1)	0.2 (- 0.2, 0.6)	0.02 (- 0.007, 0.05)	-90	1.2 (0.45,1. 9)	0.33 (0.14,0 .5)	-73	0.2 (- 0.17,0. 5)	0.004 (- 0.002, 0.012)
College	(M) 11,340 (F) 6,586	(M) 7,811 (F) 9,424	11.1 (10.2, 11.9)	20.7 (19.2, 22.1)	86	14.9 (13.9,15 .8)	23.9 (22.3, 25.6)	60	3.5 (3.1,3 .9)	6.7 (5.8, 7.6)	0.1 (- 0.01,0. 2)	0.11 (0.03, 0.19)	10	1.3 (0.9,1.6)	1.8 (1.4,2. 2)	39	0.05 (- 0.04,0. 14)	0.04 (- 0.017, 0.1)
High school	(M) 69,996 (F) 46,629	(M) 26,100 (F) 34,338	21.2 (20.7,2 1.8)	24.7 (23.8, .25.5)	17	23.3 (22.7,23 .9)	33.1 (32.0, 34.1)	42	7.8 (7.5, 8.2)	9.9 (9.3, 10.6)	0.2 (0.17, 0.3)	0.07 (0.04, 0.1)	-65	4.2 (3.9, 4.6)	3.4 (3.04,3 .7)	-19	0.1 (0.06,0 .13)	0.04(0. 02,0.0 6)
Primary school	(M) 21,730 (F) 20,604	(M) 12,622 (F) 19,451	32.7 (31.7,3 3.6)	35.6 (34.3, 36.9)	1	30.2 (29.2, 31.2)	41.9 (40.5, 43.4)	39	12.1 (11.4, 12.7)	14.8 (13. 8, 15.7)	0.7 (0.5,0. 8)	0.2 (0.13,0 .3)	-71	9.0 (8.4,9.6)	7.4 (6.8,8. 02)	-18	0.18 (0.13,0 .24)	0.07 (0.03,0 .11)

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Illiterate	(M) 24,966 (F) 55,104	(M) 20,302 (F) 57,403	38.9 (37.9,, 39.9)	43.9 (42.8, 45.2)	13	34.4 (33.2,35 .5)	47.1 (45.7, 48.5)	37	(15.9 (15.1, 16.6)	18.9 (17. 9,19 .9)	2.6 (2.4,,2. 9)	2.3 (2.02,2 .6)	-12	11.9 (11.4, 12.6)	13.3 (12.6, 13.0)	12	0.6 (0.53,0 .72)	0.42 (0.33,0 .51)
Wealth Quintiles																		
Richest	(M) 26,291 (F) 26,177	(M) 13,706 (F) 24,837	11.9 (11.2, 12.5)	19.9 (18.8, 21.1)	63	13.7 (12.8,14 .6)	20.4 (19.0, 21.8)	49	3.3 (2.97, 3.6)	5.8 (5.1, 6.4)	0.2 (0.1,0. 3)	0.14 (0.08,0 .2)	-30	2.2 (1.9,2.5)	2.02 (1.7,2. 3)	-8	0.05 (0.01,0 .07)	0.042 (0.009, 0.07)
Richer	(M) 26,293 (F) 26,177	(M) 13,946 (F) 24,837	19.3 (18.5, 20.04)	25.8 (24.6, 27.1)	37	19.0 (18.1,19 .9)	30.2 (28.7, 31.7)	59	5.6 (5.2,6 .02)	9.3 (8.4, 10.2)	0.46 (0.37,0 .54)	0.37 (0.27,0 .47)	-20	5.4 (4.9,5.9)	4.9 (4.4,5. 4)	-9	0.1 (0.07,0 .18)	0.06 (0.02,0 .09)
Middle	(M) 26,294 (F) 26,174	(M) 14,075 (F) 24,826	25.6 (24.7,2 6.4)	31.4 (30.1, 32.7)	25	22.9 (22.0,23 .9)	34.9 (33.4, 36.3)	52	7.6 (7.2,8 .1)	11.5 (10. 6,12 .3)	1.1 (0.9,1. 3)	0.7 (0.6,0. 9)	-36	7.8 (7.2,8.3)	6.9 (6.4,7. 4)	-11	0.23 (0.16,0 .3)	0.07 (0.04,0 .11)
Poorer	(M) 26,293 (F) 26,179	(M) 14,007 (F) 24,814	30.6 (29.7,3 1.5)	36.5 (35.2, 37.8)	21	28.9 (28.0,29 .9)	39.5 (38.0 3,40. 9)	37	11.6 (10.9, 12.2)	14.5 (13. 6,15 .5)	1.7 (1.5,1. 9)	1.7 (1.4,1. 9)	0	10.9, (10.3,11 .6)	10.5 (9.8,12 .2)	-4	0.4 (0.3,0. 5)	0.24 (0.17,0 .31)
Poorest	(M) 26,293 (F) 26,179	(M) 14,021 (F) 24,828	35.5 (34.4,, 36.5)	40.6, 39.3, 41.9)	13	36.8 (35.7,37 .9)	49.7 (48.2, 51.2)	35	16.7 (15.9, 17.5)	19.4 (18. 4,20 .5)	3.5 (3.1,3. 9)	3.2 (2.8,3. 7)	-9	14.1 (13.3,15 .0)	17.1 (16.03, 18.1)	21	0.9 (0.7,1. 0)	0.7 (0.52,0 .86)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142																

[1]Scheduled *c*astes and scheduled tribes are identified by the Government of India as socially and economically backward and needing protection from social injustice and exploitation. Other backward class is a diverse collection of intermediate castes that were considered low in the traditional caste hierarchy but are clearly above scheduled castes. General is thus a default residual group that enjoys higher status in the caste hierarchy.

[2] Post graduate:15 or more years of education; college: 13-15 years of education; high school: 8-12 years of education; secondary: 5-8 years of education; primary: 0-5 years of education; illiterate: 0 years of education

*Percentage change (**% Δ)** numbers have been rounded to the nearest integer.

*All results for prevalence are survey adjusted and age-standardised. Prevalence results are all in percentages.

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Table 2: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among men and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.37 (1.32,1.43)	1.51 (1.44,1.59)	1.37 (1.31,1.42)	1.36 (1.3,1.41)	1.37 (1.31,1.42)	1.43 (1.38,1.48)	1.33 (1.27,1.4)	1.42 (1.36,1.47)	1.42 (1.36,1.47)	1.41 (1.36,1.47)
Middle	1.71 (1.64,1.78)	1.99 (1.89,2.1)	1.71 (1.64,1.78)	1.68 (1.61,1.75)	1.7 (1.63,1.77)	1.75 (1.68,1.82)	1.63 (1.55,1.72)	1.73 (1.66,1.8)	1.72 (1.65,1.8)	1.72 (1.65,1.79)
Poorer	2.06 (1.97,2.16)	2.51 (2.37,2.65)	2.05 (1.96,2.14)	2.02 (1.93,2.11)	2.04 (1.95,2.14)	1.92 (1.84,2.01)	1.77 (1.67,1.87)	1.89 (1.8,1.97)	1.86 (1.78,1.95)	1.87 (1.79,,1.96)
Poorest	2.33 (2.22,2.46)	2.88 (2.72,3.06)	2.31 (2.19,2.43)	2.29 (2.18,2.41)	2.3 (2.19,2.42)	2.1 (1.99,2.2)	1.93 (1.82,2.05)	2.03 (1.92,2.13)	2.03 (1.932.13)	2.02 (1.93,2.12)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.38 (1.28,1.49)	1.41 (1.31,1.53)	1.34 (1.19,1.5)	1.4 (1.29,1.51)	1.4 (1.3,1.51)	1.26 (1.17,1.36)	1.28 (1.19,1.39)	1.14 (1.02,1.27)	1.29 (1.19,1.39)	1.29 (1.2,1.39)
High School	1.81 (1.69,1.95)	1.91 (1.78,2.05)	2.16 (1.95,2.4)	1.87 (1.74,2.01)	1.87 (1.74,2.01)	1.53 (1.43,1.65)	1.64 (1.53,1.76)	1.46 (1.33,1.61)	1.65 (1.54,1.77)	1.66 (1.54,1.78)
Primary	2.73 (2.54,2.94)	2.81 (2.61,3.04)	3.4 (3.05,3.78)	2.77 (2.57,2.99)	2.77 (2.57,2.99)	1.98 (1.84,2.13)	2.04 (1.9,2.2)	1.84 (1.66,2.04)	2.05 (1.9,2.21)	2.06 (1.91,2.21)
No education	3.18 (2.96,3.43)	3.27 (3.03,3.53)	4.07 (3.66,4.53)	3.19 (2.96,4.34)	3.18 (2.95,3.42)	2.09 (1.94,2.26)	2.06 (1.91,2.22)	1.93 (1.74,2.14)	2.07 (1.92,2.23)	2.08 (1.93,2.24)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.77 (0.72,0.82)	0.81 (0.76,0.87)	0.8 (0.74,0.85)	0.82 (0.75,0.9)	0.79 (0.74,0.84)	0.96 (0.89,1.02)	1.02 (0.96,1.09)	1.02 (0.96,1.09)	1.06 (0.97,1.16)	1.03 (0.97,1.1)
Town	0.78 (0.74,0.82)	0.83(0.79,0.88)	0.81(0.77,0.85)	0.88 (0.82,0.95)	0.81 (0.77,0.85)	0.92 (0.87,0.97)	1.01 (0.95,1.06)	1.01 (0.95,1.06)	1.06 (0.98,1.15)	1.01 (0.96,1.07)
Village	0.68 (0.65,0.71)	0.75 (0.71,0.78)	0.73 (0.7,0.77)	0.87 (0.82,0.92)	0.73 (0.7,0.76)	0.76 (0.73,0.79)	0.92 (0.88,0.96)	0.92 (0.88,0.96)	0.93 (0.88,0.99)	0.93 (0.88,0.97)

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Caste/Tribe (Other)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SC	1.16 (1.12,1.2)	1.15 (1.11,1.19)	1.15 (1.11,1.18)	1.15 (1.11,1.19)	1.16 (1.11,1.21)	1.12 (1.08,1.15)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.13)	1.1 (1.06,1.14)
ST	1.14 (1.09,1.2)	1.13 (1.08, 1.2)	1.14 (1.08,1.18)	1.14 (1.09,1.2)	1.15 (1.09,1.21)	3.02 (2.88,3.15)	1.1 (1.06,1.15)	1.1 (1.05,1.15)	1.1 (1.05,1.15)	1.17 (1.11,1.24)
OBC	1.00 (0.98,1.04)	0.99 (0.97,1.02)	0.99 (0.96,1.02	0.99 (0.97,1.02)	1.03 (0.99,1.07)	1.05 (1.02,1.08)	1.01 (0.97,1.03)	1.002 (0.97,1.03)	1.003 (0.97,1.03)	1.04 (0.99,1.07)
No Caste or missing	1.06 (1.01,1.13)	1.07 (1.01,1.13)	1.07 (1.01,1.13)	1.08 (1.02,1.14)	1.05 (0.98,1.13)	0.97 (0.92,1.03)	1.02 (0.96,1.08)	1.01 (0.96,1.08)	1.02 (0.96,1.08)	0.97 (0.9,1.04)
Survey Year (Yr)		1.74 (1.7,1.88)	1.67 (1.46,1.91)	1.49 (1.4,1.58)	1.24 (1.19,1.3)		1.47 (1.38,1.56)	1.34 (1.17,1.54)	1.69 (1.58,1.8)	1.72 (1.65,1.79)
Yr *Richer		0.78 (0.73,0.84)					1.15 (1.07,1.24)			
Yr*Middle		0.68 (0.63,0.73)					1.13 (1.05,1.22)			
Yr *Poorer		0.60 (0.56,0.65)					1.15 (1.07,1.24)			
Yr *Poorest		0.58 (0.53,0.62)					1.11 (1.03, 1.2)			
Yr *College			1.13 (0.97,1.32)					1.27 (1.1,1.48)		
Yr * High School			0.78 (0.68,0.89)					1.28 (1.11,1.47)		
Yr * Primary			0.66 (0.57,0.77)					1.02 (0.88,,1.18)		
Yr * No education			0.61 (0.53,0.70)					1.01 (0.87,1.17)		
Yr *Small City				0.99 (0.87,1.12)					0.94 (0.82,1.06)	
Yr * Town				0.89 (0.81,0.98)					0.9 (0.82,0.99)	
Yr * Village				0.73 (0.68,0.79)					0.98 (0.91,1.05)	
Yr *SC					0.99 (0.92,1.05)					0.99 (0.93,1.06)
Yr *ST					0.97 (0.9,1.05)					0.84 (0.78,0.91)
Yr*OBC					0.92 (0.87,0.97)					0.92 (0.87,0.97)
Yr*No Caste					1.07 (0.94,1.21)					1.15 (1.02,1.29)

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Fixed Part of the Model										
Joint Chi Test for Interaction (p-value)		174.31 (p<0.001)	13.31 (p=0.009)	13.44 (p=0.003)	0.318 (p=0.98)		15.63 (p=0.003)	8.52 (p=0.074)	2.6 (p=0.46)	1.387 (p=0.85)
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)	12.82 (p=0.003)		12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)	12.89 (p=0.0003)
Chi square for Level 2: Local Area (p-value)		650.41 (p<0.001)	655.7 (p<0.001)	654.2 (p<0.001)	660.7 (p<0.001)		801.6 (p<0.001)	802.4 (p<0.001)	802.4 (p<0.001)	801.7 (p<0.001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Table 3: Pooled Regression Models showing Odds Ratios (95% CIs) for Smoking and Chewing among women and interactions for wealth, education, residence and caste over time.

	Smoking					Chewing				
Covariates	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste	Model1: Full Model	Model 2: Interaction with Wealth	Model 3: Interaction with Education	Model 4: Interaction with Living Environment	Model 5: Interaction with Caste
Wealth Quintiles (Richest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Richer	1.48 (1.28,1.71)	1.82 (1.49,2.22)	1.48 (1.28,1.71)	1.48 (1.28,1.71)	1.49 (1.29,1.72)	1.48 (1.41,1.56)	1.41 (1.32,1.51)	1.48 (1.4,1.55)	1.51 (1.43,1.59)	1.48 (1.41,1.56)
Middle	1.9 (1.64,2.19)	2.63 (2.17,3.19)	1.87 (1.62,2.16)	1.88 (1.62,2.18)	1.9 (1.64,2.19)	1.75 (1.66,1.85)	1.58 (1.47,1.7)	1.75 (1.65,1.84)	1.81 (1.72,1.92)	1.76 (1.66,1.85)
Poorer	2.75 (2.37,3.19)	3.72 (3.07,5.52)	2.8 (2.41,3.25)	2.81 (2.42,3.26)	2.85 (2.45,3.30)	2.14 (2.02,2.27)	1.86 (1.72,2.002)	2.13 (2.01,2.25)	2.2 (2.07,2.32)	2.14 (2.02,2.27)
Poorest	3.95 (3.39,4.6)	4.83 (3.97,5.88)	4.03 (3.46,4.69)	4.05 (3.47,4.72)	4.08 (3.5,4.75)	2.67 (2.5,2.84)	2.14 (1.99,2.32)	2.65 (2.49,2.82)	2.7 (2.54,2.88)	2.7 (2.5,2.84)
Education (Post graduate)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
College	1.59 (0.91,2.8)	1.61 (0.92,2.82)	0.98 (0.37,2.58)	1.58 (0.9,2.78)	1.57 (0.9,2.75)	1.84 (1.55,2.19)	1.83 (1.54,2.17)	1.1 (0.85,1.42)	1.82 (1.53,2.17)	1.84 (1.55,2.19)
High School	1.78 (1.06,2.99)	1.67 (1.01,,2.82)	1.95 (0.83,4.56)	1.62 (0.96,2.72)	1.61 (0.99,2.7)	2.19 (1.86,2.57)	2.13 (1.82,2.51)	1.47 (1.17,1.85)	2.15 (1.82,2.54)	2.21 (1.88,2.6)
Primary	2.78 (1.66,4.68)	2.62 (1.56,4.41)	3.32 (1.42,7.76)	2.54 (1.51,4.29)	2.52 (1.5,4.24)	2.87 (2.44,3.4)	2.83 (2.4,3.33)	2.03 (1.61,2.56)	2.86 (2.42,3.37)	2.89 (2.45,3.41)
No education	4.78 (2.84,8.04)	4.91 (2.93,8.23)	6.89 (2.53,13.73)	4.72 (2.81,7.93)	4.66 (2.77,7.81)	3.85 (3.27,4.53)	3.75 (3.19,4.42)	2.58 (2.04,3.24)	3.8 (3.22,4.48)	3.85 (3.27,4.53)
Living Environment (Large city)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Small City	0.91 (0.75,1.09)	0.98 (0.82, 1.17)	1.01 (0.84,1.21)	0.78 (0.58,1.04)	1.004 (0.84,1.2)	1.23 (1.13,1.32)	1.25 (1.15,1.35)	1.22 (1.13,1.32)	0.97 (0.86,1.1)	1.2 (1.11,1.29)
Town	1.19 (1.03,1.37)	1.2 (1.04,1.38)	1.22 (1.05,1.4)	1.31 (1.06,1.62)	1.23 (1.1,1.41)	1.36 (1.27,1.45)	1.37 (1.29,1.47)	1.36 (1.27,1.45)	0.95 (0.86,1.04)	1.34 (1.25,1.43)
Village	1.4 (1.24,1.59)	1.28 (1.13,1.46)	1.31 (1.16,1.49)	1.37 (1.14,1.66)	1.32 (1.16,1.49)	1.07 (1.01,1.14)	1.09 (1.02,1.16)	1.08 (1.02,1.15)	0.69 (0.64,0.75)	1.07 (1.005,1.13)
Caste/Tribe	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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(Other)										
SC	1.5 (1.39,1.62)	1.55 (1.43,1.67)	1.54 (1.43,1.67)	1.54 (1.43,1.67)	1.4 (1.27,1.55)	1.28 (1.23,1.33)	1.28 (1.23,1.36)	1.28 (1.23,1.33)	1.29 (1.24,1.34)	1.28 (1.22,1.35)
ST	2.04 (1.86,2.24)	2.11 (1.92, 2.3)	2.11 (1.93,2.31)	2.11 (1.93,2.31)	1.99 (1.79,2.23)	1.53 (1.46,1.6)	1.53 (1.46,1.61)	1.53 (1.46,1.61)	1.52 (1.45,1.6)	1.48 (1.39,1.58)
OBC	1.11 (1.03,1.2)	1.17 (1.08,1.26)	1.16 (1.08,1.26)	1.16 (1.08,1.25)	1.13 (1.03,1.24)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.03 (0.99,1.07)	1.06 (1.02,1.12)
No Caste or missing	0.7 (0.6,0.81)	0.74 (0.64,0.86)	0.72 (0.62,0.85)	0.73 (0.62,0.85)	1.01 (0.85,1.2)	1.02 (0.95,1.09)	1.02 (0.96,1.09)	1.02 (0.95,1.09)	1.01 (0.95,1.08)	0.92 (0.85,1.01)
Survey Year (Yr)		1.004 (0.98,1.03)	0.89 (0.31,2.56)	0.67 (0.55,0.83)	0.57 (0.51,0.63)		0.81 (0.75,0.87)	0.54 (0.4,0.74)	0.52 (0.47,0.56)	1.02 (0.97,1.07)
Yr*Richer		0.66 (0.5,0.87)					1.09 (0.99,1.21)			
Yr*Middle		0.47 (0.36,0.61)					1.21 (1.1,1.34)			
Yr *Poorer		0.56 (0.44,0.72)					1.3 (1.18,1.43)			
Yr *Poorest		0.71 (0.56,0.91)					1.5 (1.37,1.64)			
Yr *College			1.98 (0.6,6.52)					2.26 (1.6,3.21)		
Yr * High School			0.77 (0.26,2.22)					1.94 (1.41,2.67)		
Yr * Primary			0.61 (0.21,1.75)					1.74 (1.27,2.4)		
Yr * No education			0.7 (0.24,2.0)					1.94 (1.41,2.66)		
Yr*Small City				1.44 (0.99,2.07)					1.61 (1.38,1.88)	
Yr * Town				0.89 (0.68,1.16)					1.94 (1.72,2.19)	
Yr * Village				0.92 (0.74,1.15)					2.26 (2.06,2.48)	
Yr *SC					1.29 (1.11,1.51)					0.99 (0.93,1.07)
Yr *ST					1.16 (0.99,1.36)					1.07 (0.98,1.16)
Yr*OBC					1.1 (0.96,1.27)					0.95 (0.89,1.01)
Yr*No Caste					0.45 (0.32,0.63)					1.22 (1.07,1.38)
Fixed Part of the Model										
Overall Chi for Interaction (p-		19.128 (p<0.001)	0.041 (p=0.99)	50.195 (p<0.001)	0.992 (p=0.91)		31.96 (p<0.0001)	17.42 (p=0.001)	157.008 (p<0.0001)	2.665 (p=0.615)

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value)										
Random Part of the Model										
Chi square for Level 3: State (p-value)		12.91 (p=0.011)	12.91 (p=0.011)	12.91 (p=0.004)	12.91 (p=0.011)		12.94 (p=0.011)	12.94 (p=0.011)	12.94 (p=0.004)	12.94 (p=0.011)
Chi square for Level 2: Local Area (p-value)		260.98 (p<0.001)	266.3 (p<0.001)	264.9 (p<0.001)	263.5 (p<0.001)		844.91 (p<0.0001)	839.3 (p<0.0001)	824.92 (p<0.0001)	837.64 (p<0.0001)

*Models are controlled for age (centered at 29 years), marital status and religion

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Web Table 1: Prevalence (%) of tobacco smoking, chewing and dual use (smoking and chewing) by living environment, age, religion and marital status among men and women in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Area of residence[1]																		
Large city	(M) 17,640 (F) 16,081	(M) 19,092 (F) 26,272	17.7 (16.6, 18.9)	27.2 (25.7, 28.8)	54	19.1 (17.4,21 .1)	30.3 (28.2, 32.5)	59	6.05 (5.4,6 .8)	10.2 (9.2, 11.3)	0.3(0.2 , 0.4)	0.4 (0.3,0. 6)	33	5.8 (4.9,6.9)	4.9 (4.1,5. 9)	-16	0.09 (0.06,0 .14)	0.055 (0.03,0 .1)
Small city	(M) 8,957 (F) 8,573	(M) 4,723 (F) 9,318	18.3 (16.4,2 0.2)	28.8 (26.5, 31.2)	57	19.4 (17.1, 22.0)	34.2 (31.1, 37.4)	76	5.8 (4.95, 6.8)	10.9 (9.6, 12.5)	0.3 (0.2,0. 5)	0.5 (0.35,0 .7)	67	5.9 (4.8,7.1)	6.6 (5.5,8. 1)	12	0.06 (0.03,0 .14)	0.09 (0.04,0 .2)
Town	(M) 18,837 (F) 18,803	(M) 12,078 (F) 21,256	19.9 (18.6,2 1.2)	30.3 (28.4, 32.2)	52	20.6 (18.7,22 .5)	31.1 (28.6, 33.7)	51	6.3 (5.6,7 .1)	10.5 (9.4, 11.7)	0.6 (0.5,0. 8)	0.6 (0.4,0. 8)	0	6.7 (5.8,7.8)	7.2 (6.1,8. 4)	8	0.2 (0.15,0 .3)	0.1 (0.07,0 .2)
Village	(M) 86,030 (F) 87,429	(M) 33,862 (F) 67,296	28.9 (28.2,2 9.6)	35.2 (34.2, 36.2)	22	28.2 (27.4,28 .9)	40.9 (39.8, 41.9)	45	11.4 (10.9, 11.8)	15.0 2 (14. 3,15 .7)	2.04 (1.85,2 .24)	1.98 (1.75,2 .24)	-3	9.8 (9.3,10. 3)	11.3 (10.6,1 1.9)	15	0.5 (0.43,0 .6)	0.4 (0.3,0. 5)
Age-groups																		
15-24	(M) 50,266 (F) 52,299	(M) 25,511 (F) 46,688	8.6 (8.2, 9.1)	19.2 (18.4, 20.1)	12 3	14.3 (13.7, 14.9)	30.3 (29.2 7,31. 4)	11 2	3.5 (3.3,3 .8)	9.45 (8.9, 10.1)	0.4 (0.31,0 .45)	0.3 (0.21,0 .36)	-25	3.1 (2.8,3.3)	4.4 (3.99,4 .7)	42	0.098 (0.07,0 .14)	0.08 (0.05,0 .13)
25-34	(M) 38,650 (F) 40,764	(M) 20,794 (F) 38,441	29.1 (28.3, 29.9)	36.3 (35.2, 37.4)	25	29.9 (29.1, 30.7)	43.1 (41.9, 44.3)	44	11.5 (10.9, 12.0)	16.0 (15. 2,16 .8)	1.4 (1.26,1 .62)	1.3 (1.1,1. 56)	-7	9.0 (8.5,9.5)	10.1 (9.45,1 0.7)	12	0.33 (0.27,0 .4)	0.23 (0.2,0. 3)
35-49	(M) 42,548 (F) 37,823	(M) 23,450 (F) 39,013	43.4 (42.5, 44.2)	44.1 (42.9, 45.2)	1.6	35.3 (34.4, 36.2)	40.2 (39.0 2,41. 3)	14	15.7 (15.1, 16.3)	15.2 (14. 4,16 .01)	3.4 (3.1,3. 8)	3.2 (2.84,3 .57)	-6	16.5 (15.8,17 .3)	15.7 (14.9,1 6.4)	-5	0.9 (0.76,1 .02)	0.6 (0.5,0. 7)
Marital Status																		
Currentl y married	(M) 77,233 (F) 95,398	(M) 40,529 (F) 87,754	36.9 (36.2,3 7.6)	40.6 (39.7, 41.5)	10	33.7 (32.9, 34.4)	42.9 (41.9, 43.9)	27	13.9 (13.5, 14.4)	15.9 (15. 3,16 .6)	1.8 (1.6, 1.94)	1.8 (1.6,2. 02)	0	9.8 (9.3,10. 3)	10.9 (10.4,1 1.5)	11	0.43 (0.37,0 .5)	0.3 (0.26,0 .4)

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Single	(M) 52,443 (F) 29,623	(M) 28,377 (F) 30,606	7.6 (7.3, 8.04)	18.9 (18.2, 19.7)	14 9	12.5 (11.9,12 .9)	27.4 (26.4, 28.4)	11 9	2.9 (2.7,3 .2)	8.6 (8.1, 9.2)	0.3 (0.22,0 .4)	0.09 (0.06,0 .14)	-70	1.9 (1.8,2.2)	2.8 (2.5,3. 2)	47	0.12 (0.08,0 .18)	0.03 (0.01,0 .06)
Widowe d	(M) 1,070 (F) 4,038	(M) 415 (F) 3,909	48.7 (45.1,5 2.3)	50.1 (43.9, 56.3)	2.8	41.6 (38.0,45 .3)	59.5 (53.2, 65.6)	43	19.5 (16.8, 22.5)	23.7 (18. 7,29 .6)	4.7 (3.86, 5.6)	3.5 (2.78,4 .3)	-26	21.3 (19.7,22 .9)	18.5 (16.9,2 0.2)	-13	1.4 (1.05,1 .89)	0.9 (0.6,1. 4)
Divorce d/ separat ed	(M) 718 (F) 1,827	(M) 434 (F) 1,873	41.7 (37.2,4 6.4)	46.6 (39.9, 53.3)	12	33.4 (29.01, 38.1)	55.9 (49.0 3,62. 7)	67	15.7 (12.5, 19.5)	25.2 (19. 7,31 .6)	2.5 (1.8,3. 6)	1.6 (1.01,2 .6)	-36	18.1 (15.9,20 .6)	18.6 (16.4, 21.01)	3	0.31 (0.13,0 .75)	0.6 (0.3,1. 2)
***Religion*[2]**																		
Hindu	(M) 100,339 (F) 99,430	(M) 51,174 (F) 89,888	26.1 (25.5,2 6.7)	33.01 (32.2, 33.8)	27	26.6 (26.0, 27.3)	38.2 (37.3, 39.1)	44	10.2 (9.8,1 0.5)	13.7 (13. 2,14 .3)	1.5 (1.4,1. 7)	1.5 (1.35,1 .7)	0	8.8 (8.3,9.2)	9.6 (9.1,10 .2)	9	0.37 (0.31,0 .43)	0.25 (0.2,0. 3)
Muslim	(M) 16,278 (F) 16,215	(M) 9,145 (F) 16,731	28.3 (26.7,2 9.9)	36.2 (34.3, 38.2)	28	23.4 (21.7,25 .1)	37.4 (35.0 2,39. 8)	60	9.5 (8.7,1 0.5)	13.1 (11. 9,14 .5)	1.9 (1.6,2. 3)	1.73 (1.25,2 .4)	-9	9.1 (8.3,9.9)	9.9 (8.9,10 .9)	9	0.5 (0.37,0 .7)	0.4 (0.3,0. 7)
Christia n	(M) 8,055 (F) 8,547	(M) 6,250 (F) 10,974	28.2 (25.9,3 0.5)	33.1 (29.9, 36.4)	17	17.5 (15.1, 20.1)	29.1 (25.0 1,33. 5)	66	8.2 (6.9,9 .6)	12.7 (10. 4,15 .5)	2.4 (1.7,3. 3)	1.3 (0.98,1 .62)	-46	9.9 (8.4,11. 6)	10.7 (9.1,12 .5)	8	0.98 (0.72,1 .33)	0.6 (0.5,0. 7)
Others	(M) 6,792 (F) 6,694	(M) 3,186 (F) 6,549	11.1 (9.5,12 .8)	16.2 (14.2, 18.4)	46	19.3 (17.1,21 .7)	26.0 (23.1, 29.2)	35	4.4 (3.4,5 .6)	6.5 (5.2, 8.0)	0.6 (0.4, 0.9)	0.4 (0.2,0. 65)	-33	7.5 (5.8,9.6)	7.6 (6.2,9. 4)	1	0.27 (0.13,0 .55)	0.2 (0.1,0. 6)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142																

[1]Large city: urban population ≥1 million; Small city: 100000-1 million; Town: ≤100000 million
[2]Others include Sikh, Buddhist, Jain, Jewish, Zoroastrian and Others
*Percentage change (**% Δ)** numbers have been rounded to the nearest integer. Estimates are not age-standardized

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Figure 1: Percentage change in smoking among men and women by education level and wealth quintiles

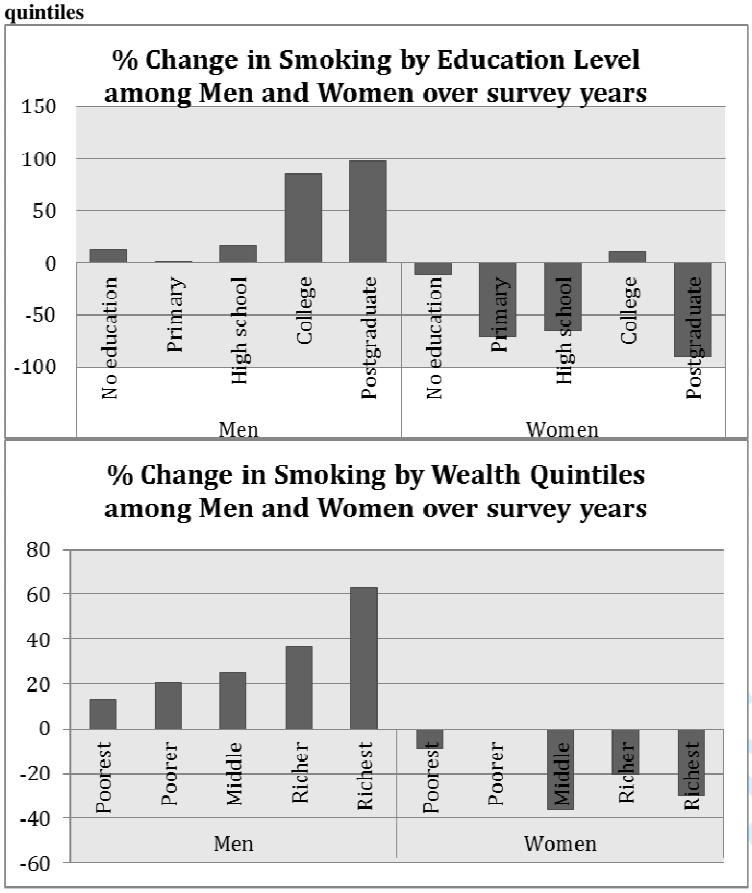

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Figure 2: Percentage change in chewing among men and women by education level and wealth quintiles

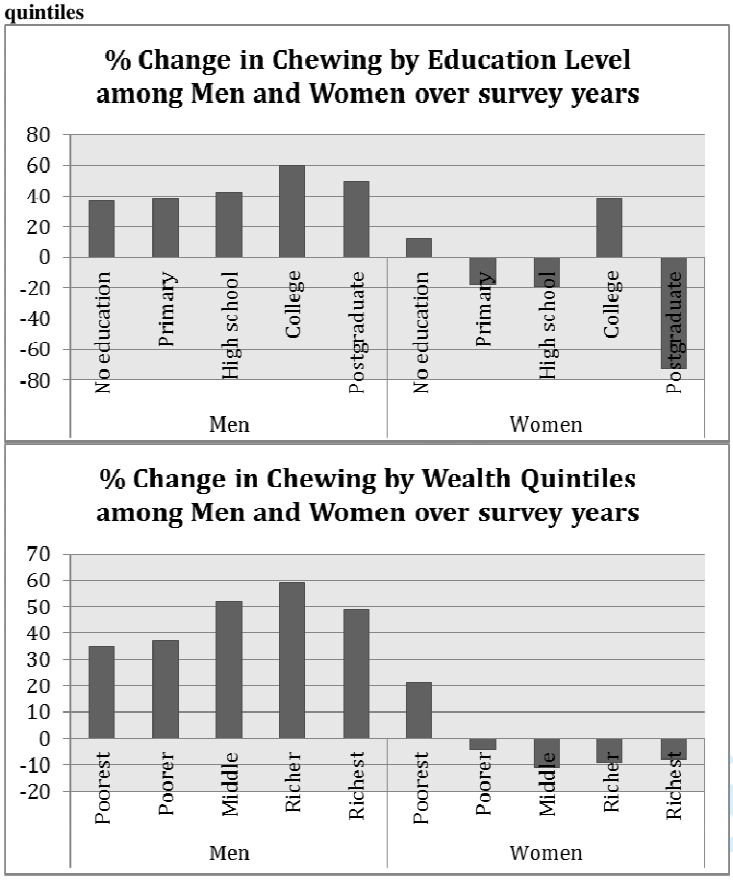

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Figure 3: Probability of smoking and chewing among men and women by education and wealth

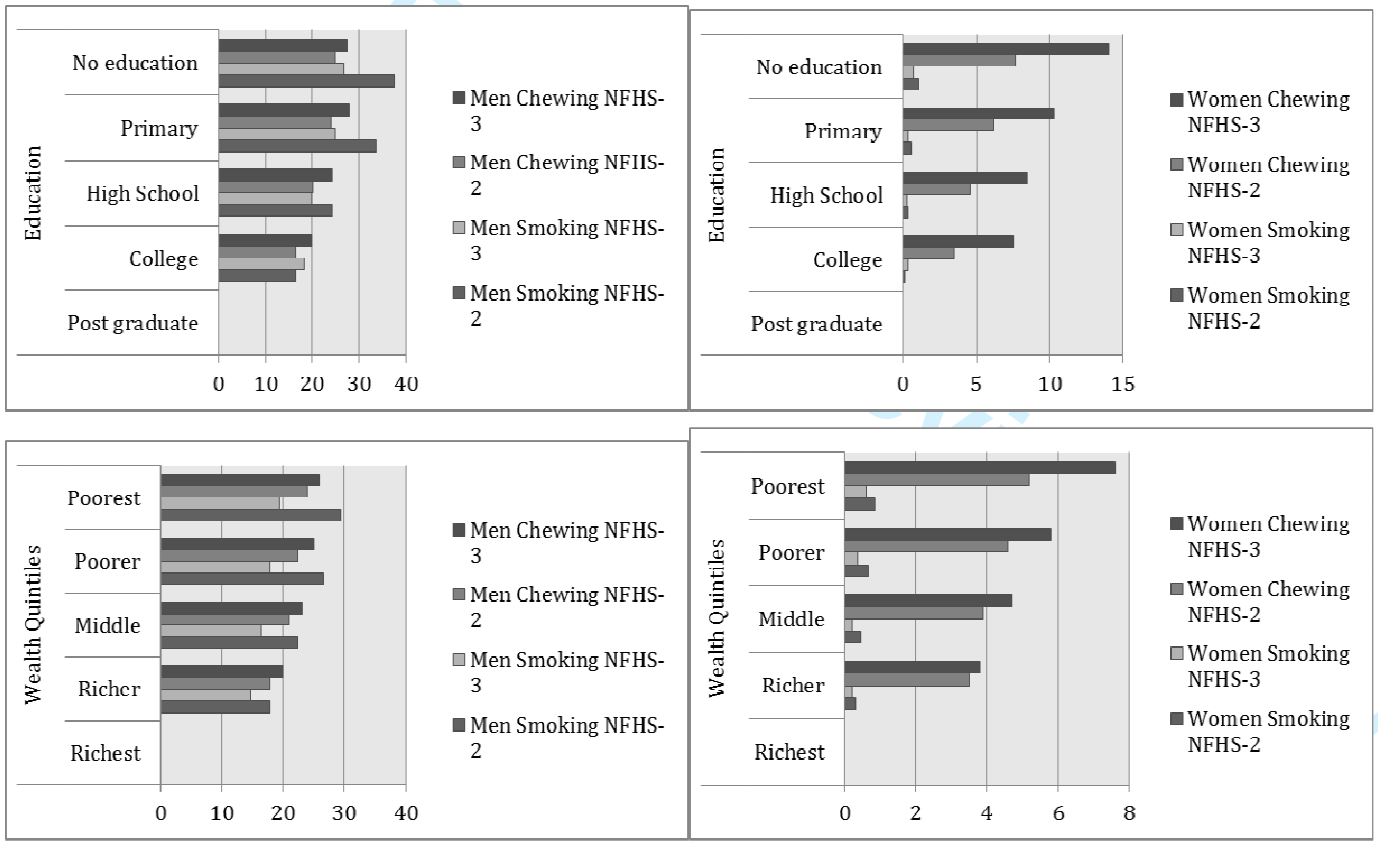

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Figure 1: Percentage change in smoking among men and women by education level and wealth quintiles

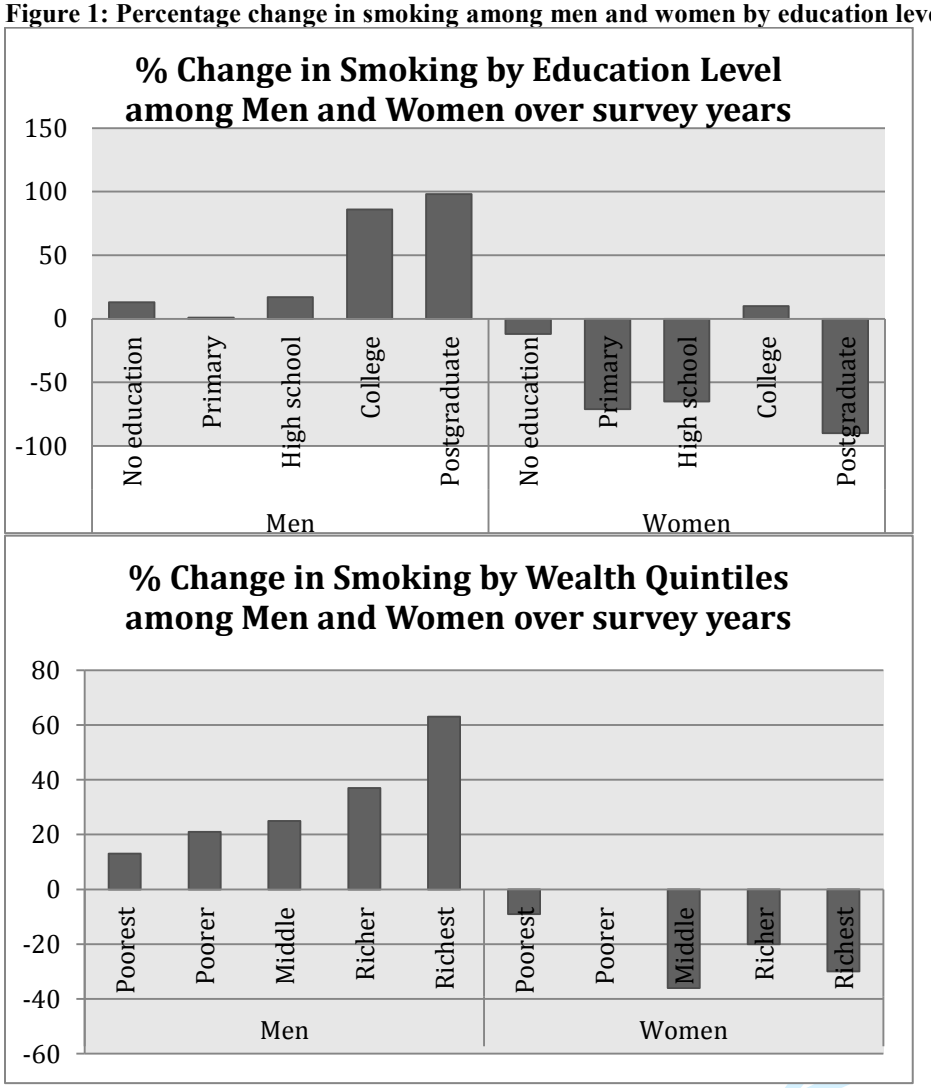

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Figure 2: Percentage change in chewing among men and women by education level and wealth quintiles

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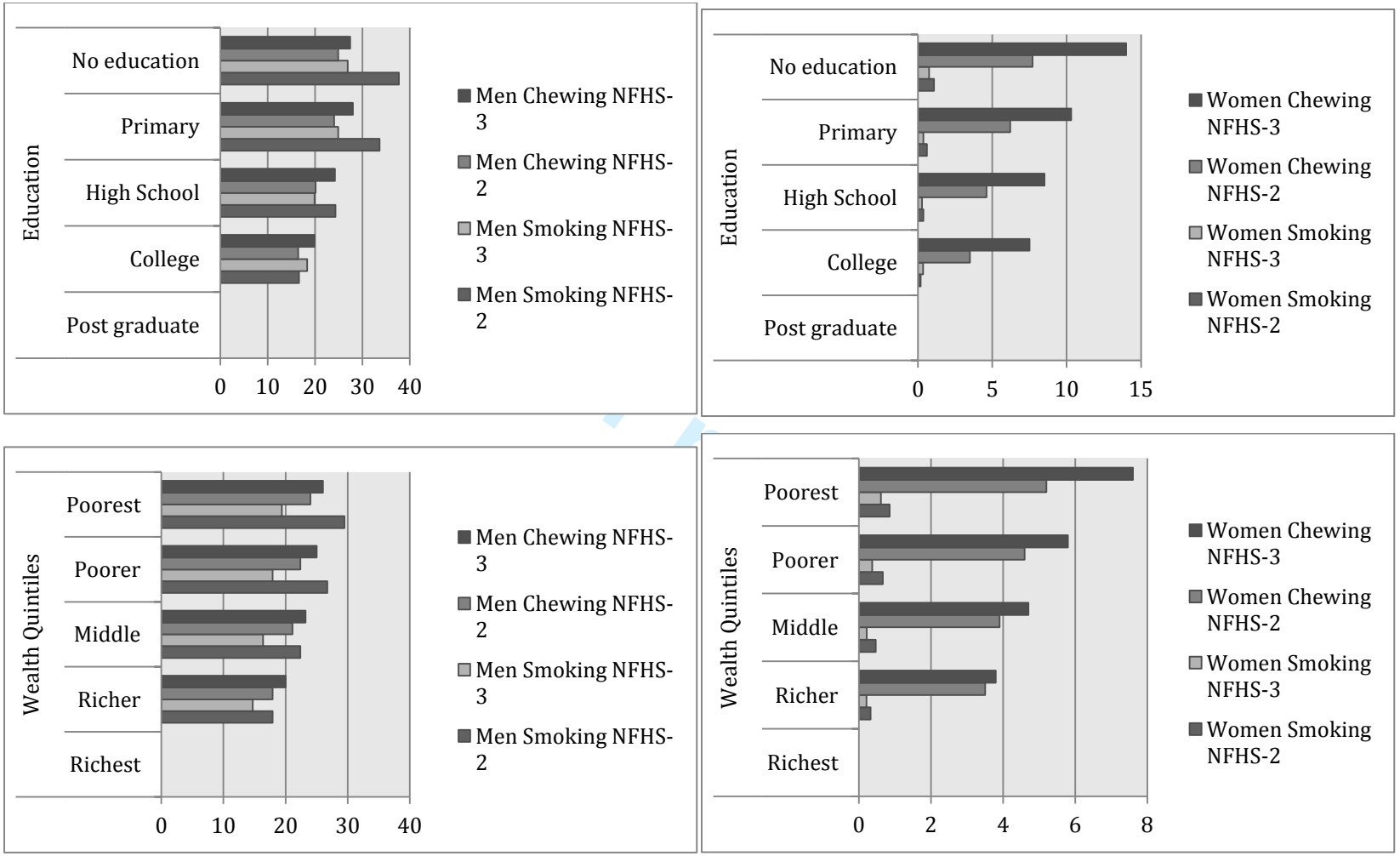
Figure 3: Probability of smoking and chewing among men and women by education and wealth



Web Table 1: Prevalence (%) of tobacco smoking, chewing and dual use (smoking and chewing) by living environment, age, religion and marital status among men and women in the National Family Health Surveys 1998-99 and 2005-6

			MEN								FEMALE							
	Sample Population		SMOKE			CHEW			DUAL		SMOKE			CHEW			DUAL	
	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6	1998-9	2005-6	% Δ	1998-9	2005-6	% Δ	1998-9	2005-6
Area of residence[1]																		
Large city	(M) 17,640 (F) 16,081	(M) 19,092 (F) 26,272	17.7 (16.6, 18.9)	27.2 (25.7, 28.8)	54	19.1 (17.4,21 .1)	30.3 (28.2, 32.5)	59	6.05 (5.4,6 .8)	10.2 (9.2, 11.3)	0.3(0.2 , 0.4)	0.4 (0.3,0. 6)	33	5.8 (4.9,6.9)	4.9 (4.1,5. 9)	-16	0.09 (0.06,0 .14)	0.055 (0.03,0 .1)
Small city	(M) 8,957 (F) 8,573	(M) 4,723 (F) 9,318	18.3 (16.4,2 0.2)	28.8 (26.5, 31.2)	57	19.4 (17.1, 22.0)	34.2 (31.1, 37.4)	76	5.8 (4.95, 6.8)	10.9 (9.6, 12.5)	0.3 (0.2,0. 5)	0.5 (0.35,0 .7)	67	5.9 (4.8,7.1)	6.6 (5.5,8. 1)	12	0.06 (0.03,0 .14)	0.09 (0.04,0 .2)
Town	(M) 18,837 (F) 18,803	(M) 12,078 (F) 21,256	19.9 (18.6,2 1.2)	30.3 (28.4, 32.2)	52	20.6 (18.7,22 .5)	31.1 (28.6, 33.7)	51	6.3 (5.6,7 .1)	10.5 (9.4, 11.7)	0.6 (0.5,0. 8)	0.6 (0.4,0. 8)	0	6.7 (5.8,7.8)	7.2 (6.1,8. 4)	8	0.2 (0.15,0 .3)	0.1 (0.07,0 .2)
Village	(M) 86,030 (F) 87,429	(M) 33,862 (F) 67,296	28.9 (28.2,2 9.6)	35.2 (34.2, 36.2)	22	28.2 (27.4,28 .9)	40.9 (39.8, 41.9)	45	11.4 (10.9, 11.8)	15.0 2 (14. 3,15 .7)	2.04 (1.85,2 .24)	1.98 (1.75,2 .24)	-3	9.8 (9.3,10. 3)	11.3 (10.6,1 1.9)	15	0.5 (0.43,0 .6)	0.4 (0.3,0. 5)
Age-groups																		
15-24	(M) 50,266 (F) 52,299	(M) 25,511 (F) 46,688	8.6 (8.2, 9.1)	19.2 (18.4, 20.1)	12 3	14.3 (13.7, 14.9)	30.3 (29.2 7,31. 4)	11 2	3.5 (3.3,3 .8)	9.45 (8.9, 10.1)	0.4 (0.31,0 .45)	0.3 (0.21,0 .36)	-25	3.1 (2.8,3.3)	4.4 (3.99,4 .7)	42	0.098 (0.07,0 .14)	0.08 (0.05,0 .13)
25-34	(M) 38,650 (F) 40,764	(M) 20,794 (F) 38,441	29.1 (28.3, 29.9)	36.3 (35.2, 37.4)	25	29.9 (29.1, 30.7)	43.1 (41.9, 44.3)	44	11.5 (10.9, 12.0)	16.0 (15. 2,16 .8)	1.4 (1.26,1 .62)	1.3 (1.1,1. 56)	-7	9.0 (8.5,9.5)	10.1 (9.45,1 0.7)	12	0.33 (0.27,0 .4)	0.23 (0.2,0. 3)
35-49	(M) 42,548 (F) 37,823	(M) 23,450 (F) 39,013	43.4 (42.5, 44.2)	44.1 (42.9, 45.2)	1.6	35.3 (34.4, 36.2)	40.2 (39.0 2,41. 3)	14	15.7 (15.1, 16.3)	15.2 (14. 4,16 .01)	3.4 (3.1,3. 8)	3.2 (2.84,3 .57)	-6	16.5 (15.8,17 .3)	15.7 (14.9,1 6.4)	-5	0.9 (0.76,1 .02)	0.6 (0.5,0. 7)
Marital Status																		
Currentl y married	(M) 77,233 (F) 95,398	(M) 40,529 (F) 87,754	36.9 (36.2,3 7.6)	40.6 (39.7, 41.5)	10	33.7 (32.9, 34.4)	42.9 (41.9, 43.9)	27	13.9 (13.5, 14.4)	15.9 (15. 3,16 .6)	1.8 (1.6, 1.94)	1.8 (1.6,2. 02)	0	9.8 (9.3,10. 3)	10.9 (10.4,1 1.5)	11	0.43 (0.37,0 .5)	0.3 (0.26,0 .4)
Single	(M) 52,443 (F) 29,623	(M) 28,377 (F) 30,606	7.6 (7.3, 8.04)	18.9 (18.2, 19.7)	14 9	12.5 (11.9,12 .9)	27.4 (26.4, 28.4)	11 9	2.9 (2.7,3 .2)	8.6 (8.1, 9.2)	0.3 (0.22,0 .4)	0.09 (0.06,0 .14)	-70	1.9 (1.8,2.2)	2.8 (2.5,3. 2)	47	0.12 (0.08,0 .18)	0.03 (0.01,0 .06)

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Widowed	(M) 1,070 (F) 4,038	(M) 415 (F) 3,909	48.7 (45.1,52.3)	50.1 (43.9, 56.3)	2.8	41.6 (38.0,45.3)	59.5 (53.2, 65.6)	43	19.5 (16.8, 22.5)	23.7 (18.7,29.6)	4.7 (3.86, 5.6)	3.5 (2.78,4.3)	-26	21.3 (19.7,22.9)	18.5 (16.9,20.2)	-13	1.4 (1.05,1.89)	0.9 (0.6,1.4)
Divorced/ separated	(M) 718 (F) 1,827	(M) 434 (F) 1,873	41.7 (37.2,46.4)	46.6 (39.9, 53.3)	12	33.4 (29.01, 38.1)	55.9 (49.03,62.7)	67	15.7 (12.5, 19.5)	25.2 (19.7,31.6)	2.5 (1.8,3.6)	1.6 (1.01,2.6)	-36	18.1 (15.9,20.6)	18.6 (16.4, 21.01)	3	0.31 (0.13,0.75)	0.6 (0.3,1.2)
Religion[2]																		
Hindu	(M) 100,339 (F) 99,430	(M) 51,174 (F) 89,888	26.1 (25.5,26.7)	33.01 (32.2, 33.8)	27	26.6 (26.0, 27.3)	38.2 (37.3, 39.1)	44	10.2 (9.8,10.5)	13.7 (13.2,14.3)	1.5 (1.4,1.7)	1.5 (1.35,1.7)	0	8.8 (8.3,9.2)	9.6 (9.1,10.2)	9	0.37 (0.31,0.43)	0.25 (0.2,0.3)
Muslim	(M) 16,278 (F) 16,215	(M) 9,145 (F) 16,731	28.3 (26.7,29.9)	36.2 (34.3, 38.2)	28	23.4 (21.7,25.1)	37.4 (35.02,39.8)	60	9.5 (8.7,10.5)	13.1 (11.9,14.5)	1.9 (1.6,2.3)	1.73 (1.25,2.4)	-9	9.1 (8.3,9.9)	9.9 (8.9,10.9)	9	0.5 (0.37,0.7)	0.4 (0.3,0.7)
Christian	(M) 8,055 (F) 8,547	(M) 6,250 (F) 10,974	28.2 (25.9,30.5)	33.1 (29.9, 36.4)	17	17.5 (15.1, 20.1)	29.1 (25.01,33.5)	66	8.2 (6.9,9.6)	12.7 (10.4,15.5)	2.4 (1.7,3.3)	1.3 (0.98,1.62)	-46	9.9 (8.4,11.6)	10.7 (9.1,12.5)	8	0.98 (0.72,1.33)	0.6 (0.5,0.7)
Others	(M) 6,792 (F) 6,694	(M) 3,186 (F) 6,549	11.1 (9.5,12.8)	16.2 (14.2, 18.4)	46	19.3 (17.1,21.7)	26.0 (23.1, 29.2)	35	4.4 (3.4,5.6)	6.5 (5.2, 8.0)	0.6 (0.4, 0.9)	0.4 (0.2,0.65)	-33	7.5 (5.8,9.6)	7.6 (6.2,9.4)	1	0.27 (0.13,0.55)	0.2 (0.1,0.6)
Total	(M) 131,464 (F) 130,886	(M) 69,755 (F) 124,142																

[1]Large city: urban population ≥1 million; Small city: 100000-1 million; Town: ≤100000 million
[2]Others include Sikh, Buddhist, Jain, Jewish, Zoroastrian and Others
*Percentage change (**% Δ)** numbers have been rounded to the nearest integer. Estimates are not age-standardized

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