Predictors of hypertension among current smokeless tobacco users in India; analysis from the fourth round of National Family Health Survey (2015–2016)

Vidya G. S[1], Garima Bhatt[2], Jeyashree Kathiresan[3], Shreyans Rai[4], Madhur Verma[5], Sonu Goel[6]

[1]Department of Community Medicine, Rajarajeswari Medical College and Hospital, Bengaluru, Karnataka, [2]Department of Community Medicine and School of Public Health, Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh, [3]National Institute of Epidemiology, Chennai, Tamil Nadu, [4]Biostatistician, Sir H.N. Reliance Foundation Hospital and Research Center, Mumbai, Maharashtra, [5]Department of Community/Family Medicine, All India Institute of Medical Sciences (AIIMS), Bathinda, Punjab, [6]Department of Community Medicine and School of Public Health, Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh, India

Abstract

Background: Hypertension is a major modifiable risk factor for cardiovascular and cerebrovascular diseases. The association between different risk factors including smoking and hypertension is studied extensively; however, there is a paucity of literature with respect to association between smokeless tobacco use and hypertension in India. In the current study, the relationship between smokeless forms of tobacco use and hypertension is being investigated. **Methodology:** This study analyzed the data from fourth round of National Family Health Survey conducted during 2015–2016. Socio-demographic variables such as age, sex, education, wealth index, body mass index, smoked forms of tobacco use, and smokeless forms of tobacco like paan, gutkha, Khaini, etc., presence of co-morbidities were the independent variables. Hypertension was the dependent variable. **Results:** It was observed from the present analysis that, smokeless tobacco use is a risk factor for hypertension both in the case of females OR-1.1**(1.08-1.13) as well as males OR-1.07**(1.03-1.1). The other predictors observed were overweight, consumption of alcohol, and diabetes. **Conclusion:** It was concluded from the present study, that consumption of smokeless tobacco use acts as an independent risk factor for hypertension.

Keywords: Hypertension, India, NFHS, risk factor, smokeless tobacco

Introduction

Cardiovascular diseases remain the leading cause of mortality globally.[1] Hypertension (HTN) is a major modifiable risk factor for most of the cardiovascular diseases including coronary artery disease, heart failure, cerebrovascular disease, and chronic renal failure.[2] In the year 2015, 1 in 4 men and 1 in 5 women had HTN, globally. Fewer, than 1 in 5 with HTN have the problem under control.[3] Worldwide, raised blood pressure (BP) is estimated to cause around 7.5 million deaths, that contributes to about 12.8% of all the deaths. HTN also accounts for 57 million disability adjusted life years (DALYs) or 3.7% of total DALYs.[4] One of the global targets for non-communicable diseases is to reduce the prevalence of HTN by 33% between 2010 and 2030.[5] Goal 3 of the Sustainable Development Goals (SDGs) aims at reducing by

Access this article online

Quick Response Code:

Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_318_22

How to cite this article: Vidya GS, Bhatt G, Kathiresan J, Rai S, Verma M, Goel S. Predictors of hypertension among current smokeless tobacco users in India; analysis from the fourth round of National Family Health Survey (2015-16). J Family Med Prim Care 2022;11:5785-91.

one third, premature mortality from non-communicable diseases through prevention and treatment by the year 2030.[6]

The prevalence of HTN has increased in the recent decades, especially in low- and middle-income countries (LMICs), with one in three persons affected by the disease.[7] India is home to 207 million hypertensive individuals.[8] As per the estimates by the World Health Organization (WHO), the overall prevalence of HTN in India for the age group of 18–49 years is around 7.5%.[9] The fourth round of the National Family Health Survey (NFHS-IV) evaluated HTN, in a large population-based sample (*n* = 799,228) and reported the prevalence of HTN to be 13.8%, and 8.8% (overall 11.3%) in men and women aged 15–54 and 15–49, respectively.[8]

Among various risk factors which predispose to HTN (both modifiable and non-modifiable), tobacco use is a modifiable and preventable risk factor.[10] According to second round of the Global Adult Tobacco Survey conducted in India between 2016 and 2017, the percentage of smokeless tobacco (SLT) users among men and women were 29.6% and 12.8%, respectively (overall 21.4%). SLT contains more nicotine than cigarettes which makes it more addicting than the smoked forms and causes similar sympathetic neural stimulation and acute cardiovascular effects.[11,12]

BP levels are also affected by the high sodium content of SLT, as well as by two of its pharmacologically active ingredients used a flavorants; Licorice and Nicotine. Licorice inhibits the metabolism of mineralocorticoids and indirectly causes sodium retention, thereby increasing BP levels.[13] The acute effects of SLT have been documented by increase of up to 21 mm Hg in systolic BP and 14 mm Hg in diastolic BP and by an average increase of 19 beats per minute in heart rate. These effects are likely related to activation of the sympathetic nervous system.[13]

The association between different risk factors and HTN is studied extensively. Overwhelming evidence supports the conclusion that, smoking leads to HTN.[14-16] However, there is a paucity of literature with respect to association between SLT use and HTN at the national level. Considering the higher prevalence of SLT usage than the smoked form of tobacco, SLT has not received desired attention from the public, researchers, and policymakers. Hence there is a pressing need for advancing and strengthening research on SLT use and HTN. With this background, the current study aims at measuring the association between SLT use and HTN at the national level.

Methodology

Study design: We adopted a cross-sectional design to do this secondary data analysis.

Data source

This study analysed the data from the fourth round of National Family Health Survey (NFHS) conducted between 2015 and 2016. NFHS is a large scale multi-round survey conducted in a representative sample of households throughout India under the stewardship of the Ministry of Health and Family Welfare (MoHFW), Government of India. The fourth round of NFHS was coordinated by the International Institute for Population Sciences (IIPS), Mumbai, and implemented by a group of Field Agencies (FAs) and Population Research Centres (PRCs). It covered all the 29 districts and 6 union territories of India. NFHS-4 sample size was approximately 601,509 households. It covered a sample size of 6,99,686 women and 1,12,122 men. The data on males and females were merged together and were analysed in the current analysis. The detailed methodology of the survey is described elsewhere (NFHS-4 manual).[17]

In the fourth round, BP measurements were recorded for the first time. It provided population-based estimates of BP levels among women and men of age group 15–49 and 15–54 years, respectively.

Study sample and sampling design

For the present study, we included the entire data set for both men and women who participated in the survey. The NFHS-IV adopted a two-stage sampling approach for the selection of primary sampling units (PSUs), that is, villages and CEB in the rural and urban stratum separately. The survey utilizes the census data of 2011 as the sampling frame. Probability proportional to size (PPS) sampling was used to select villages/CEBs within each rural/urban stratum. In all the selected urban and rural PSU, complete household listing and mapping operation were conducted before the survey. Selected PSUs with an approximate number of 300 households were divided into segments of 100–150 households. Two of these segments were selected randomly for survey by systematic sampling with probability proportional to segment size. Therefore, clusters in NFHS-4 can be either PSU or a segment of PSU. Details on validation and usage of the household questionnaires, data collection procedure, and data validation, have been comprehensively described and published as a separate report elsewhere.[18]

Study variables

HTN was our primary dependent variable. BP was measured using an OMRON BP instrument during the survey. Three consecutive readings were taken 5 min apart. The BP level was calculated using the average of the last two readings. We adopted the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7), as per which HTN is defined as a systolic BP level of 140 mm Hg or higher or diastolic BP level of 90 mm Hg or higher.[16] Apart from this, any person taking medication to lower BP at the time of the survey was also considered hypertensive and included in our analysis. HTN was based on either of the two criteria, that is, "currently taking a required medicine to lower blood pressure" or *"high blood pressure on two or more occasions told by a doctor or a health care professional"(Q No 316,323,327).* The variable "Newly detected blood pressure" was created taking the average of the last two readings of BP.

SLT usage in the form of Khaini, Gutkha, Paan, Snuff, etc., was the primary predictor variable. SLT use was ascertained in the survey based on "yes" or "no" response to the question: *Whether the respondent currently uses any form of smokeless tobacco such as, chewable tobacco, snuff, gutkha, paan etc., (Q No 709 & 710 for women and Q No 608 & 609 for men).*

Other covariates considered were based upon a literature review and scientific plausibility. We included age (20–29, 30–39, and 40–49 years for women, and 50–54 years for men), levels of education (No Education, Primary, Secondary, and higher levels), place of residence (rural/urban), wealth index quintile (poor, middle, rich), smoked tobacco consumption (ever tobacco users), and presence or absence of comorbidities (Diabetes, Heart Disease).

Statistical analysis

The information obtained from the NFHS-4 survey was analyzed using STATA version 14 softwareusing appropriate sampling weights. The weighted prevalence of HTN among men and women was reported in percentages. Bi-variate analysis was used to identify the association between HTN and predictor variable and co-variates. Variables showing *P* value less than 0.2 were included for the multi-variate logistic regression analysis. Independent predictors were identified using multi-variate logistic regression analysis and adjusted odds ratios and confidence intervals were calculated. A *P* value of less than 0.5 is considered to be statistically significant.

Ethical considerations

The data were obtained from NFHS-4 survey, which is available for open access in public domain. There are no identifiers mentioned in the data and only aggregate results are mentioned. Ethical approval for the same was obtained from the Institutional Ethics Committee of Post Graduate Institute of Medical Education and Research (PGIMER) Chandigarh. (PGI/IEC/2021/001139).
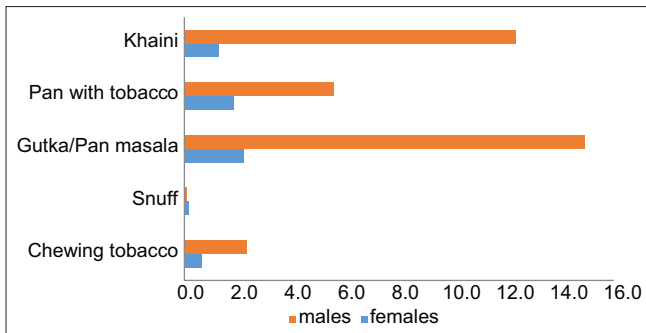
Results

A total of 8,11,808 individuals were included in the present analysis. Table 1 depicts the socio-demographic characteristics of the survey participants. The number of females were 6,99,686 (86.2%), and the number of males were 1,12,122 (13.8%). The mean ± (SD) age of the participants was 30.9 (± 10.0) years. It was observed in the present analysis that, 61.69% of the study participants lived in rural areas, 13% had no form of formal education and 14.66% belonged to the 'poor' category as per the wealth index. The proportion of smokeless tobacco users were 5.59% among females and 29.09% among males. Figure 1 represents the overall consumption of smokeless forms of tobacco among the study population. It was observed that, the consumption of smokeless forms of tobacco was more among males compared to females. Gutkha or Paan masala were the most commonly consumed forms of tobacco among both males and females. It was observed that,

the prevalence of HTN among smokeless tobacco users was 17.16% among males and 15.48% among females. Similarly, the prevalence of HTN among males and females based on selected sociodemographic variables were compared [Table 2].

It was observed that, consumption of smokeless tobacco was significantly associated with HTN both among females

Table 1: Sociodemographic details of the adults who participated in the fourth round of the National Family Health Survey-India (2015-2016)

	Female		Male	
	n	**%**	*n*	**%**
Smokeless Tobacco	39,145	5.6	32,621	29.1
Smoked Tobacco	6,763	1.0	16,705	14.9
Type of place of residence				
Urban	2,42,225	34.6	42,952	38.3
Rural	4,57,461	65.4	69,169	61.7
Age Group				
15-24	2,74,608	39.3	39,368	35.1
25-34	2,10,148	30.0	31,049	27.7
35 plus	2,14,930	30.7	41,705	37.2
Highest Education Level				
No education	1,92,135	27.5	14,590	13.0
Primary	87,233	12.5	14,091	12.6
Secondary	3,31,037	47.3	64,010	57.1
Higher	89,281	12.8	19,431	17.3
Wealth Index				
Poor	1,24,054	17.7	16,440	14.7
Poorer	1,36,900	19.6	20,904	18.6
Middle	1,43,814	20.6	23,687	21.1
Richer	1,47,978	21.2	24,976	22.3
Richest	1,46,939	21.0	26,114	23.3
Currently has diabetes				
No	6,77,308	98.3	1,08,464	97.9
Yes	11,655	1.7	2,384	2.2
Currently has heart disease				
No	6,86,424	98.7	1,10,154	98.8
Yes	9,417	1.4	1,320	1.2
Alcohol Consumption				
No	6,91,048	98.8	79,036	70.5
Yes	8,638	1.2	33,086	29.5
BMI				
Underweight	1,54,300	22.5	21,453	19.7
Normal	3,92,668	57.1	65,982	60.7
Overweight	1,40,187	20.4	21,265	19.6
Smokeless Tobacco				
Chewing tobacco	4,643	0.7	2,618	2.3
Snuff	1,029	0.2	97	0.1
Gutkha/Pan masala	15,440	2.2	16,729	14.9
Pan with tobacco	12,780	1.8	6,244	5.6
Khaini	8,926	1.3	13,861	12.4
Smoke Tobacco				
Cigarrette	639	0.1	15,341	13.7
Pipe	219	0.0	210	0.2
Cigars	588	0.1	539	0.5
Smokes Others	4,212	0.6	512	0.5
Hookah	1,202	0.2	714	0.6

Figure 1: Pattern of smokeless tobacco use among the adults included in the National Family Health Survey-4, in India, 2016 (n = 811808)

OR-1.1** (1.1-1.1) and males OR-1.07** (1.0-1.1). However no significant association between consumption of smoked forms of tobacco and HTN was found both in males OR-0.97 (0.9-1.0) and females OR-1.0 (1.0-1.1). Presence of other risk factors like, "currently having diabetes, heart disease, and consumption of alcohol and being overweight" were significantly associated with HTN [Table 3].

Discussion

SLT use had received less attention from the global health community than smoked tobacco use. However, the practice is popular in many parts of the world including India and has been linked to several adverse health outcomes.[19] India is the second largest consumer of tobacco.[20] The use of SLT is more than twice that of smoking (10.7%). This can be attributed to a variety of tobacco products that are available at very low prices in the country.[21] In the present secondary data analysis of NFHS-IV which included 8,11,808 adults in India, we observed that, the prevalence of SLT usage was more among the males (29.09%) compared to the females (5.59%). We also observed high prevalence of SLT usage with wide disparities among men and women. These percentages when translates into numbers cannot be ignored. According to Mishra *et al.*,[22] about 22.30% of the total female population consumed tobacco, which was mainly in SLT form, compared to 0.5% of the tobacco users using smoked tobacco. This is similar to the present study, where the consumption of SLT of tobacco use is more, compared to smoked forms of tobacco, which can be attributed to accessibility and availability of smokeless forms of tobacco at lower prices in India. The high usage depicts the wide gap in existing SLT control policies and their enforcement due to lack of research, training, capacity, and adequate resources. India has taken steps in tobacco control both at national and sub-national levels which has resulted in significant reduction in tobacco use between 2009–2010 and 2016–2017, but with wide regional variations. Several tobacco control policies applicable to smoking products hitherto did not apply to SLT products.[13]

We observed that gutkha and khaini are the two most commonly used forms of SLT in India, which is in concordance to previous

Table 2: Overall prevalence of hypertension among males and females based on selected sociodemographic co-variates		
	Hypertension (%)	
	Male	**Female**
Total participants		
Overall percentage	16.1	11.0
Type of place of residence	***	***
Urban	18.1	12.0
Rural	14.9	10.4
Age Group	***	***
15-24	5.8	3.8
25-34	14.6	9.7
35 plus	26.7	21.3
Highest Education Level	***	***
No education	17.2	14.1
Primary	18.4	13.2
Secondary	14.8	9.3
Higher	17.5	7.9
Wealth Index	***	***
Poor	11.4	9.3
Poorer	12.6	9.9
Middle	15.9	10.4
Richer	18.9	12.3
Richest	19.4	12.6
Currently has diabetes	***	***
No	15.6	10.6
Yes	37.8	30.2
Currently has heart disease	***	***
No	15.9	10.8
Yes	29.2	22.7
Drinks alcohol	***	***
No	14.2	10.9
Yes	20.6	18.0
BMI	***	***
Underweight	6.7	5.6
Normal	14.2	9.1
Overweight	31.3	22.1
Smokeless tobacco	***	***
No	15.6	10.7
Yes	17.2	15.5
Smoke tobacco	***	***
No	15.7	10.9
Yes	18.1	14.3

*** $P < 0.001$

estimates.[13] Khaini is prepared from sun-dried tobacco and slaked lime. Gutkha is a ready-to-eat SLT product comprised of areca nut, slaked lime, catechu, tobacco, flavoring agents, and sweeteners. In addition, it also contains iron, magnesium, and a number of other toxic trace elements. The addition of slaked lime and other alkaline agents like magnesium carbonate boosts the pH of the product and results in increased availability of free nicotine, the form that is most easily absorbed increasing the potential for addiction.[23] The addiction is responsible for a plethora of adverse effects.[24] High levels of nicotine cause immediate vasoconstriction by increasing the levels of adrenaline, elevated pulse rate, and high BP. Some SLT products contain

Table 3: Multivariate binary logistic regression analysis to depict the predictors of hypertensionamong malesand females adults included in the National Family Health Survey -4 (2015-2016)

Hypertension	Female		Male	
	UOR (95% CI)	AOR (95% CI)	UOR (95% CI)	AOR (95% CI)
Smokeless tobacco				
No	1	1	1	1
Yes	1.4*** (1.4, 1.5)	1.1*** (1.1,1.1)	1.1*** (1.1, 1.6)	1.1*** (1.0,1.1)
Smoke tobacco				
No	1	1	1	1
Yes	1.4*** (1.3, 1.4)	1.0 (0.9,1.1)	1.2 *** (1.1,1.2)	1.0 (0.9,1.0)
Place of residence				
Urban	1	1	1	1
Rural	0.9 *** (0.8,0.9)	1.1*** (1.0,1.1)	0.8*** (0.8, 0.8)	1.0 (1.0,1.0)
Age Group				
15-24	1	1	1	1
25-34	2.6*** (2.5, 2.7)	2.1*** (2.0,2.1)	2.6*** (2.5,2.8)	2.0*** (1.9,2.2)
35 plus	6.3*** (6.2, 6.5)	4.5*** (4.4,4.6)	5.6*** (5.1, 5.6)	3.9*** (3.8,4.2)
Highest Education				
No education	1	1	1	1
Primary	0.9*** (0.9, 0.9)	1.03** (1.0,1.1)	1.0 (0.9,1.1)	1.0 (0.9,1.1)
Secondary	0.6*** (0.6, 0.6)	0.9*** (0.9,0.93)	0.8*** (0.8, 0.9)	1.0 (0.9,1.0)
Higher	0.5*** (0.5, 0.6)	0.8*** (0.7,0.8)	1.1** (1.0,1.1)	1.1** (1,1.1)
Wealth Index				
Poor	1	1	1	1
Poorer	1.1*** (1.1, 1.1)	1.1*** (1.1,1.1)	1.2*** (1.1,1.2)	1.2*** (1.1,1.2)
Middle	1.2*** (1.2, 1.2)	1.1*** (1.1,1.1)	1.4*** (1.4, 1.5)	1.3*** (1.2,1.4)
Richer	1.4*** (1.3, 1.4)	1.1*** (1.1,1.1)	1.8*** (1.6, 1.8)	1.4*** (1.3,1.5)
Richest	1.4*** (1.4, 1.5)	1.1*** (1.1,1.1)	2.0*** (1.9, 2.1)	1.4*** (1.34,1.5)
Currently has diabetes				
No	1	1	1	1
Yes	3.6*** (3.5, 3.8)	1.8***(1.7,1.9)	2.7*** (2.5, 2.9)	1.5*** (1.3,1.6)
Currently has heart disease				
No	1	1	1	1
Yes	2.3*** (2.2, 2.4)	1.5*** (1.4,1.6)	2.0*** (1.7, 2.2)	1.4*** (1.2,1.6)
Drinks alcohol				
No	1	1	1	1
Yes	1.9*** (1.8, 2.0)	1.6*** (1.5,1.7)	1.6*** (1.5, 1.6)	1.4*** (1.3,1.4)
BMI				
Underweight	1	1	1	1
Normal	1.7*** (1.6,1.7)	1.4*** (1.3,1.4)	2.2*** (2.1, 2.3)	1.7*** (1.6,1.8)
Overweight	4.8*** (4.7, 4.9)	3.0*** (3.0,3.1)	6.3*** (5.9, 6.7)	3.8*** (3.5,4.0)
Constant		0.03*** (0.03,0.03)		0.03*** (0.03,0.03)
Pseudo R^2		0.0989		0.10

large amounts of sodium as part of the sodium bicarbonate alkaline buffer that is necessary to facilitate nicotine absorption that contributes to HTN.

In our study we observed that, the consumption of SLT was a statistically significant risk factor for HTN in both females and males. The findings of the present study were in par with the other sub-national studies from India. **Gupta** *et al*.[25] observed that SLT users from north western India had a significantly higher (p < 0.001) systolic and diastolic BP, resting heart rate, total cholesterol, LDL cholesterol, and triglycerides compared to the controls and the risk was similar to smoker group. Another study conducted by **Pandey** *et al*.[26] **also depicted**

higher mean systolic and diastolic BP in exclusive SLT users (systolic BP = 139.2 + 17.4, diastolic BP = 86.8 + 11.5) compared to the non-users (systolic BP = 135.7 + 18.8, diastolic BP = 82.6 + 11.5; *P* value < 0.05).[2] The prevalence of diastolic HTN was also significantly higher in exclusive SLT users compared to the non-users (40.9%, 22.9%; *P* value < 0.01). Another study by **Annaji B** *et al*.[27] also observed higher mean systolic and diastolic BP in SLT users. The mean (± SD) of systolic and diastolic BP were 158.72 ± 24.84 and 98.78 ± 9.87 mm Hg. A similar study from SEAR compared BP between smokers and SLT users and found a significantly higher mean diastolic BP in SLT users compared to smokers, but was limited by a small sample size.[28]

There were higher odds of developing HTN in SLT users compared to the smoked form which is in coherence to the previous studies. Higher age, richest quintile (in males), alcohol consumption, and higher BMI emerged as significant predictors of HTN in our study. These factors are in concordance to previous studies from India and aboard.[29]

There are certain strengths and limitations of the present study that should be acknowledged. The major strength is the large sample size of the survey that was collected following a rigorous methodology which is nationally representative along with strong data quality assurance. The weighted analysis makes the estimates robust and generalizable. However, since the present study was cross sectional in nature, temporal association between exposure to SLT and development of HTN could not be assessed. Being a secondary data analysis, it was not possible to evaluate certain other covariates that may affect HTN in people with SLT usage.

To conclude, we reinforce that fact that the consumption of SLT is an independent risk factor for HTN. The study highlights the confluence of two major public health problems in India; HTN and SLT usage which is taking the shape of an epidemic. They cause of a plethora of adverse effects and have a significant impact on morbidity and mortality, which are exponentiated when the two factors work together. Considering a high number of people consuming SLT in India as compared to smoked forms of tobacco, it is recommended that appropriate advocacy against the harmful effects of tobacco should be done with the same magnitude that is used against cigarettes and smoked forms of tobacco. The current policies against consumption of smokeless forms of tobacco should be strengthened and strictly enforced. There is also a need for a bidirectional screening, where doctors and other health workers should emphasize on quitting tobacco use at HTN clinics and measurement of HTN in de-addiction clinics coupled with appropriate referral, which would help in reducing the burden of the two problems in the years to come.

Conflicts of interest

There are no conflicts of interest.

References

1. Namara KM, Alzubaidi H, Jackson JK. Cardiovascular disease as a leading cause of death: How are pharmacists getting involved?. Integr Pharm Res Pract 2019;8:1-11.

2. Ibekve RU. Modifiable risk factors of hypertension and socio-demographic profile in Oghara, Delta State; Prevalence and correlates. Ann Med Health Sci Res 2015;5:71–7.

3. "Hypertension". World Health Organization. 2019. Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension. [Last accessed on 2021 Oct 28].

4. The global health observatory. WHO. Available from: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/3155. [Last accessed on 2021 Sep 20].

5. Global NCD target to reduce high blood pressure. Available from: https://www.who.int/beat-ncds/take-action/policy-brief-reduce-high-blood-pressure.pdf. [Last accessed on 2021 Jul 15].

6. Sustainable development goals; WHO 2020. Available from URL: https://www.who.int/health-topics/sustainable-development-goals. [Last accessed on 2021 Dec 10].

7. Sarki AM. Prevalence of hypertension in low and middle income countries. A systematic review and meta-analysis. Medicine (Baltimore) 2015;94:e1959.

8. Gupta R, Gaur K, Ram CVS. Emerging trends in hypertension epidemiology in India.-Nature. J Hum Hypertens 2019;33:575-87.

9. Hypertension fact Sheets. WHO. Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension. [Last accessed on 2021 Aug 15].

10. Non Communicable Diseases. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases. [Last accessed on 2021 Dec 12].

11. Smokeless Tobacco Products, Including Dip, Snuff, Snus, and Chewing TobaccoU S Food & Drug Administration. Available from: https://www.fda.gov/tobacco-products/products-ingredients-components/smokeless-tobacco-products-including-dip-snuff-snus-and-chewing-tobacco. [Last accessed on 2021 Dec 12].

12. Global Adult Tobacco Survey (GATS)-2 Fact Sheet India (2016-17). Available from: https://www.who.int/tobacco/surveillance/en_tfi_india_gats_fact_sheet.pdf. [Last accessed on 2021 Dec 12].

13. Yadav A, Singh PK, Yadav N, Kaushik R, Chandan K, Chandra A, *et al*. Smokeless tobacco control in India: Policy review and lessons for highburden countries. BMJ Global Health 2020;5:e002367.

14. Virdis A, Giannarelli C, Neves MF, Taddei S, Ghiadoni L. Cigarette smoking and hypertension. Curr Pharm Des 2010;16:2518-25.

15. Omvik P. How smoking affects blood pressure. Blood Press 1996;5:71-7.

16. Primatesta P, Falaschetti E, Gupta S, Marmot MG, Poulter NR. Association between smoking and blood pressure. Hypertension 2001;37:187–93.

17. International Institute for Population Sciences (IIPS). National Family Health Survey (NFHS-4), 2015-16: India. Vol 1. Mumbai: IIPS; 2017.

18. National Family Health Survey, India. Available from: http://rchiips.org/nfhs/nfhs4.shtml. [Last accessed on 2021 Dec 12].

19. Kendrick PJ, Reitsma MB, Abbasi-Kangevari M, Abdoli A,

Abdollahi M, Abedi A, *et al.* Spatial, temporal, and demographic patterns in prevalence of chewing tobacco use in 204 countries and territories, 1990–2019: A systematic analysis from the Global Burden of Disease Study 2019. Lancet Public Heal 2021;6:e482–99.

20. Giovino GA, Mirza SA, Samet JM, Gupta PC, Jarvis MJ, Bhala N, *et al.* GATS Collaborative Group. Tobacco use in 3 billion individuals from 16 countries: An analysis of nationally representative cross-sectional household surveys. Lancet 2012;380:668-79.

21. Tobacco. World Health Organization. Available from: https://www.who.int/india/health. [Last accessed on 2021 Dec 12].

22. Mishra GA, Kulkarni SV, Gupta SD, Shastri SS. Smokeless tobacco use in Urban Indian women: Prevalence and predictors. Indian J Med Paediatr Oncol 2015;36:176–82.

23. Shukla AK, Khaitan T, Gupta P, Naik SR. Smokeless tobacco and its adverse effects on hematological parameters: A cross-sectional study. Adv Prev Med 2019;2019:3182946.

24. Rostron BL, Chang JT, Anic GM, Tanwar M, Chang CM, Corey CG. Smokeless tobacco use and circulatory disease risk: A systematic review and meta-analysis. Open heart 2018;5:e000846.

25. Gupta R, Gupta S, Sharma S, Sinha DN, Mehrotra R. A systematic review on association between smokeless tobacco & cardiovascular diseases. Indian J Med Res 2018;148:77-89.

26. Pandey A, Patni N, Sarangi S, Singh M, Sharma K, Vellimana AK, *et al.* Association of exclusive smokeless tobacco consumption with hypertension in an adult male rural population of India. Tob Induc Dis 2009;5:15.

27. Annaji B, Sreedevi P, Sudheer K. Changes in Cardiovascular system among smokeless tobacco users attending tertiary care hospital in Andhra Pradesh, India. IJMRR 2020;8:4.

28. Habib N, Rashid M, Begum U, Ahter N, Akhter D. Blood pressure parameters among smokers and smokeless tobacco users in a tertiary level hospital. Med Today 2013;25:28-31.

29. Diendéré J, Zeba AN, Nikièma L, Kaboré A, Savadogo PW, Tougma SJB, *et al.* Smokeless tobacco use: Its prevalence and relationships with dental symptoms, nutritional status and blood pressure among rural women in Burkina Faso. BMC Public Health 2020;20:579.