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Relationship between tobacco use, alcohol consumption and non-communicable diseases among women in India: evidence from National Family Health Survey-2015-16

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Abstract

Background: Based on an increased prevalence of diabetes, asthma and hypertension among women in reproductive age, understanding the risk factors of non-communicable diseases (NCDs) is crucial to inform policy and program interventions to address the problem. In this study, we empirically assessed the associations of behavioural factors such as alcohol consumption and tobacco use and a variety of socioeconomic characteristics with prevalence of NCDs in adult women.

Methods: The data were derived from the National Family Health Survey conducted in 2015–16. The effective sample size for the present paper was 699,686 women aged 15–49 years in India. Descriptive statistics along with bivariate analysis were conducted to find the preliminary results. Additionally, multivariable logistic regression analysis was conducted to find the relationship between NCDs and behavioural factors such as alcohol consumption and tobacco use. Moreover, population attributable risk was estimated in the present study.

Results: It was revealed that 15.9% of women had any of the NCDs. A proportion of 0.8% of women smoked tobacco whereas 5.5% of women consumed smokeless tobacco. Also, a proportion of 1.2% of women consumed alcohol in the current study. The odds of having NCDs among women who smoked tobacco, consumed smokeless tobacco and consume alcohol were 16, 8 and 20% significantly higher than the odds of having NCDs among women who did not smoke tobacco, consume smokeless tobacco and consume alcohol respectively. The population attributable risk of having NCDs was 1.8% ($p < 0.001$) for women who smoked, 0.8% ($p < 0.001$) for women who consumed smokeless tobacco and 2.2% ($p < 0.001$) for women who consumed alcohol. Besides, the odds of having NCDs among overweight and obese women were 2.25 and 3.60 times greater than the odds of having NCDs among women who were underweight.

Conclusion: The findings revealed that smoking and using smokeless tobacco and alcohol consumption were risk factors of NCDs in women. The findings also alarm the focus of maternal and child health programs on NCDs' risk factors like maternal obesity, due to their adverse health consequences on their children too. Also, the coexistence of higher levels of tobacco use and alcohol consumption requires different strategies to address the vulnerability of

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women towards NCDs, including screening and early detection of NCDs especially among those who smoke or chew tobacco and consume alcohol.

Keywords: Non-communicable disease, Tobacco, Alcohol, Population attributable risk, Women, India

Background

More than two-thirds of the deaths worldwide are caused by non-communicable diseases (NCDs), whereas, three-fourth of such mortality occurs in less-developed countries [1]. Smoked and smokeless tobacco which are highly prevalent in South Asia along with problematic alcohol consumption is responsible for a large number of diseases and deaths [2].

A growing body of literature suggests that women are more likely to experience the co-occurrence of behavioural risk factors thus increasing the risk of NCDs among them and in the future generation [3–5]. Multiple studies in different socio-cultural settings show that higher consumption of alcohol increase the risk of coronary artery disease and related mortality [6–9]. Further, the socioeconomic determinants of NCDs among women are well documented with a higher risk among women in poor resource settings [10–13]. The low-income women were more likely to smoke and had a higher prevalence of many chronic diseases and related risk factors than higher-income mothers [14, 15]. Also, the prevalence of overweight and central obesity which are risk factors for NCDs have been found to be consistently higher in women in India than men in multiple studies [16–18].

However, studies focusing on behavioural risk factors of NCDs with a wider sample of Indian women are still lacking. Based on an increased prevalence of diabetes, asthma and hypertension among women in reproductive age, understanding the risk factors of NCDs is crucial to inform policy and program interventions to address the problem. In this study, we empirically assess the associations of behavioural factors such as alcohol consumption and tobacco use and a variety of socioeconomic characteristics with the prevalence of NCDs. In addition, we estimate the population-attributable risk (PAR) of NCDs due to tobacco, alcohol and other exposures among women in India.

Methods

Data

The data were derived from the National Family Health Survey (NFHS-4), the fourth in the NFHS series conducted in 2015–16 [19]. It provides information on population, health, and nutrition of people in India and each state and union territory of the country. All four rounds of NFHS survey have been conducted under the stewardship of the Ministry of Health and Family Welfare

(MoHFW), Government of India. MoHFW designated the International Institute for Population Sciences (IIPS), Mumbai, as the nodal agency for conducting the surveys. Decisions about the overall sample size required for NFHS-4 were guided by several considerations, paramount among which was the need to produce indicators at the district, state/union territory and national levels, as well as separate estimates for urban and rural areas in 157 districts that have 30–70% of the population living in urban areas as per the 2011 census, with a reasonable level of precision. The NFHS-4 sample is a stratified two-stage sample [19]. The 2011 census served as the sampling frame for the selection of Primary Sampling Units (PSUs). PSUs were villages in rural areas and Census Enumeration Blocks (CEBs) in urban areas. PSUs with fewer than 40 households were linked to the nearest PSU. Within each rural stratum, villages were selected from the sampling frame with probability proportional to size [19]. In each stratum, six approximately equal substrata were created by crossing three substrata, each created based on the estimated number of households in each village, with two substrata, each created based on the percentage of the population belonging to Scheduled Castes and Scheduled Tribes. Four survey questionnaires (Household Questionnaire, Woman's Questionnaire, Man's Questionnaire, and Biomarker Questionnaire) were canvassed in 17 local languages using Computer Assisted Personal Interviewing (CAPI). In the interviewed households, 723,875 eligible women aged 15–49 years were identified for individual women's interviews [19]. Interviews were completed with 699,686 women, with a response rate of 97%. In all, there were 122,051 eligible men aged 15–54 years in households selected for the state module. Interviews were completed with 112,122 men, with a response rate of 92% [19]. The effective sample size for the present study was 699,686 women aged 15–49 years in India.

Variable description

Outcome variable

The outcome variable was 'presence of NCDs' which was recoded as no and yes. The diseases considered for measuring NCDs were hypertension, diabetes, asthma, heart disease and cancer. Blood pressure was measured among women aged 15–49 using an Omron Blood Pressure Monitor to determine the prevalence of hypertension [19]. Blood pressure measurements for each respondent

were taken three times with an interval of 5 min between readings [19]. Hypertension is defined as when an individual had average systolic blood pressure of more than or equals to 140 mmHg and/or diastolic blood pressure of more than or equals to 90 mmHg [20]. If the random blood glucose level exceeds 140 mg/dl, the person is termed diabetic. The FreeStyle Optium H glucometer with glucose test strips was used to measure random blood glucose for women aged 15–49 using a finger-stick blood sample [19]. Further, asthma, heart disease and cancer were self-reported [21]. If the respondent had any of the above diseases, they were considered to be having NCDs.

Explanatory variable

The explanatory variables were selected on the basis of extensive literature review. The variables were divided into three sections that are behavioural, individual and household characteristics.

Behavioural characteristics

- i. Cigarettes, *bidis*, *cigars*, *hookah*, *gutkha/paan masala*, *paan* and *khaini* are tobacco products commonly consumed in India. The variable ‘smoke tobacco’ was generated using the questions a. Do you currently smoke cigarettes? b. Do you currently smoke *bidis*? c. Do you currently smoke *cigar*? and e. Do you currently smoke *hookah*? All the responses were recoded as no and yes. And if the female respondents smoked any of these products, they were coded as yes and otherwise no.
- ii. The variable ‘consume smokeless tobacco’ was generated using the questions a. Do you currently chew tobacco? b. Do you currently consume *gutkha/paan masala* with tobacco? c. Do you currently consume *paan* with tobacco? and e. Do you currently consume *khaini*? All the responses were recoded as no and yes. And if the female respondents consumed any of these products, they were coded as yes and otherwise no.
- iii. Women who consume alcohol were coded as no and yes. The variable was generated using the question “Do you currently drink alcohol?” the response was coded as no and yes.

Individual characteristics

Age was grouped into 15–24 years, 25–34 years and 35–49 years. Educational status was categorized as not educated, primary, secondary and higher. Working status was coded as no and yes. The variable on working status was asked under state module hence cannot be used for

multi-variate analysis. Marital status was coded as never married, currently married and others. Others included those who were divorced, separated or widowed. Media exposure was coded as not exposed and exposed. The variable was generated using the question on whether women watched television, read newspaper or listened to radio. If the response was affirmative to any of these, it was coded as yes otherwise no. Body mass index (BMI) was recoded as underweight (less than 18.5), normal (18.5 to 24.9), overweight (25–29.9) and obese (30 and above) [22].

Household characteristics

The variable wealth status was generated using the information given in the NFHS 2015–16 survey. Households were given scores based on the number and kinds of consumer goods they own, ranging from a television to a car or bicycle, and housing characteristics such as toilet facilities, source of drinking water, and flooring materials. These scores are derived using principal component analysis (PCA). National wealth quintiles are compiled by assigning the household score to each usual (de jure) household member, ranking each person in the household population by their score, and then dividing the distribution into five equal categories, each with 20% of the population [23]. The wealth status was coded as poorest, poorer, middle, richer and richest.

Religion was coded as Hindu, Muslim, Christian and others. Others included Buddhist, Sikh, Jain, etc. Caste was coded as Scheduled Tribe, Scheduled Caste, Other Backward Class and others [23]. Others include those who were identified as having higher social status [24, 25]. Place of residence was coded as urban and rural. Regions of India were coded as North, Central, East, North-East, West and South [19].

Statistical analysis

All the analyses have been conducted using STATA 14. Descriptive statistics along with bivariate analysis were performed at the initial stage. Chi-square test was used to find the significance level for the prevalence estimates of NCDs by background variables. Additionally, multivariable logistic regression analysis [26] was used to estimate the extent of association between NCDs and behavioural factors along with other individual and household factors.

The binary logistic regression model is usually put into a more compact form as follows:

$$\text{Logit}[P(Y = 1)] = \beta_0 + \beta * X$$

The parameter β_0 estimates the log odds of NCDs for the reference group, while β estimates the maximum likelihood, the differential log odds of NCDs associated with

a set of predictors X , as compared to the reference group. Variance inflation factor (VIF) was estimated to check the multicollinearity among the variables used in the study [27]. The *svyset* command in STATA 14 was used to control the analysis for complex survey design. Additionally, this command also incorporated the weights which make the estimates representative.

Model-2, model-3 and model-4 reveal the combined effects of smoking and consuming smokeless tobacco, smoking tobacco and alcohol consumption and consuming smokeless tobacco and alcohol consumption. An “interaction variable” is a variable constructed from an original set of variables to represent either all of the interaction present or some part of it. In exploratory statistical analyses, it is common to use products of original variables as the basis of testing whether interaction is present with the possibility of substituting other more realistic interaction variables at a later stage. When there are more than two explanatory variables, several interaction variables are constructed, with pairwise-products representing pairwise-interactions and higher order products representing higher order interactions [28–30].

Thus, for a response Y and two variables x_1 and x_2 , an additive model would be:

$$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \varepsilon_0$$

In contrast to this,

$$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + (\beta_3 x_s * x_a) \varepsilon_0$$

Where, Y is dependent variable (various NCDs) and α is intercept, x_1 is individual level independent variable, x_2 is individual level independent variable, x_a is alcohol users, x_s is smokers, $(\beta_3 x_s * x_a)$ is the interaction of alcohol and smoking and ε_0 is error. Often, models are presented without the interaction term $d(x_1 * x_2)$, but this confounds the main effect and interaction effect (i.e., without specifying the interaction term, it is possible that any main effect found is actually due to an interaction) [31].

Further, population attributable risk (PAR) was calculated to verify the extent of risk for NCDs among women who were exposed to negative behavioural factors i.e., smoking tobacco, consuming smokeless tobacco and alcohol [32]. The “regpar” command in STATA was used to calculate the PAR. The regpar generates confidence intervals for both population attributable risks and scenario proportions [33]. After an estimating command that interprets projected values as conditional proportions, such as logit, logistic, probit, or generalized linear model, regpar can be utilised [33]. It calculates two scenario proportions: a baseline (“Scenario 0”) and a fantasy (“Scenario 1”), in which one or more exposure variables are presumed to be set to specific values (usually zero)

and all other predictor variables in the model remain unchanged. It also calculates the difference between the proportions in Scenario 0 and Scenario 1. This difference is referred to as the population attributable risk (PAR), and it shows the risk associated with living in Scenario 0 rather than Scenario 1 [33].

Results

Table 1 presents the socioeconomic profile of women aged 15–49 years in India. A proportion of 0.8% of the women smoked tobacco whereas 5.5% of women consumed smokeless tobacco. Also, a proportion of 1.2% of women consumed alcohol in the current study.

Figure 1 presents percentage of NCDs among women aged 15–49 years. A proportion of 6.0% of women were diabetic and 8.7% were hypertensive. Additionally, 1.9% had asthma, 1.4% had heart diseases and 0.2% had cancer. Moreover, 15.9% of women had any of the NCDs. Further, Fig. 2 reveals that the prevalence of NCDs (more than 16%) was concentrated in the states of Jammu and Kashmir, Punjab, Himachal Pradesh, Chhattisgarh, North Eastern states and in almost all the Southern states of India.

Table 2 presents percentage of women aged 15–49 years having NCDs by their background characteristics. It was revealed that 25.1% of women who smoked vs 15.9% who did not smoke had NCDs and, 22.8% who consumed smokeless tobacco vs 15.5% who did not consume smokeless tobacco had NCDs. Also, a higher percentage of women who consumed alcohol (24.8%) had NCDs in comparison to those who did not consume alcohol (15.8%).

Table 3 presents the logistic regression estimates for women having NCDs by their background characteristics. Women aged 35–49 years had significantly higher odds of having NCDs in comparison to women aged 15–24 years. The odds of having NCDs among women with higher educational status were 25% higher than the odds of having NCDs among women who were not educated. The odds of having NCDs among women who were divorced/separated/widowed were 16% higher than the odds of having NCDs among women who were never married. Similarly, women who smoked tobacco had 16% significantly higher odds of having NCDs than women who did not smoke tobacco. Women who consumed smokeless tobacco had 8% significantly higher odds of having NCDs than women who did not consume smokeless tobacco. Besides, the odds of having NCDs among women who consumed alcohol were 20% significantly higher than those who did not consume alcohol. Model-2, model-3 and model-4 reveal the combined effect of tobacco use and alcohol consumption on having NCDs among women in India. The odds

Table 1 Socio-economic profile of the women aged 15–49 years in India, NFHS 2015–16

Background characteristics	Sample	Percentage
Behavioural characteristics		
Smoke tobacco		
No	694,274	99.23
Yes	5412	0.77
Chew tobacco		
No	661,453	94.54
Yes	38,233	5.46
Alcohol consumption		
No	691,048	98.77
Yes	8638	1.23
Individual characteristics		
Age (in years)		
15–24	244,518	34.95
25–34	211,812	30.27
35–49	243,357	34.78
Educational status		
Not educated	192,135	27.46
Primary	87,233	12.47
Secondary	331,037	47.31
Higher	89,281	12.76
Working status^b		
No	92,996	76.01
Yes	29,355	23.99
Marital status		
Never married	159,035	22.73
Currently married	511,373	73.09
Others	29,279	4.18
Media exposure		
Not exposed	132,158	18.89
Exposed	567,528	81.11
Body Mass Index^a		
Underweight	153,331	21.91
Normal	390,201	55.77
Overweight	105,038	15.01
Obese	34,269	4.90
Household characteristics		
Wealth status		
Poorest	124,054	17.73
Poorer	136,900	19.57
Middle	143,814	20.55
Richer	147,978	21.15
Richest	146,939	21.00
Religion		
Hindu	563,739	80.57
Muslim	96,461	13.79
Christian	16,620	2.38
Others	22,866	3.27
Caste		
Scheduled Caste	142,619	20.38

Table 1 (continued)

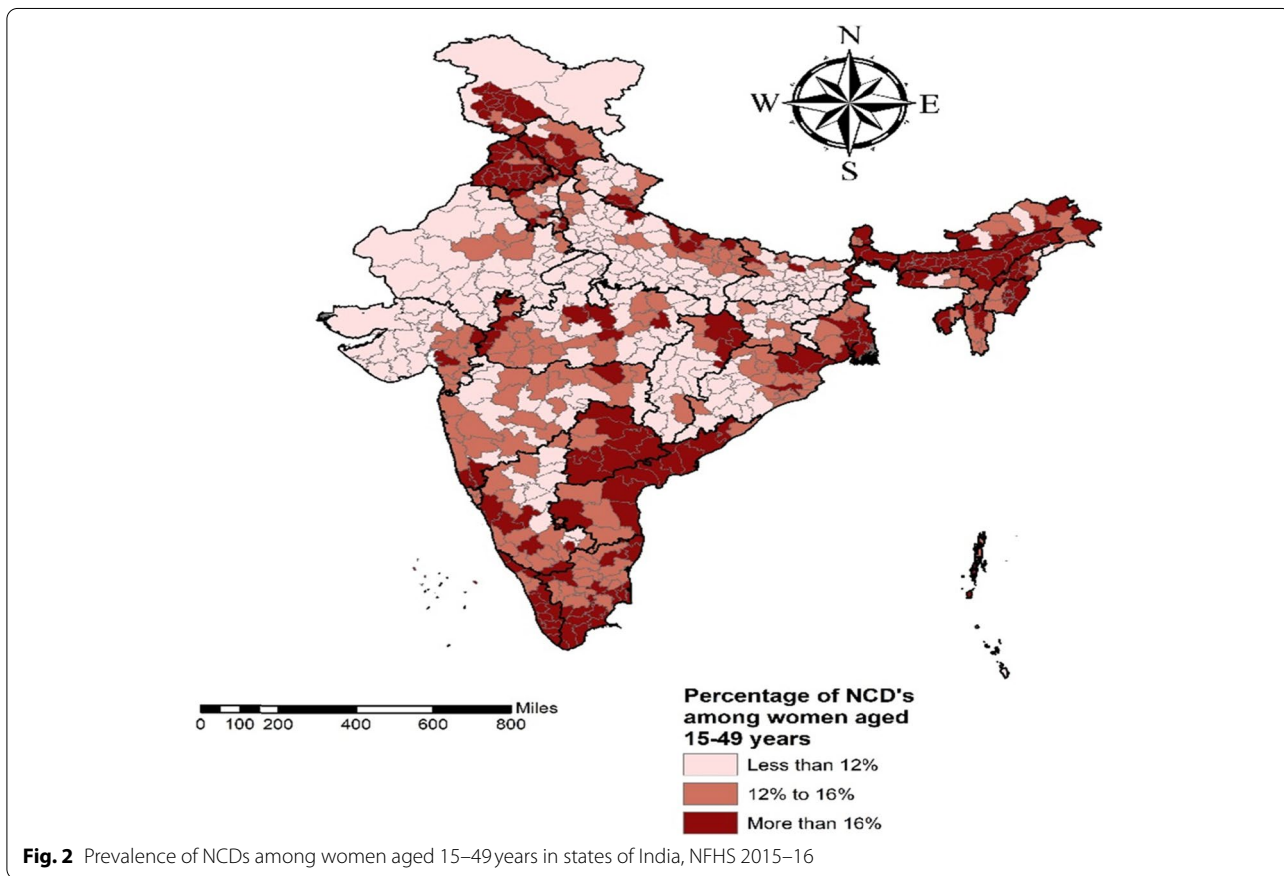
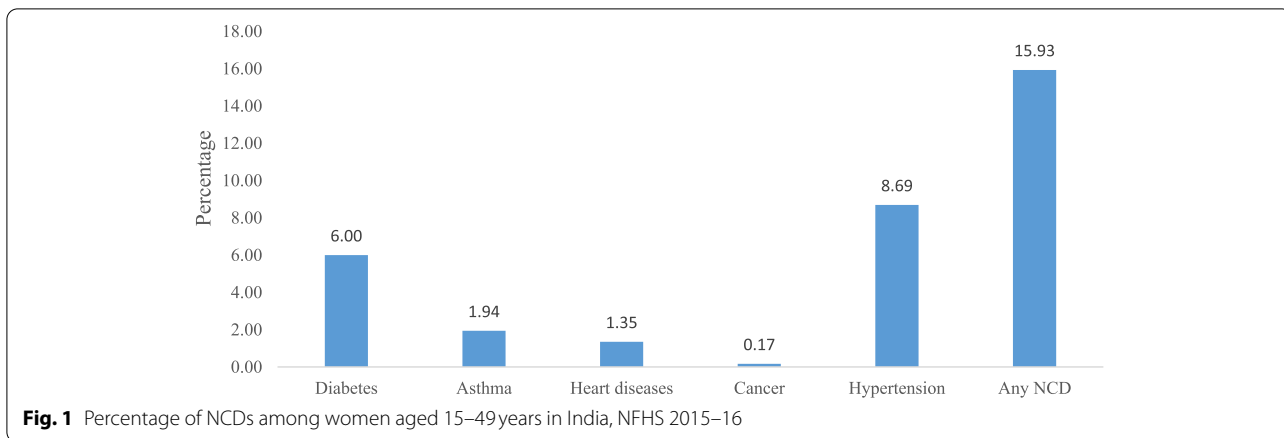
Background characteristics	Sample	Percentage
Scheduled Tribe	64,144	9.17
Other Backward Class	303,837	43.42
Others	189,086	27.02
Place of residence		
Urban	242,225	34.62
Rural	457,461	65.38
Regions		
North	95,098	13.59
Central	165,474	23.65
East	154,698	22.11
North East	24,615	3.52
West	100,535	14.37
South	159,266	22.76
Total	699,686	100.00

^a Sample is low due to missing cases

^b The question was asked on state module therefore sample is low

of having NCDs among women who smoked and consumed smokeless tobacco were 8% significantly higher than the odds of having NCDs among women who did not consume any of these. Women who smoked tobacco and consumed alcohol had 42% significantly higher odds of having NCDs than women who did not consume any of these. On the other hand, the odds of having NCDs among women who consumed smokeless tobacco and consumed alcohol were 32% significantly higher than the odds of having NCDs among women who did not consume any of these. Also, women who were overweight and obese had 2.25- and 3.60-times greater odds of having NCDs than women who were underweight as revealed from model-1. Table S1 in supplementary file represented the regression estimates for individual diseases, i.e., diabetes, asthma, heart disease, cancer and hypertension.

Table 4 presents the PAR of presence of NCDs among women who smoked tobacco, consumed smokeless tobacco and consumed alcohol. The proportion of NCDs that was attributable to smoked tobacco was 17.8% in comparison to 15.9% who did not smoke tobacco. The difference between two situations is PAR, which was measured to be 1.8% ($p < 0.001$). Similarly, the PAR for women who consumed smokeless tobacco was 0.8% ($p < 0.001$) and it was 2.2% ($p < 0.001$) among women who consumed alcohol. Tables S2, S3, S4, S5, S6 and S7 display the results for PAR for diabetes, asthma, heart disease, cancer and hypertension separately.



Discussion

In this study using nationally representative secondary data in India, we extensively explored the prevalence of major risk factors of NCDs which include tobacco use, alcohol consumption, overweight, and obesity among women of reproductive age. Furthermore, we investigated the population attributable risk of behavioural factors on the prevalence of NCDs to understand

the pattern of the problem and how best to prevent and control it. The findings of this study revealed that a large number of women in India were having any of the NCDs. The findings in our study showed a higher prevalence of hypertension, diabetes, asthma and heart disease among women of reproductive age in India compared to other earlier surveys, with 14% of them having any of the NCDs. These findings were

Table 2 Percentage of women aged 15–49 having NCDs by their background characteristics

Background characteristics	No NCD	Any NCD	p-value
Behavioural characteristics	%	%	
Smoke tobacco			0.001
No	84.14	15.86	
Yes	74.94	25.06	
Chew tobacco			0.001
No	84.46	15.54	
Yes	77.24	22.76	
Alcohol consumption			0.001
No	84.18	15.82	
Yes	75.23	24.77	
Individual characteristics			
Age (in years)			0.001
15–24	93.58	6.42	
25–34	86.92	13.08	
35–49	72.03	27.97	
Educational status			0.001
Not educated	79.94	20.06	
Primary	80.97	19.03	
Secondary	86.14	13.86	
Higher	88.3	11.7	
Working status			0.001
No	85.06	14.94	
Yes	82.21	17.79	
Marital status			0.001
Never married	93.18	6.82	
Currently married	81.8	18.2	
Others	74.21	25.79	
Media exposure			0.001
Not exposed	84.25	15.75	
Exposed	84.02	15.98	
Body Mass Index			0.001
Underweight	90.14	9.86	
Normal	86.17	13.83	
Overweight	72.64	27.36	
Obese	61.85	38.15	
Household characteristics			
Wealth status			0.001
Poorest	85.91	14.09	
Poorer	85.25	14.75	
Middle	84.51	15.49	
Richer	82.34	17.66	
Richest	82.71	17.29	
Religion			0.001
Hindu	84.4	15.6	
Muslim	83.18	16.82	
Christian	80.23	19.77	
Others	82.52	17.48	
Caste			0.001
Scheduled Caste	84.78	15.22	

Table 2 (continued)

Background characteristics	No NCD	Any NCD	p-value
Scheduled Tribe	84.28	15.72	
Other Backward Class	84.59	15.41	
Others	82.61	17.39	
Place of residence			0.001
Urban	82.97	17.03	
Rural	84.65	15.35	
Regions			0.001
North	85.4	14.6	
Central	85.76	14.24	
East	83.72	16.28	
North East	79.22	20.78	
West	84.85	15.15	
South	82.11	17.89	
Total	84.07	15.93	

comparable to the reports from previous studies in India [34–36].

The present study also revealed that smoking and consuming of tobacco products and alcohol consumption were associated with an increased prevalence of NCDs among women. Other studies have also shown that consuming smokeless tobacco which is also a risk factor for oral cancers is a major problem associated with morbidity in Indian women particularly those with a lower socioeconomic status [37, 38]. The combined exposure of alcohol consumption and tobacco use was strongly associated with a higher prevalence of NCDs among women. The higher population-attributable risk of smoking, using smokeless tobacco and drinking alcohol for NCDs among women in the current study were noticeable and support the previous findings from India and other developing countries on the higher risk of smoking and alcohol consumption on hypertension and other NCDs [20, 39–41]. Thus, the results suggest a need for developing an efficient preventive strategy against the growing trend of NCDs through control of tobacco use and alcohol consumption. For example, as evidence suggests, a 10% increase in the price of tobacco reduces smoking by about 8% in low- and middle-income countries [42]. Similarly, an increase in taxation can be a potential strategy to control tobacco use especially among the poorest segment of the population.

Urbanization and adoption of unhealthy lifestyles that contribute to inappropriate food choices such as increased intake of sugar and fat led to an increase in body weight in the general population and women in particular [43]. Similarly, studies have shown maternal obesity as a major risk factor for gestational diabetes and pregnancy-induced hypertension in women [44, 45].

Table 3 Multivariable logistic regression estimates for NCDs by background characteristics among women aged 15–49 years in India, 2015–16

Background characteristics	Model-1 AOR (95% CI)	Model-2 AOR (95% CI)	Model-3 AOR (95% CI)	Model-4 AOR (95% CI)
Behavioural characteristics				
Smoke tobacco				
No	Ref.			Ref.
Yes	1.16*(1.1,1.22)			1.16*(1.1,1.22)
Consume smokeless tobacco				
No	Ref.		Ref.	
Yes	1.08*(1.05,1.1)		1.08*(1.05,1.1)	
Alcohol consumption				
No	Ref.	Ref.		
Yes	1.20*(1.16,1.25)	1.20*(1.16,1.25)		
Individual characteristics				
Age (in years)				
15–24	Ref.	Ref.	Ref.	Ref.
25–34	1.79*(1.75,1.84)	1.79*(1.75,1.84)	1.79*(1.75,1.84)	1.79*(1.75,1.84)
35–49	4.11*(4.01,4.21)	4.10*(4.4,21)	4.10*(4.4,21)	4.10*(4.4,21)
Educational status				
Not educated	Ref.	Ref.	Ref.	Ref.
Primary	1.02*(1,1.04)	1.02*(1,1.05)	1.02*(1,1.05)	1.02*(1,1.05)
Secondary	0.89*(0.88,0.91)	0.90*(0.88,0.91)	0.90*(0.88,0.91)	0.90*(0.88,0.91)
Higher	0.75*(0.73,0.77)	0.75*(0.73,0.77)	0.75*(0.73,0.77)	0.75*(0.73,0.77)
Marital status				
Never married	Ref.	Ref.	Ref.	Ref.
Currently married	0.99(0.96,1.01)	0.99(0.96,1.01)	0.99(0.96,1.01)	0.99(0.96,1.01)
Others	1.16*(1.11,1.20)	1.16*(1.11,1.20)	1.16*(1.11,1.20)	1.16*(1.11,1.20)
Media exposure				
Not exposed	Ref.	Ref.	Ref.	Ref.
Exposed	1.04*(1.02,1.07)	1.04*(1.02,1.07)	1.04*(1.02,1.07)	1.04*(1.02,1.07)
Body Mass Index				
Underweight	Ref.	Ref.	Ref.	Ref.
Normal	1.18*(1.15,1.2)	1.18*(1.15,1.2)	1.18*(1.15,1.2)	1.18*(1.15,1.2)
Overweight	2.25*(2.2,2.31)	2.25*(2.2,2.31)	2.25*(2.2,2.31)	2.25*(2.2,2.31)
Obese	3.60*(3.49,3.72)	3.60*(3.49,3.72)	3.60*(3.49,3.72)	3.60*(3.49,3.72)
Household characteristic's				
Wealth status				
Poorest	Ref.	Ref.	Ref.	Ref.
Poorer	1.04*(1.01,1.06)	1.04*(1.01,1.06)	1.04*(1.01,1.06)	1.04*(1.01,1.06)
Middle	1.05*(1.03,1.08)	1.05*(1.03,1.08)	1.05*(1.03,1.08)	1.05*(1.03,1.08)
Richer	1.12*(1.09,1.16)	1.13*(1.09,1.16)	1.13*(1.09,1.16)	1.13*(1.09,1.16)
Richest	1.10*(1.07,1.14)	1.10*(1.07,1.14)	1.10*(1.07,1.14)	1.10*(1.07,1.14)
Religion				
Hindu	Ref.	Ref.	Ref.	Ref.
Muslim	1.15*(1.12,1.17)	1.15*(1.12,1.17)	1.15*(1.12,1.17)	1.15*(1.12,1.17)
Christian	0.98(0.95,1.01)	0.98(0.95,1.01)	0.98(0.95,1.01)	0.98(0.95,1.01)
Others	1.03(1,1.06)	1.03(1,1.06)	1.03(1,1.06)	1.03(1,1.06)
Caste				
Scheduled Caste	Ref.	Ref.	Ref.	Ref.
Scheduled Tribe	1.03*(1,1.06)	1.03*(1,1.06)	1.03*(1,1.06)	1.03*(1,1.06)

Table 3 (continued)

Background characteristics	Model-1 AOR (95% CI)	Model-2 AOR (95% CI)	Model-3 AOR (95% CI)	Model-4 AOR (95% CI)
Other Backward Class	0.95*(0.93,0.97)	0.95*(0.93,0.97)	0.95*(0.93,0.97)	0.95*(0.93,0.97)
Others	1.04*(1.02,1.07)	1.04*(1.02,1.07)	1.04*(1.02,1.07)	1.04*(1.02,1.07)
Place of residence				
Urban	Ref.	Ref.	Ref.	Ref.
Rural	1.04*(1.02,1.06)	1.04*(1.02,1.06)	1.04*(1.02,1.06)	1.04*(1.02,1.06)
Regions				
North	Ref.	Ref.	Ref.	Ref.
Central	1.06*(1.04,1.09)	1.06*(1.04,1.09)	1.06*(1.04,1.09)	1.06*(1.04,1.09)
East	1.13*(1.11,1.16)	1.13*(1.11,1.16)	1.13*(1.11,1.16)	1.13*(1.11,1.16)
North East	1.48*(1.44,1.52)	1.48*(1.44,1.52)	1.48*(1.44,1.52)	1.48*(1.44,1.52)
West	1(0.98,1.03)	1.01(0.98,1.04)	1.01(0.98,1.04)	1.01(0.98,1.04)
South	1.09*(1.06,1.12)	1.09*(1.06,1.12)	1.09*(1.06,1.12)	1.09*(1.06,1.12)
Smoke tobacco # Consume smokeless tobacco				
No # no		Ref.		
Yes # no		1.09*(1.06,1.11)		
No # yes		1.23*(1.16,1.31)		
Yes # yes		1.08*(1.03,1.19)		
Smoke tobacco # alcohol consumption				
No # no			Ref.	
Yes # no			1.2*(1.15,1.25)	
No # yes			1.15*(1.09,1.22)	
Yes # yes			1.42*(1.23,1.62)	
Consume smokeless tobacco # alcohol consumption				
No # no				Ref.
Yes # no				1.18*(1.13,1.25)
No # yes				1.07*(1.05,1.1)
Yes # yes				1.32*(1.25,1.41)

Ref Reference, AOR Adjusted odds ratio, CI Confidence interval, *if $p < 0.05$

Interaction term

Consistently, the current analysis shows that women who were overweight or obese were more likely to have NCDs. This association of indices of obesity with an increased risk for NCDs among women of reproductive age confirms the results of other studies in both developed and developing countries [12, 46, 47]. Further, findings of overweight and obesity as factors associated with NCDs agree with the general view that body fat in humans is linked to a higher rate of cardiovascular diseases [48, 49].

In addition, lower levels of education, increasing age, being divorced /separated /widowed were associated with a higher risk of NCDs among women of reproductive age. More so, the association of increasing age with the higher risk of NCDs can be explained by the negative biological effects as women grow older [50, 51]. Furthermore, the associations of education and marital status with NCDs were similar to past studies showing that lower levels of education and being divorced, separated

or widowed increased the odds of having NCDs in comparison to uneducated and never married women [52, 53]. Factors such as hormonal changes in reproductive cycle, chronic stress, women's sociocultural vulnerability and marital relationship satisfaction might have influenced the observed association of marital status with NCD prevalence [54, 55]. Future research is necessary to confirm this association and explore the underlying mechanisms. On the other hand, the current study depicts that the chances of having NCDs were higher among women with higher household economic status which was also observed in previous studies [3, 13, 56]. This however, could be attributed to the lower levels of healthcare utilisation and less likelihood of women from poor socioeconomic background to be diagnosed and report medical conditions.

The calculation of population-attributable risks of smoking, consuming smokeless tobacco and alcohol

Table 4 Population attributable risk for NCDs among women aged 15–49 years

Population attributable risk (PAR)	
Behavioural factors	NCDs
Smoke tobacco	
No	0.159*(0.159, 0.160)
Yes	0.178*(0.171, 0.185)
PAR	0.018*(0.011, 0.027)
Consume smokeless tobacco	
No	0.159*(0.159, 0.169)
Yes	0.168*(0.165, 0.170)
PAR	0.008*(0.005, 0.010)
Alcohol consumption	
No	0.159*(0.159, 0.160)
Yes	0.182*(0.177, 0.188)
PAR	0.022*(0.017, 0.028)

The analysis was controlled for individual and household characteristics

CI Confidence Interval, *if $p < 0.05$

consumption was the major strength of the current study. Also, this study used nationally representative secondary data and the findings are generalizable for the women of reproductive age in India. However, a major drawback is that the cross-sectional study design used cannot adequately establish causality. Moreover, the self-reported nature of data on NCDs not diagnosed or tested is subject to several biases which have influenced the current findings. The lack of information on several diseases and many behavioural factors limited this study to reveal the evidence around NCDs' risk factors with sufficient depth. Future work might include the longitudinal assessment of NCDs with more diseases and their combinations along with assessing the population-attributable risks of several behavioural factors for increased NCD prevalence and for particular diseases in women.

Conclusion

The findings revealed that smoking and using smokeless tobacco and alcohol consumption were risk factors of NCDs in women. The study findings urge health decision-makers to invest in women's health especially those who are more exposed to the risk factors of having NCDs. The findings also alarm the focus of maternal and child health programs on NCDs' risk factors like maternal obesity, due to their adverse health consequences on their children too. Also, the coexistence of higher levels of tobacco use and alcohol consumption requires different strategies to address the vulnerability of women towards NCDs. The screening and early detection of several NCDs such as diabetes, hypertension and heart disease should strongly

be emphasised especially among those who smoke or chew tobacco and consume alcohol. Furthermore, interventions that focus on modifiable factors such as smoking and alcohol consumption, and related obesity can help prevent the increasing burden of NCDs among women in India.

Abbreviations

NCDs: Non-Communicable Diseases; NFHS: National Family Health Survey; MoHFW: Ministry of Health and Family Welfare; IIPS: International Institute for Population Sciences; PSUs: Primary Sampling Units; CEBs: Census Enumeration Blocks; CAPI: Computer Assisted Personal Interviewing; BMI: Body mass index; PAR: Population Attributable Risk; AOR: Adjusted Odds Ratio; RR: Relative Risk; CI: Confidence Interval; VIF: Variance inflation factor.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-022-13191-z>.

Additional file 1: Table S1. Logistic regression estimates for Diabetes, Asthma, Heart diseases, Cancer, Hypertension by background characteristics among women aged 15–49 years in India, 2015–16. **Table S2.** Population attributable risk for Diabetes among women aged 15–49 years in India, 2015–16. **Table S3.** Population attributable risk for Asthma among women aged 15–49 years in India, 2015–16. **Table S4.** Population attributable risk for Thyroid among women aged 15–49 years in India, 2015–16. **Table S5.** Population attributable risk for Heart diseases among women aged 15–49 years in India, 2015–16. **Table S6.** Population attributable risk for Cancer among women aged 15–49 years in India, 2015–16. **Table S7.** Population attributable risk for hypertension among women aged 15–49 years in India, 2015–16.

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Authors' contributions

Conceived and designed the research paper: VM and PM; analysed the data: SS; Contributed agents/materials/analysis tools: VM, TM and PM; Wrote the manuscript: TM, SS, VM and PM; Refined the manuscript: SS and TM. All authors read and approved the final manuscript.

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Availability of data and materials

The study utilizes secondary source of data which is freely available in public domain through dhsprogram.com.

Declarations

Ethics approval and consent to participate

Not applicable. All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare that there is no competing interest.

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