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Original article

Association of tobacco with hypertension in adult females: Evidence from National Family Health Survey-IV for an aspirational Indian state

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ABSTRACT

Background: Elevated blood pressure and tobacco consumption have been the top two causes of preventable mortality worldwide. Females in the reproductive age carry a higher health impact for self and the offspring when exposed to one or both these risks. An in-depth assessment of the sociocultural determinants of hypertension and tobacco usage in an aspirational Indian state like Odisha is carried out through secondary analysis of the National Family Health Survey-IV (NFHS-4) dataset.

Methods: Data of 30,587 women aged between 15 and 49 years were extrapolated for analysis through frequency, percentage and logistic regression model to determine the predictors of tobacco use and hypertension and to correlate the two in the study population.

Results: In Odisha, 12.8% adult women were addicted to tobacco, mostly smokeless form (93.3%). High blood pressure was recorded in 7.3% of the respondent females. Increasing age, urban residence, extremes of wealth index, ever married status, obesity, diabetes, and tobacco usage (more for smokeless) were the predictors of hypertension. Education, caste and occupation had no significant associations.

Conclusion: Targeted interventions involving gender, marital status, obesity, residence and other socio-economic profiles may be adopted for risk reduction of non-communicable diseases like hypertension in the reproductive age females.

1. Introduction

The prevalence of non-communicable diseases (NCDs) has attained an epidemic proportion in developed and developing nations. NCDs share more than half of the disease burden and more than three-quarters of the deaths on the globe. Cardiovascular diseases (CVDs), cancers, respiratory diseases, and stroke account for 80% of premature NCD deaths and around 44% of CVD deaths.[1]

Every fourth person on the earth is hypertensive. Hypertension is the third killer disease in the list of all age mortality. It accounts for 57% of stroke and 24% coronary heart disease deaths in India.[2] Even though there is a declining trend (11%) in the prevalence from 2000 to 2010, the figures are still worrying at 28.4% in low-income countries and 17.7% in high-income countries as per 2015 data.[3] By 2025, it is estimated to swell by 60%.[2]

Modifiable risk factors for NCDs include environmental and life style parameters. The socio-behavioral factors like food, exercise, stress, sleep, body mass index (BMI), drugs, alcohol, and tobacco are some known correlates. Hypertension and tobacco consumption have been the top two causes of preventable mortality worldwide.[1] Consumption of tobacco in smoke or smokeless forms has been a social malady for years across the globe. Sustainable Development Goal (SDG) aims at reduction

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in global burden of hypertension by one third by 2030. World Health Organization (WHO) has proposed a 25% reduction tobacco use by 2025.An estimate of the association between tobacco usage and hypertension and other interplaying risk factors will contribute towards risk reduction via guidelines and policies.

India, a classic member of the low income nations faces the dual challenges of NCDs and Communicable diseases today. Odisha, an aspirational Indian state ranks third from the bottom in National Institute of Transforming India (NITI) Ayog health index list-2017-18. This Eastern Indian state boasts of a high tobacco usage as well. An in-depth assessment of the association between hypertension and tobacco usage among the female population of the state will be a helpful guide for the policy makers and health planners at large.

2. Methods

The study was designed to determine the predictors of hypertension and tobacco usage among females in Odisha aged 15–49 years and the associations between them.

2.1. Study design and study population

The current study used the data set of 33,721 adult females aged between 15 and 49 years from the thirty districts of the state of Odisha collated in National Family Health Survey (NFHS-4)[4], a nationwide cross-sectional study conducted during 2015–16. The fourth round of the survey, for the very first time covered all the 640 districts of the country and expanded the domain of clinical, anthropometric, and biochemical testing to include measurement of blood glucose and blood pressure.

The surveyors recorded three readings of blood pressure in each subject at a gap of 5 min and the average of the last two readings was reported discarding the first reading. Respondents with 'observer recorded hypertension' defined as 'systolic blood pressure of more than 140 mmHg and/or diastolic blood pressure of more than 90 mm Hg' were considered 'hypertensive'.1953 subjects with 'missing data' were excluded. 1181 pregnant females were also excluded to avoid 'pregnancy-associated hypertension' as an effect modifier. A total of 30,587 samples were included for the analysis.

2.2. Data variables

A respondent who reported smoking or using any smokeless tobacco product on a daily or less-than-daily basis at the time of the survey is labeled as a 'current tobacco user'. A subject who denied using smoke or smokeless tobacco in any form on a daily or less-than-daily basis at the time of the survey was identified as a 'tobacco non-user'. A female who smoked cigarettes/pipe/cigars/bidis/hookah is labeled as 'tobacco smoker'. A subject who chewed tobacco in the form of khaini/gutkha/paan masala-tobacco/paan-tobacco is called as 'smokeless tobacco user'.

Socio-demographic variables (age, wealth status, gender, caste, marital status, occupation, education and place of residence), physical factors like BMI and risk factors like diabetes were the other study variables included for analysis.

2.3. Data collection methods

Two of the researchers of our team went through the NFHS-4 data sheet provided to us and entered the requires variables in SPSS version.21. and after completion of data entry; data were cleaned up and the missing data were excluded and normality of test were checked and analysis was done.

2.4. Data analysis

Data were analyzed using SPSS software version-21. Descriptive statistics characterized the study population and the hypertension and tobacco use status. Application of Kolmogorov-Smirov test and Shaipro Wilks test confirmed that the data were having normal distribution with a significance level of 0.025. The Chi-Square test assessed the association between socio-demographic variables with tobacco usage and the hypertension prevalence. A Logistic regression analysis model was used to assess the determinants of tobacco usage and hypertension. Initially we conducted an uni-variate analysis by using all the determinants and crude odds ratio was calculated and then we have done the multivariate analysis by adjusting all the confounders and got the Adjusted odds ratio with 95% confidence interval. Hosmer and Lemeshow test and Cox & Snell R square tested the goodness-of-fit of the models. A p-value below 0.05 was considered significant to acknowledge the association.

3. Results

The mean age of the study population (n = 30,587) was 30.50 (±SD 9.92) years. 'Observer recorded hypertension' was noted in 2231 (7.3%) subjects who had a mean age of 37.44 (±SD 8.33) years. Normotensive females had a mean age of 29.95 (±SD 9.83) years. The mean systolic and diastolic blood pressure readings in the hypertensive group was 154.53 (±SD 24.254) and 96.66 (±S.D 16.554) mmHg respectively. For non-hypertensive subjects, the corresponding means were 112.53(±SD 11.142) and 76.71(±S.D 18.291 mmHg.

Among the hypertensives, '45–49 years' constituted the largest age quintile (25.7%), and '15–19 years' was the smallest age quintile (2.9%). Majority of the respondents (76.8% hypertensives and 80.6% non-hypertensives) were from rural background and Hindus (93–95%). 'Females with secondary education' constituted the largest education quintile in either group. Majority of the women (84.4% & 68.9%) were 'married'.

Table 1 presents that the odds of tobacco usage were 29 times higher (aOR, 29.508[95% CI, 22.857–38.093]) in women of higher age (45–49 years) as compared to lower age (15–19 years). Rural subjects had 1.8 times higher odds (aOR, 1.818[95% CI, 1.641–2.016]) of using tobacco. Educational grades demonstrated no significant association with tobacco usage. Only agricultural workers were found with a significantly lower odds (aOR, 0.059 [95% CI, 0.375–0.881]) of addiction as compared to the unemployed or other professions. The wealth status of the respondents had an inverse association with tobacco usage. The poorest had 7 times higher odds (aOR, 7.240 [95% CI, 5.608–9.346]) of being addicted to tobacco. Tribal subjects had higher odds (1.538 ± 1.412–1.675) of tobacco addiction. The odds of tobacco usage increased from 'unmarried' to 'currently married' (6 times) to 'widowed' (12 times) to 'divorcee' (7 times) to 'separated' (10 times) women in that order.

The state had a 7.3% prevalence of hypertension in adult females The district reporting the maximum and minimum prevalence in the state were Deogarh (8.8%) and Nayagarh (4.16%) as shown in Fig. 1.

Table 3 presents that the odds of developing hypertension increased with increasing age. Older females (45–49 years) had 14 times higher odds (aOR, 14.515[95% CI, 11.206–18.801]) of being hypertensive than the young females (15–19 years). Urban females had higher odds (aOR, 1.25[95% CI, 1.13–1.38]) of being hypertensive. Urban subjects demonstrated a higher risk of having higher blood pressure (aOR, 1.254 [95% CI, 1.131–1.389]). Education and caste profile of the subject had no significant association with hypertension. 'Unmarried' women had the minimum risk for hypertension; 'widows' carried the highest risk (aOR, 6.33 [95%CI, 5.013–7.991]). Tobacco usage of both smoke and smokeless form had a higher risk (smoke: aOR, 1.769[95% CI, 1.206–2.594], smokeless: aOR, 1.804 [95% CI, 1.606–2.027]). Obesity had 2.5 times higher odds (aOR, 2.511[95% CI, 2.118–2.975]) of elevated blood pressure where as 'Diabetes' carried no significant risk. Tobacco consumption in any form was associated with higher risk of hypertension, more so with the smokeless form.

Table 1
Multivariate logistic regression analysis for predictors of tobacco usage.

Independent variables of tobacco usage	Adjusted Odds Ratio (AOR)	95% CI	P-value
Age (in yrs)			
15–19	1(Ref)		
20–24	2.907	2.184–3.869	0.001*
25–29	5.868	4.486–7.676	0.001*
30–34	10.656	8.206–13.838	0.001*
35–39	16.364	12.645–21.175	0.001*
40–44	21.946	16.976–28.372	0.001*
45–49	29.508	22.857–38.093	0.001*
Residence	1 (Ref)	1.641–2.016	0.001*
Urban	1.818		
Rural			
Education			
Illiterate	1 (Ref)		
Primary	1.047	0.938–1.168	0.416
Secondary	0.977	0.900–1.060	0.573
Higher secondary	1.031	0.894–1.189	0.671
Occupation			
Unemployed	1 (Ref)		
Professional	0.648	0.298–1.412	0.275
Clerical	1.945	0.412–9.191	0.401
Salesman	1.353	0.726–2.520	0.341
Agricultural	0.579	0.375–0.881	0.011*
Services	0.855	0.629–1.163	0.381
Skilled/Unskilled	0.893	0.620–1.286	0.542
Others	1.184	0.668–2.097	0.563
Wealth index			
Richest	1 (Ref)		
Poorest	7.240	5.608–9.346	0.001*
Poorer	5.159	3.983–6.682	0.001*
Middle	3.570	2.735–4.660	0.001*
Richer	2.099	1.570–2.807	0.001*
Caste			
Non-Tribal	1 (Ref)		
Tribal	1.538	1.412–1.675	0.001*
Marital status			
Unmarried	1 (Ref)		
Married	6.101	5.288–7.038	0.001*
Widow	12.042	9.861–14.706	0.001*
Divorcee	7.355	4.511–11,990	0.001*
Separated	10.407	7.570–14.306	0.001*

* Significant with p-value of below 0.05.

Smokeless tobacco was found to be the dominant form (~93%) of tobacco consumption in the respondents as presented in Table 2. They mostly used paan-tobacco, gutkha-paan masala and chewable tobacco.

Table 2
Forms of tobacco consumption (n = 30,587).

Tobacco form	Tobacco users amongst hypertensives (n = 461) No (%)	Tobacco users amongst non-hypertensives (n = 3472) No (%)	Total (n = 3933) No (%)
N	**461**	**3472**	3933
Smoke	**30 (6.51)**	**237(6.82)**	304(7.61)
Cigarette	1 (0.22)	10 (0.29)	**11 (0.28)**
Pipe	0 (0.0)	4 (0.12)	**4 (0.10)**
Cigar	0 (0.0)	6 (0.17)	**7 (0.15)**
Other smokes	29 (6.3)	217 (6.25)	**246 (6.25)**
Smokeless	**431 (93.49)**	**3235(93.17)**	3629 (92.39)
Chewing tobacco	58 (12.6)	363 (10.5)	**421 (10.7)**
Snuff	5 (1.1)	20 (0.6)	**25 (0.6)**
Gutkha/ paan masala	162 (35.1)	1406 (40.5)	**1568 (39.9)**
Paan-tobacco	206 (44.7)	1446 (41.6)	**1652 (42.0)**

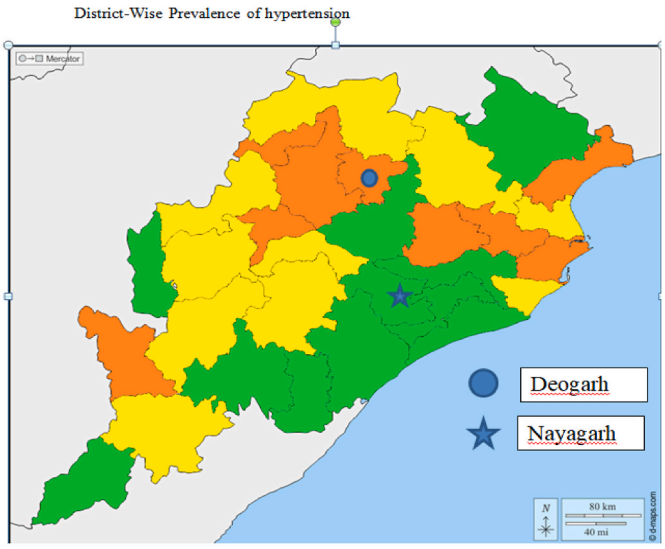

Fig. 1. Distric-Wise prevalence of hypertension.

Table 3
Multivariate logistic regression for various predictors of hypertension.

Independent variables of Hypertension	Adjusted Odds Ratio (AOR)	95% CI	P-value
Age (years)			
15–19	1(Ref)		
20–24	2.167	1.612–2.912	0.001*
25–29	3.362	2.539–4.451	0.001*
30–34	5.939	4.539–7.772	0.001*
35–39	9.422	7.250–12.245	0.001*
40–44	11.943	9.203–15.499	0.001*
45–49	14.515	11.206–18.801	0.001*
Residence		1.131–1.389	0.001*
Rural	1 (Ref)		
Urban	1.254		
Education			
Illiterate	1 (Ref)		
Primary	1.071	0.935–1.227	0.321
Secondary	0.980	0.885–1.085	0.698
Higher Secondary	1.170	0.987–1.388	0.070
Wealth index			
Poorest	1 (Ref)		
Poorer	0.878	0.785–0.982	0.023*
Middle	0.958	0.846–1.084	0.493
Richer	0.982	0.848–1.138	0.813
Richest	1.274	1.089–1.490	0.002*
Caste			
Tribal	1 (Ref)		
Non-Tribal	1.032	0.919–1.158	0.595
Marital status			
Unmarried	1(Ref)		
Married	3.895	3.345–4.536	0.001*
Widow	6.330	5.013–7.991	0.001*
Divorcee	3.135	1.567–6.272	0.001*
Separated	2.715	1.627–4.530	0.001*
Diabetes			
No	1(Ref)		
Yes	1.158	0.884–1.517	0.287
Obesity			
No	1(Ref)		
Yes	2.511	2.118–2.975	0.001*
Tobacco use			
No	1(Ref)		
Yes	1.802	1.609–2.017	0.001*
Tobacco type			
No Tobacco	1(Ref)		
Smoke	1.769	1.206–2.594	0.004*
Smokeless	1.804	1.606–2.027	0.001*

* Significant with p-value of below 0.05.

4. Discussion

The prevalence of tobacco usage among the 15–49 years females of Odisha was estimated from NFHS dataset. 12.85% of the study population used tobacco. It is higher than the national average of 6.8% reported in NFHS-4(2016) for adult females.[5] There has been a decreasing trend of tobacco use across the globe during the last two decades, a drop by 8.2% in females and 12.6% in males. Indian women reported 14.2% prevalence of tobacco addiction (esp. smokeless) as the national average in Global Adult Tobacco Survey (GATS)-2(2017), an encouraging drop of 6% since GATS-1 in 2010. Alarmingly, Odisha, alongside its neighboring states of West Bengal and Jharkhand reported the highest all-age-prevalence of 56.53% of smokeless tobacco users in GATS-II, a surge from 35.6% in 2010.[6]

Most (~93%) tobacco users consumed smokeless forms; 'paan-tobacco' and 'gutkha-paan masala' topped the preference list. Different studies on Indian women have consistently reported smokeless form to be the predominant form of tobacco usage. GATS-I highlighted snuff/oral gul gudakhu (5.82%) and GATS-II reported about 'betel quid with tobacco'(3.91%) to be the most used forms.[6] In 2016, Kerala, Odisha, Tamil Nadu and Goa reported zero prevalence of smoking in females.[7] This pattern may be explained by postulations like more social and familial acceptance of smokeless tobacco in females as it is for smoking in males.

The prevalence of tobacco use increased with increasing age; it was 29 times higher in the 45–49 years sub-group than the 15–19 years sub-group of females. A systematic review by Priya Mohan et al., in 2018 confirms this pattern of relationship of tobacco use and age.[8] A study on Nepalese women aged between 36 and 49 years reported 2.4 times higher usage of any form of tobacco than their younger (15–24 years) counterparts. A number of studies corroborate that prevalence of smokeless tobacco usage increase with age.[5,9,10]

The rural women in Odisha in the reproductive age group had 1.8 times higher risk of tobacco addiction. The country average estimated from NFHS-4 data in some studies reports 8.1% rural prevalence,4.4% urban and 6.8% total prevalence.[8] GATS-II reports that most tobacco consuming women were from rural background with minimal education.[6] Gupta et al. also highlighted about rural dominance in their study in North Indian community.[11]

Among the female subjects surveyed in the present study, the wealth status inversely correlated with tobacco usage in Odisha. Similarly, risk of tobacco addiction in the poorest quintile was more than the richest quintile across all states and UTs except Bihar, Nagaland, and Tripura as reported in GATS-II study.[6]

Educational status carried no association with tobacco usage in the study population covered. Some studies have highlighted educational level as an important contributing factor for tobacco usage with an inverse relationship especially for smokeless forms.[6]

Researchers report an inconsistent association between profession and tobacco addiction.[6,8,12] Odisha demonstrated a similar pattern. Surprisingly, women working in agricultural sector had less risk of being a tobacco user as compared to the unemployed or any other job. This aberration may be explained by the idea that, most probably the NFHS survey missed them during the day time when most of them were in the fields.

The present study reports tribal women having higher prevalence of tobacco abuse in Odisha like any other Indian state.[12] As per 2011 census, Odisha houses the third largest and the sixth densest (22.8%) tribal population in India.[13] Among the tribals in India, 40.6% are below poverty line, 90% live in rural areas, 41% are illiterate. They are identified with poor health indicators, greater morbidity burden and limited access to health care services.[12,14]

Odisha had a prevalence of hypertension at a rate of 7.3% amongst the adult females studied. NFHS-IV data reflected a prevalence of 11.3% as national average in the year 2016. The all age and sex prevalence of hypertension in India was 30.7%; it was 23.7% in women. Eastern zone adults have the highest prevalence in men and women.[15] A similar prevalence of 26.5% was reported by a study using health survey–based nationwide blood pressure data.[16] Anchala et al. reported a similar prevalence of 29.8% in their meta-analysis from 142 hypertension prevalence studies from 1950 to 2013.[17] The lower prevalence reflected in NFHS-IV data may be due to overrepresentation of women (87.2%) and higher younger population (15–49 years).

The present study population demonstrated a linear association between high blood pressure risk and increasing age. The risk increased by about 11–14 folds for the women in the forties as compared to the teens. J. Kishore et al. recognized age as non-modifiable risk factor, attributing to an increased risk of cardiovascular problems, such as hypertension.[18]

Urban females carried a higher risk for hypertension in the present analysis. Gupta et al. (2012) had reported ~17% higher prevalence in urban women aged between 35 and 70 years.[19] A meta-analysis conducted in India in 2014 reports the gap to be 8%.[17] Epidemiological studies over the last 20 years have reported a stabilized urban prevalence around 25–30% with a rising rural trend from 15 to 25%. This urban-rural convergence of hypertension in India may be ascribed to changes in lifestyles of the rural folks.[20]

In Odisha, females in the extremes of wealth strata (poorer & richest) were having higher risk of hypertension. Gupta et al. had reported a higher hypertension prevalence in Indian states with higher urbanization and social development.[21] A study from Maharashtra, based on DLHS-4 (2013) dataset had reports of higher blood pressure prevalence among the elderly, urbanites, rich and obese.[22] In a study in 2020, higher prevalence was linked to older age, male sex, higher BMI, higher wealth status, and urban residence.[21]

In the present study, education status of the respondents did not correlate with risk of hypertension. Most other studies have yielded variable results as regard association of education and hypertension. In an Indian study from Banaras, education, socioeconomic status, and alcohol use were not statistically linked to hypertension.[23] Higher educational status correlated with higher systolic blood pressure in a series of cross-sectional studies on middle-SES urban localities in Jaipur during 1992–2010.[24] Gupta et al. had found similar trends.[19]

Women in tribal community in Odisha were found to be having no protection from hypertension risk as reported in the present study. A study on tribal females in Bihar reported high (12.1%) prevalence of hypertension.[25] Another secondary data analysis in 2020 highlighted scheduled tribes to be having higher risk than those from the upper caste.[26] Kani tribe in Kerala had 48.3% prevalence of hypertension, higher than non-tribals in the state (Sajeev P et al.).[27] The traditional myth that tribals are naturally shielded form CVD risks is slowly melting away. Upliftment in socio-economic standards is exposing the thrifty phenotypes to the risks of abundance.

After adjustment of other confounders, 'ever married' status was found to be a significant determinant (6–10 times) of hypertension risk in adult females. Similarly, in an Iranian longitudinal study 'never married status' had a lower risk of hypertension.[28] Studies form Ghana (2014) and Bhutan (2021) demonstrate that marital status is an independent risk factor for hypertension in Ghana for women, rather than men.[29–31]

Obesity carried a 2.5-fold higher risk for hypertension in the females enrolled from Odisha NFHS-4. However, diabetes had no significant associations with risk of hypertension. A study on nonpregnant females involving 319 subjects by NICPR (National Institute of Cancer Prevention and Research, India) in 2016 had published significant correlation of BMI with systolic and diastolic blood pressure. This association assumes significance since weight is a modifiable risk factor for hypertension and its complications.[32] The working definition of 'diabetes' in the survey did not have the 'postprandial or fasting blood glucose criteria', it only used the 'random blood sugar' instead and hence might have allowed for some missed cases. The lower number of diabetics in the relatively younger female subjects sampled in NFHS-4 may be the explanation. Multiple studies have favored obesity/overweight as a

strong determinant of hypertension in adult females.[33–36]

The present study reports tobacco abuse to be a significant (1.8-fold) determinant of hypertension in adult females even after adjustment of other confounders. This association has been strongly corroborated by various other studies in India and abroad. One publication has highlighted the dual risk of high blood pressure and tobacco consumption esp. in poor women in reproductive age group.[36] Studies from Europe reported higher risk of hypertension for snuff users.[37,38] Use of smokeless tobacco has been proved to be strongly associated with systolic hypertension in females in India.[32] Another study had emphasized about the overlapping risk of CVDs when both hypertension and tobacco use combined.[39] Chewing tobacco have been thought to allow for higher and longer blood levels of nicotine than smoking. The sodium consumed alongside smokeless tobacco also contributes to high blood pressure.

4.1. Strengths and limitations of the study

The survey participants demonstrated a very high response rate of 97% among the eligible women. Respondents with missing data were eliminated during analysis. Confounders like pregnancy have been excluded from the study. The study bears some limitations as well. Overrepresentation of women in the survey may have reflected underreporting or overreporting for some variables Apart from anthropometric, blood pressure and blood sugar measurements, all other information provided was self-reported, which were likely to involve some bias. The blood pressure and blood sugar estimation was done only in single sitting leaving scope for error. Some cases of secondary hypertension might have been included in the surveyed data. The load of tobacco usage in terms of duration and volume has not been estimated in the survey. Second and third hand smoke exposure for the subjects have not been factored in to asses tobacco risks. Causality could not be derived from this cross-sectional study.

4.2. Clinical implication for health managers and policy makers

Health policies and planning need to be prioritized towards targeted approach instead of 'one size fits all' approach followed till date so far as prevention and control of risk factors of tobacco usage and non-communicable diseases like hypertension are concerned.

4.3. Recommendation for future research

Quasi experimental study designs like regression-discontinuity method and interrupted time series can yield more reliable insights towards causality assessment of the risk factors. Quantifying tobacco usage in terms of usage-years or dosing in the primary data series can be more useful.

5. Conclusion

Convergence of many risk factors (residence, wealth status, marital status, age, caste) for both tobacco usage and hypertension in adult females in the reproductive age pose as a multiplying impact on health outcomes in this representative study in a aspirational state of India like Odisha.

Ethical approval

The project was undertaken after allotment under 'open call for writing manuscripts' using NFHS-IV data advertised by the Resource Center for Cardiovascular Health, Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh under the project 'Strengthening management of hypertension services through capacity building, media and communication and stakeholder engagement in the state of Punjab'. The ethical approval for study was obtained from the Institute Ethics Committee, PGIMER, Chandigarh (PGI/IEC/2021/001139).

Availability of data and material

This research work was performed based on secondary data which is freely available in public domain for all registered users from the Demographic and Health Surveys Program (DHS) at https://dhsprogram.com.

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Declaration of competing interest

The authors declared no potential conflicts of interest concerning the research, authorship and/or publication of this article.

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