

Tobacco use and uncontrolled hypertension among Indian men: Insights from the National Family Health Survey (NFHS-4), 2015-2016

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ABSTRACT

Background: Tobacco use is a modifiable risk factor for developing cardiovascular diseases, of which hypertension is a major killer. Uncontrolled hypertension (UHT) is a major public health concern that exerts a financial and service burden on the health system. **Aim:** The current analysis aimed to determine the association between tobacco use and UHT among Indian males. **Material and Methods:** Data from the 4th National Family Health Survey (NFHS) of 1,04,120 men aged 15–54 years were used. We estimated the adjusted prevalence ratio for having UHT among reported tobacco users and non-users. **Results:** The prevalence of UHT was the lowest (41.02%) among those who did not consume tobacco in any form. Among tobacco users, those smoking tobacco had the highest prevalence (53.53%) of UHT followed by those using both smoked and smokeless forms of tobacco (43.84%) and those using only smokeless forms of tobacco (42.26%). Factors significantly associated with UHT were alcohol consumption (aPR: 1.30; 95% CI: 1.19–1.43), belonging to the richer wealth quintile (richest quintile- aPR: 1.27; 95% CI: 1.05–1.38), being overweight (aPR: 3.14, 95% CI: 2.35–4.21), and being obese (aPR: 2.89, 95% CI: 2.12–.94). Higher educational status was significantly protective against UHT (aPR: 0.75; 95% CI: 0.63–0.88). **Conclusions:** Tobacco use is significantly associated with hypertension in Indian men. Addressing tobacco control and prevention of UHT remain the cornerstones for achieving the SDG target 3.4 by 2030, which aims to reduce premature mortality from NCDs by a third by 2030 relative to 2015 levels.

Keywords: Indian men, NHFS-4, tobacco use, UHT

Introduction

Cardiovascular diseases continue to be the world's leading

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cause of disease burden. Hypertension is one of the foremost modifiable risk factors for cardiovascular diseases. It impacts more than 1 billion individuals globally, with two-thirds living in low- and middle-income economies.^[1] Between the years 1975 and 2015, the age-standardized prevalence of high blood pressure decreased globally, by 5.4% in men and 6% in women. In contrast to the worldwide decline in the age-standardized prevalence of hypertension, mean blood pressure has increased among both men and women in Southeast Asia by approximately 3% and 2.5%, respectively.^[2] As per the Indian Council of Medical Council Research (ICMR), one in four adults has high blood

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pressure. Among people with high blood pressure, only half have been diagnosed and only 1 in 10 have blood pressure under control.^[3] Uncontrolled hypertension (UHT) can lead to lower quality of life, disability, and rapid progression to cardiovascular and cerebrovascular endpoints. Ischemic heart disease and stroke, two non-communicable diseases related to hypertension, are among the five leading causes of disability-adjusted life years (DALYs) globally. Between the years 1990 and 2017, the global DALYs for non-communicable diseases (NCDs) surged by 40.1% (36.8–43.0). An epidemiological shift in the most common causes of DALYs for males and females both at middle to high sociodemographic index levels, led by NCDs, has been observed.^[4] As per a recent mathematical modeling study by Das *et al.* conducted over 20 years, at 70% coverage and adherence, the hypertension control intervention could avert 1.68% DALYs and save \$25.6 million annually on CVD prevention and treatment.^[5] The absence of guidelines specific to UHT in India until recently posed an increased challenge towards its prevention and control.^[6]

Tobacco use is a well-known modifiable risk factor for cardiovascular disease. It causes mitochondrial oxidative stress that leads to dysfunction of the endothelium and the development of hypertension.^[7] The use of tobacco by individuals with hypertension accelerates the disease's progression and causes early complications.^[8]

The overall economic costs of tobacco smoking, including healthcare costs and productivity losses, have been estimated to be 1.8% of the global annual gross domestic product (GDP). Nearly 40% of these costs were borne by developing economies, underlining the significant burden these nations incur.^[9] The second Global Adult Tobacco Survey (GATS-2, 2016–17) reports that 42.5% of males and 14.2% of females in India currently use any form of tobacco.^[10]

Target 3.4 of the Sustainable Development Goals aims to decrease premature deaths from NCDs to a third by 2030 relative to 2015 levels. India was the first country to define its national NCD monitoring framework in alignment with the global goals. By 2025, the framework targets a 25% reduction in the prevalence of high blood pressure.^[11] Control of hypertension, a vital risk factor, will remain one of the most crucial steps toward achieving the SDG goal.^[12] An increase in consumption of tobacco products in developing countries may seriously jeopardize the ability to implement effective preventive strategies and manage the rise in regional and national hypertension trends. The 4th National Health Family Survey (NFHS-4), for the first time, has collected data on health-related issues such as hypertension, obesity, and blood glucose levels.

There has been a dearth of literature related to tobacco as an independent risk factor for UHT, particularly in the Indian context. A recent study done on the women of childbearing age (20–35 years) in India based upon the same survey found that the odds of having UHT for tobacco-using women in India was 1.1 (95% CI: 1.01–1.19) times that of tobacco non-users.^[13]

This study is the first to determine the association between tobacco use and UHT in Indian men by collating the available data. The findings of this analysis may provide fresh evidence to policymakers for strengthening the prevention of hypertension and its effective control in developing nations by integrating with tobacco control as both UHT and tobacco control are amenable to be addressed at the primary health care level.

Material and Methods

Data sources and measurement

The current analysis was conducted on data obtained from the 4th NFHS in 2015–2016. The NFHS-4 was a multi-round survey carried out by the International Institute of Population Sciences Mumbai under the Ministry of Health and Family Welfare, Government of India. This nationwide survey collected data from 601,509 households by employing a stratified two-stage sampling design. The sampling units in rural areas were villages, and in urban areas were census enumeration blocks (CEBs).^[14]

The status of tobacco usage and hypertension in 1,04,120 men aged 15–54 years was included in our analysis. The NFHS-4 survey gathered self-reported data on participant's current use of tobacco products in any form, whether smoked (e.g., cigarette, bidi, cigar, pipe, and hookah) or smokeless tobacco products (e.g., paan masala or gutkha, khaini, paan with tobacco, chewing tobacco, snuff, and other). Men's blood pressure measurements are also provided in the survey. The participant's systolic and diastolic blood pressures (SBP and DBP) were recorded three times in a single visit, with at least a 5-min gap between each measurement. All men aged 15–54 years with at least two available readings of blood pressure measurement were included in the analysis; 8002 men, for whom only one reading was available, were excluded from the analysis.

Variables

The NFHS-4 questionnaires (man's and biomarker) contain questions related to the dependent and independent variables. The dependent variable was taken as the presence or absence of UHT (Related Q. No.: 319, 416, 423, and 427). UHT was defined as individuals who were currently on anti-hypertensive medication with an SBP of ≥ 140 mm Hg or a DBP of ≥ 90 mm Hg.^[15] We took the mean of the last two available blood pressure readings. Independent variables included were age (Q. No. 103), education level (Q. No. 108), wealth index quintiles (Q. No. 37, 48, 50, 52), place of residence, tobacco (Q. No. 604, 606, 608, 609), alcohol use and (Q. No. 615), having diabetes mellitus (Q. No. 622), and body mass index (Q. No. 205, 206), which is divided into four broad categories: underweight (BMI: 18.5 kg/m^2), normal (BMI $18.5\text{--}24.9 \text{ kg/m}^2$), overweight (BMI: $25\text{--}29.9 \text{ kg/m}^2$), and obese (BMI: 30 kg/m^2).

Individuals were classified as tobacco users if they said they were currently using one or more of the tobacco products at the time of the survey.

Statistical analysis

IBM SPSS Statistics for Windows, Version 22.0 and Stata v17.0, were utilized to code, enter, and analyze data. We undertook weighted analysis to present categorical data (age, education level, wealth index, type of residence, type of tobacco used, alcohol use, BMI, and presence of diabetes mellitus as numbers and percentage, whereas continuous data were displayed as a mean as well the standard deviation (SD). The prevalence was calculated and reported using descriptive statistics as percentage and 95% confidence intervals. The magnitude of the association was given as adjusted prevalence ratios with 95% CI.

Ethical approval

The study was ethically approved by the Ethics Committee of Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh (PGI/IEC/2021/001139).

Results

Prevalence of UHT and tobacco use

The prevalence of UHT among those taking medication to lower BP was 43.84% (95% CI: 41.31–46.4). The proportion of men using any form of tobacco was 45.5% (95% CI: 44.9–46.1). The majority consumed smokeless tobacco [29.1% (95% CI: 28.6–29.6)], followed by smoked form [24.6% (95% CI: 24.1–25.1)]; dual usage was reported to be 8.4% (95% CI: 8.1–8.7).

Factors associated with UHT

An increase in the prevalence of UHT was observed with increasing age [Table 1]. The prevalence of UHT was higher in the age groups of 40–49 years (54.53%) followed by 50–54 years (53.47%). The highest prevalence of UHT was observed in those educated up to the primary level (50.52%). The prevalence was observed to decrease with increasing levels of education; 43.05% in those educated up to higher secondary and 39.46% in those having education higher than higher secondary. The prevalence was observed to be highest in the richer class (47.79%) and lowest in the poorest class (26.61%). Those residing in urban areas had a significantly higher prevalence of UHT as compared to those residing in rural areas (48.17% vs. 39.92%) [Table 1].

Among tobacco users, those smoking tobacco (cigarette, bidi, and hookah) had the highest prevalence (53.53%) of UHT followed by those using both smoked and smokeless forms of tobacco (43.84%) and those using only smokeless forms of tobacco (khaini, gutkha, and paan masala with tobacco and other chewable tobacco) (42.26%) [Table 1].

Prevalence of UHT was observed to be the highest in the overweight category (55.63%) followed by those who were obese (53.48%), and the lowest prevalence was observed in those who were underweight (18.03%). The prevalence was higher in those suffering from diabetes mellitus as compared to non-diabetics (54.5% vs. 42.36%) and in those consuming alcohol than in non-drinkers (52.54% vs. 39.27%) [Table 1].

Table 1: Prevalence of UHT by selected background characteristics among hypertensive men aged 15-54 years on medication, India, 2015-16 (n=2588)

Characteristics	UHT					P
	Absent		Present		Total	
	n	%	n	%		
Age (years)						<0.001
15-19	129	97.11	8	2.89	137	
20-29	305	82.59	65	17.41	370	
30-39	343	61.11	225	38.89	568	
40-49	448	45.47	506	54.53	954	
50-54	251	46.53	308	53.47	559	
Educational level						0.027
No education	173	51.58	154	48.42	327	
Primary	164	49.48	157	50.52	321	
Secondary	805	56.95	568	43.05	1373	
Higher Secondary and above	334	60.54	233	39.46	567	
Wealth index						0.003
Poorest	153	73.39	73	26.61	226	
Poorer	210	58.99	138	41.01	348	
Middle	298	56.89	228	43.11	526	
Richer	380	52.21	299	47.79	679	
Richest	435	54.03	374	45.97	809	
Type of place of residence						0.014
Urban	574	51.83	486	48.17	1,060	
Rural	902	60.08	626	39.92	1,528	
Tobacco use						0.216
No	797	58.98	556	41.02	1,353	
Smoking	274	46.47	234	53.53	508	
Smokeless	267	57.74	211	42.26	478	
Dual	138	58.29	111	43.84	249	
Drinks alcohol						<0.001
No	1057	60.73	653	39.27	1710	
Yes	419	47.46	459	52.54	878	
Body mass index						<0.001
Underweight	193	81.97	39	18.03	232	
Normal BMI	797	63.05	479	36.95	1276	
Overweight	360	44.37	457	55.63	817	
Obese	123	46.52	132	53.48	255	
Currently has Diabetes*						0.010
No	1351	57.64	980	42.36	2331	
Yes	112	45.5	123	54.5	235	
Total	1476	57.0	1112	43.0	2588	

*n refers to unweighted numbers and the % are weighted, Cases may not be equal, due to "do not know" or missing values

Factors significantly associated with UHT were belonging to the richer wealth quintile (richest quintile- aPR: 1.27; 95% CI: 1.02–1.58), alcohol use (aPR: 1.30; 95% CI: 1.19–1.43), having a normal BMI (aPR: 2.13; 95% CI: 1.59–2.86), being overweight (aPR: 3.14; 95% CI: 2.35–4.21) and being obese (aPR: 2.89; 95% CI: 2.12–3.94). Higher educational status was observed to be significantly protective against UHT: secondary level (aPR: 0.80; 95% CI: 0.69–0.92) and higher than secondary level (aPR: 0.75; 95% CI: 0.63–0.88) [Table 2]. No statistically significant association was observed between the prevalence of UHT and tobacco use: only smoked (aPR: 1.03, $P = 0.64$), only smokeless (aPR: 1.07, $P = 0.24$), and dual use (aPR: 0.99, $P = 0.99$) [Table 2].

Overall hypertension

The prevalence of hypertension in the Indian male population aged 15–54 years was 14.62% (95% CI: 14.28–14.98). Overall, the prevalence of hypertension was significantly higher among the urban people compared to rural (16.39 vs. 13.58%), who consume alcohol (19.34% vs. 12.64%), are either overweight (27.28%) or obese (34.1%) compared to those who are underweight (5.73%) and are currently suffering from diabetes (31.41% vs. 14.25%). Prevalence was significantly lower (13.14%) among those who did not consume tobacco in any form compared to tobacco users (16.74%) [Table 3].

Tobacco use was significantly associated with prevalence of hypertension (only smoked- aPR: 1.11, only smokeless tobacco- aPR: 1.23, dual use- aPR: 1.08; $P < 0.001$) [Table 3]. Wealth quintile (richest quintile- aPR: 1.51; 95% CI: 1.43–1.61), alcohol consumption (aPR: 1.41; 95% CI: 1.37–1.46), being overweight (aPR: 4.17; 95% CI: 3.93–4.43), or obese (aPR: 5; 95% CI: 4.65–5.38) were significantly associated with the prevalence of hypertension [Table 4].

Discussion

UHT is a significant cause of ischemic and hemorrhagic strokes, heart failure, and chronic renal failure; these place a significant economic and service burden on healthcare systems. Demographic and epidemiologic transition, accompanied by increasing population of elderly people, increase in sedentary lifestyle, and obesity associated with expanding urbanization, accompanied by other lifestyle factors such as high salt intake, tobacco, and alcohol consumption are contributing to the

Table 2: Association of tobacco use with UHT among hypertensive men aged 15-54 years currently on medication by selected background characteristics, India, 2015-16

Variables	aPR	Std. err.	P>z	[95% conf. interval]	
Tobacco					
Only smoked	1.03	0.06	0.64	0.91	1.15
Only Smokeless	1.07	0.06	0.24	0.95	1.20
Dual	0.99	0.08	0.99	0.85	1.17
Education level					
Primary	0.92	0.07	0.315	0.78	1.08
Secondary	0.80	0.05	0.001	0.69	0.92
Higher	0.75	0.06	<0.001	0.63	0.88
Wealth quintile					
Poorer	1.15	0.13	0.211	0.92	1.44
Middle	1.23	0.13	0.057	0.99	1.52
Richer	1.22	0.13	0.072	0.98	1.50
Richest	1.27	0.14	0.031	1.02	1.58
Drinks alcohol					
Alcohol	1.30	0.06	<0.001	1.19	1.43
BMI					
Normal BMI	2.13	0.32	<0.001	1.59	2.86
Overweight	3.14	0.47	<0.001	2.35	4.21
Obese	2.89	0.46	<0.001	2.12	3.94

increasing burden of hypertension in India.^[16] Our paper's findings answer the research question involving two critical public health concerns not only in India but worldwide: UHT and tobacco use. Our study reports the prevalence of UHT to be 43.84% among Indian males aged 15–54 years currently on medication to lower BP. An analysis on Indian women of 20–35 years of age by using the same survey data reports the prevalence of UHT as 6%.^[13] The pooled prevalence of UHT was reported to be 48% by a systematic review and meta-analysis done in Ethiopia.^[17] A nationwide survey in Thailand found that 25.6% of males had UHT.^[18] Another large cross-sectional study done in an Indian state reported a 39% prevalence of UHT.^[19] The variations can be explained by the differences in study settings and demographics.

Table 3: Prevalence of hypertension among men aged 15-54 years by selected background characteristics, India, 2015-16 (n*=1,04,120)

Characteristics	Hypertension					P
	Absent		Present		Total	
	n	%	n	%		
Age (years)						<0.001
15-19	16,823	97.42	586	2.58	17,408	
20-29	27,331	91.56	2842	8.45	30,173	
30-39	21,594	83.03	4821	16.97	26,415	
40-49	15,965	75	6007	25	21,972	
50-54	5595	72.27	2557	27.73	8152	
Wealth quintile						<0.001
Poorest	15,436	89.56	1903	10.44	17,339	
Poor	18,960	88.38	2771	11.62	21,731	
Middle	19,289	85.45	3358	14.55	22,647	
Richer	17,799	82.78	3744	17.22	21,543	
Richest	17,044	82.55	4055	17.45	21,099	
Educational level						<0.001
No education	11,350	84.03	2373	15.97	13,723	
Primary	10,769	82.81	2441	17.19	13,210	
Secondary	50,611	86.48	8864	13.52	59,475	
Higher Secondary and above	14,578	84.62	3135	15.38	17,713	
Type of place of residence						<0.001
Urban	31,694	83.61	7055	16.39	38,749	
Rural	55,613	86.42	9757	13.58	65,371	
Drinks alcohol						<0.001
No	62,874	87.36	10394	12.64	73,267	
Yes	24,434	80.66	6418	19.34	30,853	
Body mass index						<0.001
Underweight	18,730	94.27	1472	5.731	20,202	
Normal BMI	55,862	86.97	9765	13.03	65,627	
Overweight	10,596	72.72	4972	27.28	15,568	
Obese	1,748	65.9	1166	34.1	2914	
Currently has Diabetes						<0.001
No	85,387	85.75	15852	14.25	1,01,239	
Yes	1,368	68.59	848	31.41	2216	
Tobacco usage						<0.001
No Tobacco	45,569	86.66	7195	13.14	52,764	
Smoking	14,438	82.88	3000	17.12	17,438	
Smokeless	19,027	83.6	3809	16.4	22,836	
Dual	9,494	85.16	1,827	14.84	11,321	

*n refers to unweighted numbers and the % are weighted, Cases may not be equal due to "do not know" or missing values

Table 4: Association of tobacco use with hypertension among men aged 15-54 years by selected background characteristics, India, 2015-16

Variables	aPR	Std. err.	P>z	[95% conf. interval]	
Tobacco					
Only smoked	1.11	0.02	<0.001	1.06	1.16
Only Smokeless	1.23	0.02	<0.001	1.188	1.28
Dual	1.08	0.02	0.001	1.03	1.14
Education level					
Primary	0.92	0.02	0.004	0.88	0.97
Secondary	0.75	0.02	<0.001	0.71	0.78
Higher	0.76	0.02	<0.001	0.72	0.80
Wealth quintile					
Poorer	1.18	0.03	<0.001	1.11	1.24
Middle	1.30	0.03	<0.001	1.24	1.38
Richer	1.45	0.04	<0.001	1.37	1.53
Richest	1.51	0.04	<0.001	1.43	1.61
Drinks alcohol					
Alcohol	1.41	0.02	<0.001	1.37	1.46
BMI					
Normal BMI	2.01	0.05	<0.001	1.90	2.13
Overweight	4.17	0.13	<0.001	3.93	4.43
Obese	5.00	0.19	<0.001	4.65	5.38

The current study shows that the prevalence of UHT increases with an increase in age and decreases as education level and wealth increases and in urban dwellers. With an increase in household wealth, low- and middle-income countries have witnessed transitions in lifestyle and nutrition leading to increased consumption in high-fat and high-calorie diets accompanied by physical inactivity, following a trend that was observed in the developed countries decades ago.^[20] A recent Indian study also reported higher odds of having high blood pressure in those with higher household wealth.^[21] However, the lowest prevalence observed in the poorest class could be to lack of awareness leading to under or late diagnosis in them.

Constituents of smoked tobacco (nicotine, carbon monoxide, and oxidant gases) and smokeless forms of tobacco (nicotine, licorice, and sodium) are the major contributors and aggravators of cardiovascular disease. Click or tap here to enter text.^[22,23] Among tobacco users, those using smoked forms of tobacco had the highest prevalence of UHT followed by those using both smoked and smokeless forms. A study conducted in Iran to estimate relevant predictors in an adult Iranian population also found high tobacco smoking as one of the main predictors of uncontrolled blood pressure.^[24] The Hypertension Optimal Treatment (HOT) study also found UHT to be associated with tobacco smoking.^[25] However, the prevalence of UHT (among those taking medication for hypertension) was not significantly different among smoked and smokeless tobacco users. This could mean that tobacco use is a significant risk factor for having high BP, while its association with UHT, though aPR >1, was not statistically significant. This, being a cross-sectional study, could be affected by a bias of under-reporting, and those diagnosed

as UHT may have consciously quit tobacco use after some intervention or by self-motivation.

Increased weight gain accompanied with visceral adiposity is a major cause of hypertension, accounting for up to 75% risk for essential hypertension.^[26] Accumulation of adipose tissue in the heart causes various adaptations and alterations besides causing an altered metabolic profile.^[27] Another significant observation in our study is that an increase in BMI is associated with an increased risk of having UHT. Overweight or obese individuals had a 4–5 times higher prevalence of UHT. A study in western India to study the risk predictors of UHT also reported increased BMI as one of the significant attributes for poor BP control.^[28]

Our study also finds that another established risk factor for non-communicable diseases, that is, alcohol, is also independently associated with UHT. Ethanol chronically consumed in large amounts acts as a toxin to the heart and vasculature. The cardiac injury produced by chronic alcohol abuse can lead to heart failure and eventual death. Furthermore, alcohol abuse may exacerbate preexisting heart conditions such as hypertension and cardiomyopathy.^[29] The CONSTANCES population-based study also revealed that the odds of UHT were 1.3 times more with high alcohol consumption in comparison to mild-or-never drinking.^[30]

Strengths

The present paper presents an analysis done using the data from NHFS-4, which is a nationally representative survey. The study included the variables, the data for which has been collected for the first time in the Indian context, namely hypertension, obesity, and diabetes. The study adds to the growing body of evidence establishing a link between tobacco use and UHT, particularly in the Indian context, which may have policy implications for larger public health benefits.

Limitations

NHFS-4 reports data for men aged 15–54 years. The exclusion of older men might have influenced the findings. Because the tobacco use data is based on self-reporting, there is a possibility of reporting bias. The social stigma associated with tobacco use and resultant reporting bias may have led to underestimating the results. Further, only current use of tobacco is measured. Thus, users of tobacco who had quit, especially after a diagnosis of hypertension, may have influenced the strength of association between tobacco use and UHT. Data regarding the optimality of treatment for hypertension was not available and could not be inferred. The study's cross-sectional nature prevents us from drawing causal inferences.

Conclusions

The analysis demonstrates a statistically significant independent association between tobacco use and hypertension in Indian

men and lists the independent risk factors for UHT-alcohol consumption, belonging to richer wealth quintile, and increased BMI. Effective prevention of UHT cannot be possible without addressing the established risk factors, which mainly include tobacco, alcohol, high BMI, and diabetes mellitus. Addressing tobacco control and prevention of UHT could be the critical interventions toward achieving the SDG target 3.4 and national targets, which aim at decreasing premature deaths from NCDs through prevention and treatment by 2030. As prevention of UHT and tobacco control are amenable to be managed at the primary health care level, integration of National Program for Non-Communicable Diseases (NPCDCS) with the National Tobacco Control Program (NTCP) can more effectively address the critical risk factor and strengthen NCD prevention. Scaling up screening for risk factors, awareness generation, and offering cessation services at the existing NCD clinics at CHC and district level^[31] by leveraging strengths of the existing primary health care system and inter-sectoral coordination, the dual burden of tobacco and UHT can be reduced. Besides, roping in existing telemedicine services and health and wellness centers (HWCs) under the flagship scheme of Ayushman Bharat, the Government of India can also support timely identification of risk factors and the population at risk to monitor the progression of disease along with improving the accessibility to health services. Further research in public health practice concerning hypertension and different forms of tobacco would provide impetus to efforts aimed at reduction in NCD rates.

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Conflicts of interest

There are no conflicts of interest.

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