Original Article

Urban–rural disparities in blood pressure and lifestyle risk factors of hypertension among Indian individuals

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Abstract

Objectives: This study aims to assess the urban–rural difference in prevalence of hypertension (HT) and to explore the disparities in lifestyle risk factors of HT among urban and rural individuals aged 15–49 years in India. **Study Design:** The cross-sectional data collected as a part of the fourth round of National Family Health Survey (NFHS-4) was analysed in this observational study. NFHS-4 was conducted between January 2015 and December 2016 amongst men aged 15–54 years and women aged 15–49 years. In order to maintain uniformity, age group of 15–49 years was considered. Descriptive analyses were performed for sociodemographic and lifestyle factors. Binary logistic regression was conducted to assess the predictors of HT in men and women in urban and rural settings. The presence of HT was considered as the outcome variable. **Results:** The overall age adjusted prevalence of HT was 17.2% and was greater in urban (18.3%) than in rural population (15.5%). The age adjusted prevalence was also higher in males (18.2%) as compared to females (16.1%). Age and wealth were associated with HT in both urban and rural population. Education and dietary habits played a role in all except rural men. Alcohol consumption, diabetic status and marital status were significantly associated with HT in both urban and rural women. Occupation was associated with HT only in urban women. **Conclusions:** The study has shown higher HT prevalence in urban areas despite higher prevalence of lifestyle risk factors in rural settings. This calls for more robust screening and health education in the entire population, especially in rural areas.

Keywords: Blood pressure, hypertension, NFHS-4, risk factors

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Introduction

Hypertension (HT) is a major noncommunicable disease (NCD) and preventable risk factor for cardiovascular diseases (CVDs) around the globe.[1] Global Burden of Hypertension Survey shows that HTN (in India) accounts for 32% of adult deaths and around 39 million Disability Adjusted Life Years in the year

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2016.[2] HT is associated with 9.5 million deaths worldwide. A sharp increase in HT prevalence from 23.8% in 2000 to 31.5% in 2010 was recorded amongst low- and middle-income countries (LMICs), despite recognition of HT as a risk factor for CVD, robust screening mechanisms and availability of inexpensive treatment. This may be attributed to rapid transition in demographics, environment and lifestyle.[3]

The Sustainable Development Goal targets for NCD include the reduction of prevalence of HT by 25% between 2010 and 2025[4], and India, as a developing nation, aims one-third reduction in the premature deaths due to NCDs by 2030. A National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke was launched by the Ministry of Health and Family Welfare, Govt. of India in 2010 and a component of population-based screening was added subsequently for achieving the committed targets. With age standardization, HT was higher in males (31.9%) than females (30.1%). Likewise, HTN is 31.9% in LMICs compared to 28.5% in high-income countries.[5]

The Prospective Urban Rural Epidemiology study conducted between 2003 and 2009 included 153,996 adults aged 35–70 years from 17 countries compared HT prevalence between rural–urban populations. The study found that awareness, treatment and control of HT were higher in urban than in rural populations in low-income countries. Pointers representing human resource development and infrastructure were developed to understand the rural–urban disparity. The proportion of hypertensive patients with controlled blood pressure was higher in urban areas in all countries invariably.[6]

A study by Daştan İ, Erem A and Çetinkaya V found that factors like age, obesity, diabetes mellitus, hyperlipidemia, alcohol intake and smoking were associated with HT regardless of the residential area (urban and rural). However, rural–urban differences were significant in the factors like marital status, occupation, mental health, diet and physical activity.[7]

Studies on urban rural disparities with respect to lifestyle factors have been conducted only on regional levels and the findings vary between the studies. Urbanization has been shown to cause a higher prevalence of risk factors of NCDs among women than men.[8] Rural to urban migration have shown to increase the prevalence of obesity, blood pressure, lipid and fasting glucose levels only in men.[9] Altered diets and diminished physical activity partly increase the conventional CVD risk factors in urban middle class men.[10] The current study attempts to assess the urban–rural disparities in HT prevalence and lifestyle risk factors of HT, using nationally representative data in India.

Methods

The data collected in one of the Demographic and Health Surveys (DHS), that is, National Family Health Survey 4 (NFHS-4), conducted between January 20, 2015 and December 4, 2016 across all 29 states and 7 union territories was used for the present study. NFHS 4 was led by the Indian Institute of population sciences, under Ministry of Health and Family Welfare, with technical guidance from ICF International. The survey is illustrative at the district, state and national levels. NFHS-4 followed a two-stage stratified random sampling approach by allotting primary sampling units and households in the first and second stage, respectively. Any respondent unavailable at the visits was tried to be contacted for a maximum of three times. The survey included men of 15–54 years and women of 15–49 years considering a 5-year spousal age gap. However, during analysis, men and women aged 15–49 years were taken to maintain uniformity in the age range.

The biomarker questionnaire collected details on blood pressure, which included three BP readings. The respondents were also asked if they had ever got their blood pressure measured before, if they had been diagnosed with HT previously and/or if they were taking any prescribed medicine for the same. The survey used a standardized field procedure for measuring biomarkers, questionnaires to provide high-quality data and ensure comparability across the country. The respondents' arm circumference was measured to select an appropriate blood pressure monitor cuff size. Blood pressure readings were recorded thrice using the BP monitoring device OMRON. The first reading was made null and void, and the average of second and third readings was considered. If only two readings were available, the second was considered and if only single reading was available, the same was considered.

Ethical approval

This study is limited to publicly available, deidentified data collected as part of periodic surveillance. The study was ethically approved by the Institute's Ethical Committee, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh (PGI/IEC/2019/002357).

Statistical analysis

SPSS licensed version 21.0 was used to perform the statistical analyses. The outcome of this study was the presence of HT. Hence, regression analysis was conducted only on those had either been diagnosed with HT previously (Q318) or taking prescribed antihypertensive medications (Q319) or had systolic reading of >139 mm Hg or diastolic reading >89 mm Hg (Q329–335). As shown in Figure 1, out of a total of 103,525 men and 699,686 women interviewed, 100,449 men and 687,246 women have responded to thequestions related to BP and/or had their blood pressure recorded.

Age-adjusted prevalence of HT was estimated for all states and urban–rural populations. Binary logistic regression was performed with relevant sociodemographic and lifestyle factors. Gender, an important determinant, was considered to provide better insight into understanding the variations of HTN prevalence and predictors in urban and rural settings. Hence, four binary logistic regression analyses were performed

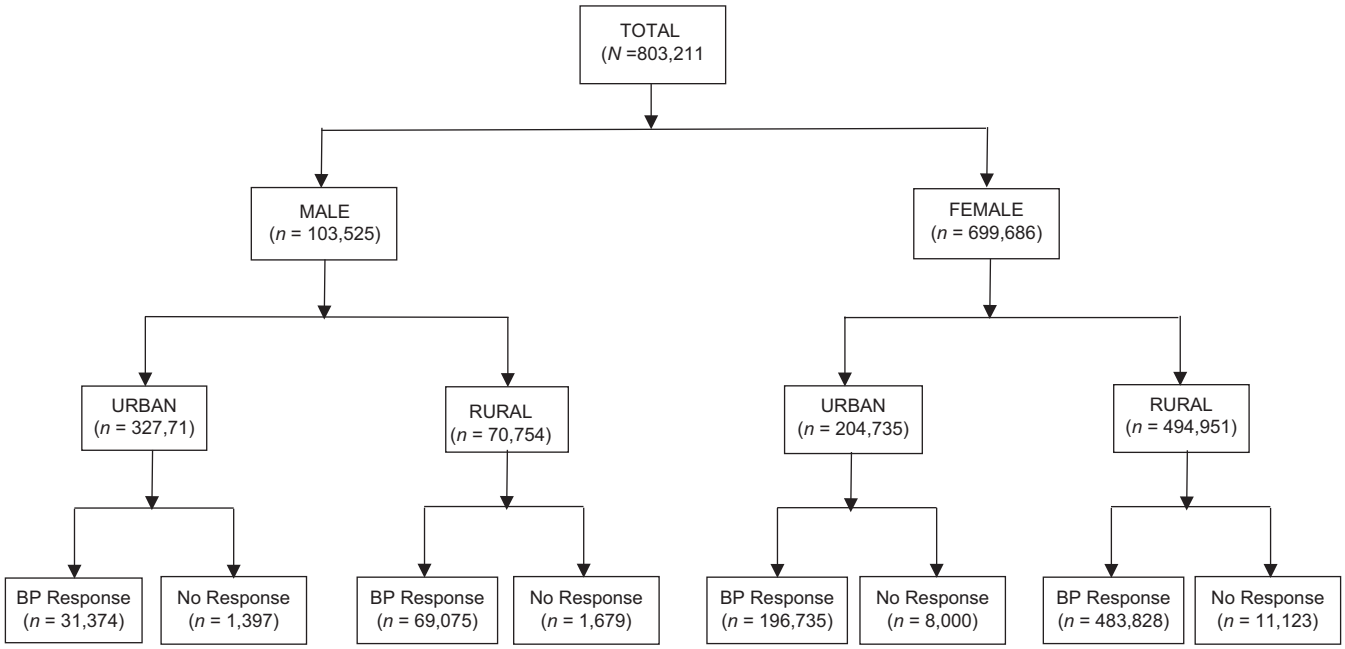

Figure 1: Flow chart showing distribution of sample population by gender, urbanity and valid BP response

by gender and by urban–rural settings (urban–male, urban–female, rural–male, rural–female). Chi-square test was used to measure the association, with a *P* value of 0.05 and lesser was considered to be significant. Odds ratios were estimated with a 95% confidence interval.

Dependent Variable:

HT was considered as a dichotomous variable for persons aged between 15 and 49 years, normotensive = 0 and hypertensive = 1.

Explanatory Variables:

Predictors were chosen based on existing scientific evidence of their effects on HT.

1. *Sociodemographic variables:* age in 10-year groups (Q103), gender, type of place of residence (urban and rural), marital status (unmarried, married, formerly married) (Q213), caste (belonging to Scheduled caste, Scheduled Tribe, Other Backward Class and others (Q117), religion (Hindu, Muslim, Christian, Sikh, Buddhist, Sikh, Jain, Jewish, Parsi, no religion and others) (Q116); education (No education, primary education, secondary and higher education) (Q108), wealth quintile (poorest, poorer, middle, richer and richest) were included. The wealth index was calculated based on the assets and utilization of 33 utilities which show the standard of living. Occupation groups (Q123) were not included in the analyses owing to a large number of missing data.
2. *Lifestyle factors of HT:* presence of diabetes mellitus (Q622a), exposure to secondhand smoke, tobacco use, various forms of tobacco usage (cigarettes, bidis, pipe, hookah, chewing tobacco, snuff, cigars, khaini, ghurka, pan and others) (Q604–614) frequency of alcohol consumption (Everyday, once a week, less than once a week and never), type of alcohol consumed (tadi madi, country liquor, beer, wine, hard liquor and others) (Q615–617), frequency of intake of milk/cord, pulse/beans, green leafy vegetables, fruits, eggs, fish, chicken/meat, fried foods, aerated drinks (never, daily, weekly and occasionally)(Q626a–i) besides screening for HT (Q317), oral cavity (Q627), cervical and breast cancers were included in the analyses. Dietary intake of any food item was considered frequent if the consumption was daily or weekly and infrequent if consumption was occasional or never.

Results

The study included a total of 803,211 participants, with 87% women and 13% men. Of them, 70% were rural residents and 30% belonged to urban areas. The overall age-adjusted prevalence of HT was 17.2%; it was higher in urban (18.3%) than in rural (15.5%) populations and in males (18.2%) as compared to females (16.1%). Figure 2 shows the spatial distribution of HT prevalence across the states of India. The prevalence of HT was found to be higher in the states of Haryana (32.25%) and Tamil Nadu (32.12%) in urban population, and in case of rural population, the prevalence of HT was found to be higher in the states of Sikkim (28.1%) and Tamil Nadu (27.8%).

Table 1 shows the sociodemographic characteristics of the study sample by urban–rural location. Around 60% of the participants belonged to lower socioeconomic status (poorest, poorer and middle wealth quintile), 70% were married, 50% reported to have attained secondary education and 74% practiced Hinduism.

Table 2 shows the distribution of exposure to established lifestyle risk factors of HT in the sample population by urbanity.

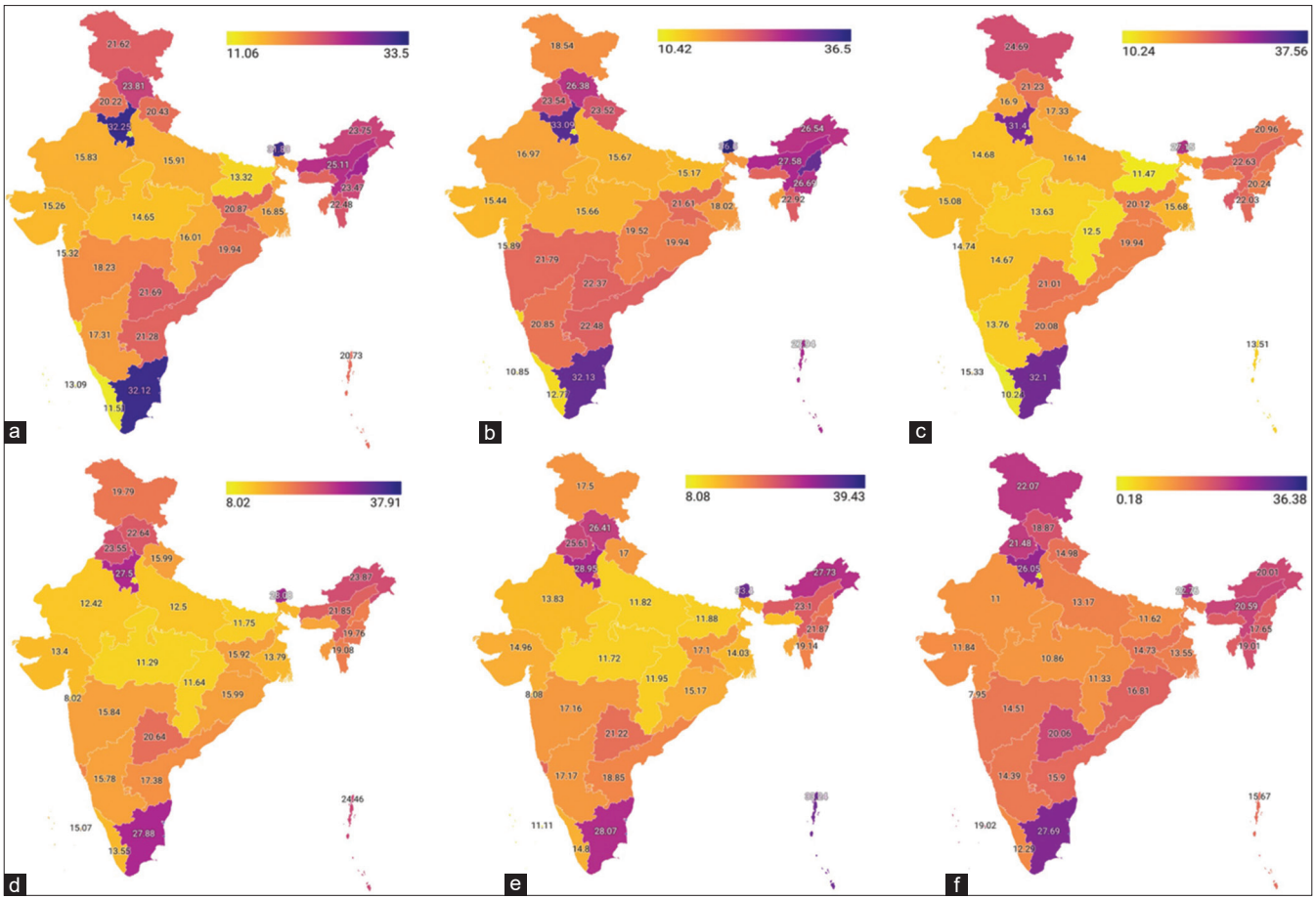

Figure 2: Spatial distribution of hypertension across states: (a) Urban, (b) Urban Men, (c) Urban Women, (d) Rural, (e) Rural Men and (f) Rural Women

Around 97% of the sample population claimed that they did not suffer from diabetes mellitus, 60% had been screened for HT at least once, 12% of the sample population had an oral cavity examination at least once previously, and merely 9% of women had breast examination and 21% had a cervical examination, previously. About 85% of the population claimed not to use tobacco and 94% claimed not to consume alcohol. Exposure to secondary smoke was present in 52% of the sample population. Prevalence of diabetes and screening for HTN, oral, breast and cervical cancers was significantly higher in urban population.

About 65, 87 and 82% consumed milk/curd, pulses/beans and green leafy vegetables frequently, whereas only 43, 38 and 30% consumed fruits, eggs and fish/chicken/meat often, respectively. About 45% consumed fried foods and 25% consumed aerated drinks frequently. Urban population was noted to have significantly higher proportion of consuming all the mentioned food items.

Table 3 shows the statistical association between lifestyle factors, dietary habits, alcohol, tobacco consumption and type of residence (urban, rural) in both male and female populations. A statistically significant association was also observed between the place of residence and most factors, including the previous diagnosis of diabetes, previous screening for HT, exposure to secondary smoke, last oral cavity examination, tobacco and alcohol consumption, dietary intake of milk/curd, pulses/beans, green leafy vegetables, fruits, egg, fish, chicken, fried foods and aerated drinks. There was a significant association between distribution of sociodemographic characteristics like age group, wealth quintile, religion, caste, marital status and occupation in both male and female populations. Having had breast and cervical examinations were also significantly associated with place of residence in females.

Binary logistic regression analyses were performed with HTN as a dependent variable and sociodemographic profile, lifestyle factors including dietary behaviours as independent variables to assess variations in the determinants of HTN between urban–rural populations. Table 4 show the results of binary logistic regression analyses in the urban and rural settings.

Variates like wealth index [OR 1.12 (1.05,1.21)], education[OR 0.88 (0.81,0.95)], caste [OR 0.93 (0.87,0.99)] and oral screening[OR 1.13 (1.03,1.24)] were significant predictors of HT in urban men in addition to the consumption of milk/curd [OR (0.85 (0.73,0.99)], chicken[OR 0.85 (0.74,0.98)] and aerated drinks[OR 1.09 (1.03,1.18)].

Table 1: Sociodemographic characteristics of sample population by urbanity, National Family Health Survey, 2015-2016

Variable	Urban (*n*, %)	Rural (*n*, %)	Total (*n*, %)
Hypertension			
No	186,830 (78.66)	469,656 (83.02)	656,486 (81.55)
Yes	43,523 (18.33)	87,686 (15.5)	131,209 (16.3)
No response	7,153 (3.01)	8,363 (1.48)	15,516 (1.93)
Gender			
Male	32,771 (13.8)	70,754 (12.5)	103,525 (12.9)
Female	204,735 (86.2)	495,951 (87.5)	699,686 (87.1)
Age group in years			
15-19	39,067 (16.45)	104,893 (18.54)	143,960 (17.88)
20-29	79,671 (33.54)	191,141 (33.79)	270,812 (33.64)
30-39	66,171 (27.86)	149,847 (13.7)	216,018 (26.83)
40-49	52,597 (22.2)	119,824 (21.18)	172,421 (21.4)
Education			
No education	35,451 (14.93)	173,698 (30.7)	209,149 (25.98)
Primary	23,527 (9.91)	77,447 (13.69)	100,974 (12.54)
Secondary	126,653 (53.33)	269,980 (47.72)	396,633 (49.27)
Higher	51,875 (21.84)	44,580 (7.88)	96,455 (11.98)
Wealth quintile			
Poorest	7,325 (3.08)	142,959 (25.27)	150,284 (18.67)
Poorer	18,201 (7.66)	152,849 (27.02)	171,050 (21.25)
Middle	39,075 (16.45)	130,697 (23.1)	169,772 (21.09)
Richer	72,128 (30.37)	87,890 (15.54)	160,018 (19.88)
Richest	100,777 (42.43)	51,310 (9.07)	152,087 (18.89)
Religion			
Hindu	164,540 (69.28)	431,856 (76.34)	59,6396 (74.09)
Muslim	44,655 (18.8)	64,373 (11.38)	109,028 (13.54)
Christian	18,098 (7.62)	41,041 (7.25)	59,139 (7.35)
Sikh	4,804 (2.02)	12,706 (2.25)	17,510 (2.18)
Buddhist/ Neo-Buddhist/ Jain/Jewish/Parsi	3,477 (1.46)	8,251 (1.46)	11,728 (1.46)
No religion/other	1,932 (0.81)	7,478 (0.2)	9,410 (1.17)
Marital status			
Never married	70,144 (29.53)	141,522 (25.02)	211,666 (26.29)
Currently married	157,842 (66.46)	403,876 (71.39)	561,718 (69.78)
Widowed/ Divorced/ Separated	9,520 (4.01)	20,307 (3.59)	29,827 (3.71)

Wealth index[OR 0.89 (0.83,0.97)], age [OR 1.06 (1.01,1.13)] and caste[OR 1.07 (1.01,1.13)] were significantly associated with HT in rural men. However, age [OR 6.14 (5.24,7.20); OR 5.18 (4.65,5.77)], marital status [OR 1.65 (1.41,1.93); OR 1.50 (1.34,1.69)], wealth index [OR 1.34 (1.11,1.62); OR 1.78 (1.63,1.95)], education [OR 1.13 (1.03,1.23); OR 1.09 (1.03,1.17)], alcohol consumption [OR 1.51 (1.03,2.2); OR 1.6 (1.38,1.86)] diabetic status [OR 1.97 (1.7,2.29); OR 1.88 (1.63,2.17)] and fish consumption [OR 0.84 (0.72,0.99); OR 0.76 (0.67,0.87)] were significant in relation to HTN in urban and rural women, respectively. Dietary intake of green leafy vegetables [OR 0.63 (0.41,0.97)], fish [OR 0.84 (0.72,0.99)] aerated drinks [OR 1.19 (1.02,1.37)] and fried foods [OR 0.851 (0.726,0.997)] were also significantly associated with HTN in urban women.

Dietary consumption of milk[OR 0.906 (0.837,0.981)] pulses/ beans [OR 0.77 (0.6,0.99)], chicken/meat [OR 1.32 (1.06,1.63)] and fried foods [OR 0.81 (0.74,0.89)] were significantly higher in rural female population.

Discussion

HTN is emerging as a global public health in the developing economies including India and accounts for 9.5 million deaths globally.[3] Various factors including age, gender, lifestyle and degree of urbanization affect the prevalence of HTN. This study provides the prevalence of HT across urban–rural populations in India and assesses associated sociodemographic and lifestyle factors, based on data from NFHS-4 (2015–2016).

HT was found in over 17% of the Indian population aged 15–49 years. The age-adjusted prevalence of HT was relatively higher in urban (18.3%) than in rural areas (15.5%). The increasing prevalence of HT in India based on the study findings could be partially attributed to acculturation along with rapid and uncontrolled urbanization which brings along environmental risk factors and poor sanitation. The level of urbanization in India increased to 31.1% in 2011 from 27.7% in 2001[11], which has led to the drastic changes in land cover, resulting in a sprawl that lacks basic amenities, more often than not.[12] Urbanization with a different pattern of occupation endorses a more sedentary lifestyle, which increases the occurrence of NCDs.[13] Although urbanization and modernization mean better standards of living, it comes with an increased risk of lifestyle related disorders. Moreover, it also leads to dietary and lifestyle changes which ultimately pose a greater risk to HT. Many studies have shown great HT prevalence in urban compared to rural population.[11] A meta-analysis showed that the prevalence of HT varies between 4.5 and 45% in rural population, and a higher prevalence (13.9–48.2%) in the urban population, with an increasing trend over time.[14]

Further, increased levels of awareness coupled with increased access to health services in urban areas might have led to higher detection of HT cases in urban population. This re-emphasizes the need for aggressive community-based screening and health education focusing on rural population.[15]

This study showed that the odds of having HT increased with age more among urban women than men. Further, the odds of having HT increased by three times and six times in women belonging to 30–39 and 40–49 years of age, respectively. The odds of having HT increased with age in both rural men and women. Previous studies have clearly established age and gender as factors explaining the variations in HT prevalence both in rural and urban settings.[16] It is well established that prevalence of HT varies between male and female population, more so with advancing age.[3,17,18] A study conducted by Zhang Y. and Moran A.E. showed that the weighted prevalence of HT in China was higher in men (24.5%) than in women (21.9%) both in rural and urban settings.[18] The Seventh Report of the Joint National

Table 2: Lifestyle risk factors of hypertension among the sample population by urbanity, National Family Health Survey, 2015-2016

Variable	Urban (*n*, %)	Rural (*n*, %)	Total (*n*, %)
Currently has diabetes			
No	229,597 (96.67)	550,591 (97.33)	780,188 (96.92)
Yes	4,911 (2.07)	6,245 (1.1)	11,156 (1.39)
Do not know	2,998 (1.26)	8,869 (1.57)	11,867 (1.47)
Secondary smoke exposure	115,992 (48.84)	298,461 (52.76)	414,453 (51.48)
Smokes cigarettes	6,772 (2.85)	11,706 (2.07)	18,478 (2.3)
Smokes pipe	77 (0.03)	382 (0.07)	459 (0.06)
Uses chewing tobacco	2,572 (1.08)	6,718 (1.19)	9,290 (1.15)
Uses snuff	226 (0.1)	686 (0.12)	912 (0.11)
Smokes cigars	327 (0.14)	733 (0.13)	1,060 (0.13)
Gutkha/Paan masala with tobacco	11,273 (4.75)	27,492 (4.86)	38,765 (4.82)
Paan with tobacco	9,526 (4.01)	24,793 (4.38)	34,319 (4.26)
Smokes others	1,187 (0.5)	5,361 (0.95)	6,548 (0.81)
Smokes nothing	205,572 (86.55)	474,574 (83.89)	680,146 (84.49)
Currently smoke bidis	3,641 (1.53)	15,304 (2.71)	18,945 (2.35)
Hookah usage	408 (0.17)	2,115 (0.37)	2,523 (0.31)
Khaini usage	5,656 (2.38)	23,237 (4.11)	28,893 (3.59)
Alcohol consumption	12,720 (5.36)	36,814 (6.51)	49,534 (6.15)
Frequency drinks alcohol			
Almost every day	1,398 (0.59)	5,040 (0.89)	6,438 (0.8)
About once a week	4,951 (2.08)	15,191 (2.69)	20,142 (2.5)
Less than once a week	6371 (2.68)	16,583 (2.93)	22,954 (2.85)
Never	201,729 (84.94)	480,652 (84.97)	682,381 (84.77)
Tadi madi consumption*	1,344 (0.6)	12,197 (2.2)	13,541 (1.7)
Country liquor consumption	2,254 (0.9)	9,414 (1.7)	11,668 (1.5)
Beer consumption	5,776 (2.4)	9,815 (1.7)	15,591 (1.9)
Wine consumption	3,357 (1.4)	6,319 (1.1)	9,676 (1.2)
Hard liquor consumption	233,873 (98.5)	558,355 (98.7)	792,228 (98.6)
Other alcohol consumption	406 (0.2)	2,410 (0.4)	2,816 (0.4)
Ever screened for hypertension	159,234 (67.04)	311,733 (55.11)	470,967 (58.5)
Ever had oral cavity examination	34,704 (14.61)	63,439 (11.21)	98,143 (12.19)

*Tadi madi consumption: Alcoholic liquor made from palm trees

Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) reported that the prevalence of HT in USA among men and women over 20 years of age were 34.5 and 33.4%, respectively. It was also observed that men have higher incidence of HT until the age of 45 years, both genders have comparable prevalence rates in the age group of 46–64 years and prevalence of HT in higher in women than men over 65 years of age. This has been cited due to the reversal of protective effective of oestrogen postmenopause.[19] A meta-analysis of 250,741 individuals from 13 different countries demonstrated a higher prevalence of prehypertension in men (40%) than women (33%).[20] Overall, it can be concluded that gender differences in the epidemiology of HT point out unique clinical characteristic of the disease in both genders.[21] This can be due to the fact that elasticity of blood vessels reduce with increasing age, contributing to HT pathology.[22]

In a study including 1.3 million Indian adults (2017), being in the richest household wealth quintile [4.15% (3.68–4.61)] was associated with higher probability of having HT compared to belonging to the poorest quintile [3.01% (2.38–3.65)] in rural and urban populations.[23] Similarly, the current study observed that urban and rural men belonging to richest wealth quintile had 12 and 11% lower odds of developing HT as compared to those in the poorest wealth quintile respectively. The odds of having HT was 78% higher in rural women of 'richest' category as compared to the women in poorest category, whereas the odds were only 45% higher in urban settings. Likewise, rural women belonging to 'richer' and 'middle' category also had 59 and 36% higher odds of having HT than women in the 'poorest' category. A long-term follow-up study conducted in Iran concluded that never married women had a lower risk of HT (0.58; 0.37–0.90) as compared to married women.[24] The current study adds evidence to this study as currently and formerly married women had 52 and 65% higher odds of being hypertensive than their unmarried counterparts, both in urban and rural areas.

The Indian Migrant Study conducted in 2011 found that the intake of fruits, vegetables, meat, sugars and dairy products was higher in the urban population than in rural counterparts.[25] However, a cross-sectional STEPS Survey conducted by Tripathy P *et al.* among 5127 individuals in 2014–2015 found no difference

Table 3: Urban-rural disparities with respect to lifestyle risk factors, dietary habits, alcohol and tobacco consumption and socio-demographic characteristics by gender, National Family Health Survey, 2015-2016

Variable	Female			Male		
	URBAN (*n*, %)	RURAL (*n*, %)	Chi-square	URBAN (*n*, %)	RURAL (*n*, %)	Chi-square
Age group in years						
15-19	36,932 (15.2)	84,620 (18.5)	Ref	5,844 (17.8)	13,238 (18.7)	Ref
20-24	82,343 (34)	155,665 (34)	<0.01	10,459 (31.9)	22,322 (31.5)	0.017
30-39	67,691 (27.9)	119,968 (26.3)	<0.01	9,118 (27.8)	19,419 (27.5)	<0.01
40-49	55,259 (22.9)	96,939 (21.3)	<0.01	7,350 (22.4)	12,775 (22.3)	<0.01
Education						
No education	37,661 (15.5)	154,474 (33.8)	Ref	2,558 (7.8)	10,035 (14.2)	Ref
Primary	24,300 (10)	62,932 (13.8)	<0.01	3,134 (9.6)	9,550 (13.5)	<0.01
Secondary	125,208 (51.7)	205,829 (45)	<0.01	19,090 (58.3)	42,616 (60.2)	<0.01
Higher	55,055 (22.7)	34,226 (7.5)	<0.01	7,989 (24.4)	8,553 (12.1)	<0.01
Religion						
Hindu	182,608 (75.4)	381,131 (83.3)	Ref	23,095 (70.5)	54,020 (76.3)	Ref
Muslim	44,629 (18.4)	51,832 (11.3)	<0.01	6,110 (18.6)	8,327 (11.8)	<0.01
Christian	6,628 (2.7)	9,992 (2.2)	<0.01	2,227 (6.8)	4,799 (6.8)	<0.01
Sikh	3,534 (1.5)	8,084 (1.8)	<0.01	645 (2)	1,565 (2.2)	0.45
Other	4,810 (1.9)	6,421 (1.4)	<0.01	694 (2.2)	2,043 (2.9)	<0.01
Caste						
Schedule caste	41,748 (18)	100,871 (22.9)	Ref	5,112 (15.6)	13,367 (18.9)	Ref
Schedule tribe	9,944 (4.3)	54,200 (12.3)	<0.01	3,508 (10.7)	14,896 (21.1)	<0.01
OBC	104,878 (45.3)	198,959 (45.1)	<0.01	13,712 (41.8)	26,469 (37.4)	<0.01
None of them	73,211 (31.6)	84,562 (19.2)	<0.01	86,63 (26.4)	12,003 (17)	<0.01
Do not know	1,916 (0.8)	2,577 (0.6)	<0.01	110 (0.3)	172 (0.2)	<0.01
Marital status						
Never married	60,580 (25)	98,455 (21.5)	Ref	13,813 (42.2)	26,056 (36.8)	Ref
Currently married	170,815 (70.5)	340,557 (74.4)	<0.01	18,564 (56.6)	43,527 (61.5)	<0.01
Widowed/divorced/Separated	10,829 (4.5)	18,449 (4)	<0.01	394 (1.3)	1,171 (1.7)	<0.01
Wealth index			<0.01			<0.01
Lower	21,927 (10.7)	260,788 (52.6)		9,169 (28)	52,054 (73.6)	
Higher	182,808 (89.3)	234,163 (47.2)		23,602 (72)	18,700 (26.4)	
Currently has diabetes						
No	197,776 (96.6)	481,649 (97.1)	Ref	31,821 (97.1)	68,942 (97.4)	Ref
Do not know	2,673 (1.3)	8,050 (1.6)	<0.01	325 (1)	819 (1.2)	0.02
Exposure to secondary smoke	111,581 (54.5)	287,335 (57.9)	<0.01	22,892 (69.9)	52,475 (74.2)	<0.01
Smokes nothing	186,864 (91.3)	439,809 (88.7)	<0.01	18,708 (57.1)	34,765 (49.1)	<0.01
Drinks alcohol	2,681 (1.3)	12,244 (2.5)	<0.01	9,714 (29.6)	22,515 (31.8)	<0.01
Frequent intake of milk or curd	143,814 (70.2)	300,407 (60.6)	<0.01	25,382 (77.5)	48,716 (68.9)	<0.01
Frequent intake of pulses or beans	184,055 (89.9)	428,545 (86.4)	<0.01	29,593 (90.3)	62,386 (88.2)	<0.01
Frequent Intake of green leafy vegetable	178,108 (87)	41,8927 (84.5)	<0.01	28,941 (88.3)	61,830 (87.4)	<0.01
Frequent Fruit intake	120,704 (59)	178,438 (36)	<0.01	19,867 (60.6)	30,684 (43.4)	<0.01
Frequent egg intake	86,926 (42.5)	169,836 (34.2)	<0.01	16,703 (51)	30,601 (43.2)	<0.01
Frequent Fish intake	68,341 (33.4)	1422,43 (28.7)	<0.01	12,621 (38.5)	24,047 (34)	<0.01
Frequent Chicken or meat intake	74,235 (36.3)	134,851 (27.2)	<0.01	14,524 (44.3)	25,345 (35.8)	<0.01
Frequent Fried food intake	102,614 (50.1)	215,379 (43.4)	<0.01	16,678 (50.9)	31,085 (43.9)	<0.01
Frequent Aerated drinks intake	62,685 (30.6)	100,202 (20.2)	<0.01	12,522 (38.2)	19,870 (28.1)	<0.01
Ever screened for hypertension	141,543 (69.1)	281,296 (56.7)	<0.01	17,691 (54)	30,437 (43)	<0.01
Ever had oral cavity examination	33,579 (16.4)	60,528 (12.2)	<0.01	3,732 (11.4)	5,691 (8)	<0.01
Ever had cervical examination	48,811 (23.8)	98,569 (19.9)	<0.01			
Ever had breast examination	21,306 (10.4)	41,547 (8.4)	<0.01			

in dietary practices among urban and rural population of Punjab. This posed the question of great Indian equalization.[26] The current study, however, found that there was a significant association between type of residence, that is urban–rural and many lifestyle risk factors including a previous diagnosis of diabetes, previous screening for HT, exposure to secondary smoke, previous oral cavity examination, tobacco and alcohol consumption and dietary habits. The proportion of people belonging to higher socioeconomic status and having higher levels of education are greater in urban areas, which increases

Table 4: Results of binary logistic regression on hypertension in the urban and rural populations, National Family Health Survey, 2015--2016

Variable	URBAN				RURAL			
	MALE		FEMALE		MALE		FEMALE	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Age in years								
15-19	Ref	0.495	Ref	<0.01	Ref	0.071	Ref	<0.01
20-29	1.081 (0.949,1.232)	0.242	1.836 (1.588,2.123)	<0.01	0.98 (0.896,1.072)	0.658	1.747 (1.583,1.929)	<0.01
30-39	1.015 (0.923,1.116)	0.759	3.413 (2.92,3.99)	<0.01	1.008 (0.947,1.073)	0.802	3.082 (2.774,3.426)	<0.01
40-49	1.038 (0.958,1.124)	0.365	6.143 (5.241,7.201)	<0.01	1.064 (1.007,1.125)	0.028	5.181 (4.651,5.771)	<0.01
Marital status								
Never married	Ref	0.208	Ref	<0.01	Ref	0.236	Ref	<0.01
Currently married	1.064 (0.793,1.428)	0.679	1.522 (1.364,1.698)	<0.01	1.069 (0.895,1.276)	0.462	1.409 (1.296,1.532)	<0.01
Widowed/Divorced/ Separated	1.141 (0.858,1.518)	0.364	1.652 (1.414,1.931)	<0.01	1.014 (0.857,1.201)	0.87	1.504 (1.335,1.693)	<0.01
Wealth index								
Poorest	Ref	0.011	Ref	<0.01	Ref	<0.01	Ref	<0.01
Poorer	0.988 (0.827,1.181)	0.895	1.066 (0.868,1.31)	0.542	1.015 (0.932,1.105)	0.735	1.185 (1.115,1.26)	<0.01
Middle	0.992 (0.88,1.119)	0.899	1.265 (1.046,1.529)	0.016	0.917 (0.848,0.992)	0.031	1.366 (1.28,1.457)	<0.01
Richer	1.031 (0.943,1.126)	0.504	1.449 (1.202,1.746)	<0.01	0.935 (0.866,1.009)	0.083	1.597 (1.485,1.717)	<0.01
Richest	1.123 (1.046,1.205)	0.001	1.342 (1.108,1.624)	0.003	0.899 (0.831,0.973)	0.008	1.782 (1.632,1.946)	<0.01
Education								
No education	Ref	0.008	Ref	0.05	Ref	0.246	Ref	0.014
Primary	0.928 (0.814,1.056)	0.257	1.116 (1.004,1.241)	0.042	1.092 (0.999,1.194)	0.052	1.097 (1.032,1.167)	0.003
Secondary	0.93 (0.826,1.048)	0.236	1.125 (1.033,1.225)	0.007	1.037 (0.95,1.132)	0.419	1.038 (0.983,1.096)	0.175
Higher	0.878 (0.813,0.949)	0.001	1.107 (0.991,1.238)	0.072	1.042 (0.973,1.116)	0.242	0.98 (0.889,1.081)	0.692
Caste								
Others	Ref	0.218	Ref	0.778	Ref	0.001	Ref	<0.01
Scheduled caste	0.93 (0.869,0.995)	0.035	1.016 (0.928,1.113)	0.728	1.069 (1.014,1.127)	0.013	0.889 (0.836,0.946)	<0.01
Scheduled Tribe	0.977 (0.899,1.062)	0.584	1.055 (0.952,1.169)	0.309	1.101 (1.043,1.163)	0.001	0.85 (0.799,0.906)	<0.01
OBC	0.973 (0.878,1.079)	0.601	1.006 (0.941,1.076)	0.856	1.003 (0.947,1.061)	0.93	0.867 (0.824,0.913)	<0.01
Tobacco usage								
No	Ref		Ref		Ref		Ref	
Yes	0.98 (0.919,1.046)	0.55	0.999 (0.902,1.106)	0.983	1.043 (0.998,1.091)	0.064	0.981 (0.922,1.045)	0.556
Alcohol consumption								
Never drinks	Ref	0.461	Ref	0.063	Ref	0.146	Ref	<0.01
Less than once a week	0.962 (0.883,1.048)	0.375	1.591 (0.623,4.064)	0.332	0.968 (0.913,1.027)	0.283	1.471 (1.13,1.914)	0.004
About once a week	0.881 (0.745,1.043)	0.142	1.517 (1.032,2.23)	0.034	0.974 (0.874,1.085)	0.632	1.598 (1.376,1.855)	<0.01
Almost everyday	0.988 (0.886,1.101)	0.823	1.22 (0.933,1.595)	0.146	1.039 (0.965,1.118)	0.308	1.332 (1.144,1.55)	<0.01
Intake of milk or curd								
Never	Ref	0.042	Ref	<0.01	Ref	0.441	Ref	0.113
Daily	0.85 (0.725,0.995)	0.043	1.103 (0.983,1.239)	0.096	1.045 (0.961,1.137)	0.304	0.936 (0.866,1.012)	0.095
Weekly	1.057 (0.971,1.151)	0.203	0.935 (0.828,1.057)	0.282	0.975 (0.922,1.031)	0.377	0.906 (0.837,0.981)	0.015
Occasionally	1.034 (0.947,1.128)	0.458	0.901 (0.799,1.017)	0.092	0.989 (0.935,1.046)	0.692	0.937 (0.869,1.011)	0.095
Intake of pulses or beans								
Never	Ref	0.415	Ref	<0.01	Ref	0.538	Ref	0.02
Daily	0.785 (0.485,1.272)	0.326	0.74 (0.512,1.07)	0.11	0.889 (0.653,1.21)	0.454	0.77 (0.6,0.989)	0.04
Weekly	1.031 (0.922,1.154)	0.589	0.791 (0.547,1.142)	0.21	1.039 (0.966,1.117)	0.301	0.777 (0.605,0.997)	0.047
Occasionally	1.061 (0.952,1.184)	0.285	0.921 (0.633,1.34)	0.667	1.039 (0.97,1.114)	0.277	0.837 (0.649,1.078)	0.167
Intake of green leafy vegetable								
Never	Ref	0.709	Ref	<0.01	Ref	0.006	Ref	<0.01
Daily	1.273 (0.85,1.906)	0.241	0.626 (0.406,0.966)	0.034	0.801 (0.571,1.123)	0.199	0.766 (0.537,1.092)	0.141
Weekly	1.007 (0.908,1.115)	0.901	0.594 (0.385,0.917)	0.019	1.023 (0.954,1.096)	0.525	0.716 (0.503,1.022)	0.065
Occasionally	1.01 (0.914,1.116)	0.847	0.521 (0.336,0.808)	0.004	0.948 (0.886,1.014)	0.123	0.658 (0.46,0.94)	0.021
Fish intake								
Never	Ref	0.386	Ref	<0.01	Ref	0.959	Ref	<0.01
Daily	0.984 (0.877,1.103)	0.778	0.844 (0.716,0.996)	0.045	1.003 (0.928,1.083)	0.948	0.764 (0.672,0.867)	<0.01

Contd...

Table 4: Contd...

Variable	URBAN				RURAL			
	MALE		FEMALE		MALE		FEMALE	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Weekly	0.937 (0.809,1.085)	0.383	1.278 (1.127,1.45)	<0.01	0.988 (0.881,1.109)	0.839	1.037 (0.949,1.132)	0.425
Occasionally	1.046 (0.962,1.137)	0.295	1.208 (1.07,1.364)	0.002	0.984 (0.927,1.045)	0.606	1.035 (0.954,1.122)	0.413
Chicken or meat intake								
Never	Ref	0.012	Ref	0.02	Ref	0.404	Ref	<0.01
Daily	0.848 (0.741,0.972)	0.018	1.04 (0.807,1.339)	0.764	0.982 (0.897,1.075)	0.694	1.317 (1.063,1.631)	0.012
Weekly	0.889 (0.727,1.087)	0.253	1.015 (0.881,1.17)	0.837	1.008 (0.843,1.206)	0.928	1.31 (1.183,1.45)	<0.01
Occasionally	0.895 (0.827,0.97)	0.007	0.9 (0.783,1.035)	0.139	0.954 (0.902,1.009)	0.098	1.169 (1.062,1.286)	0.001
Fried food intake								
Never	Ref	0.276	Ref	0.124	Ref	0.18	Ref	<0.01
Daily	0.993 (0.882,1.119)	0.909	0.851 (0.726,0.997)	0.046	1.001 (0.924,1.084)	0.982	0.939 (0.843,1.046)	0.255
Weekly	0.921 (0.835,1.015)	0.096	0.845 (0.733,0.974)	0.02	1.068 (0.997,1.144)	0.059	0.81 (0.737,0.891)	<0.01
Occasionally	0.95 (0.888,1.016)	0.134	0.847 (0.737,0.973)	0.019	1.04 (0.991,1.091)	0.109	0.863 (0.787,0.945)	0.002
Aerated drinks intake								
Never	Ref	0.05	Ref	0.154	Ref	0.866	Ref	0.842
Daily	1.074 (0.968,1.191)	0.179	1.185 (1.024,1.372)	0.023	0.984 (0.925,1.047)	0.615	0.977 (0.874,1.093)	0.689
Weekly	1.054 (0.944,1.176)	0.349	1.052 (0.947,1.168)	0.346	1.028 (0.941,1.123)	0.545	1.024 (0.953,1.101)	0.521
Occasionally	1.098 (1.026,1.176)	0.007	1.051 (0.959,1.151)	0.29	0.997 (0.947,1.05)	0.914	1.01 (0.956,1.067)	0.72
Ever had oral cavity examination								
No	Ref		Ref		Ref		Ref	
Yes	1.129 (1.03,1.236)	0.009	0.994 (0.922,1.072)	0.884	0.975 (0.907,1.047)	0.485	1.067 (1.007,1.13)	0.029
Currently has diabetes								
No	Ref	0.337	Ref	<0.01	Ref	0.589	Ref	<0.01
Yes	1.145 (0.851,1.541)	0.372	1.971 (1.698,2.289)	0	1.042 (0.867,1.253)	0.661	1.879 (1.629,2.168)	<0.01
Don't know	1.289 (0.903,1.839)	0.162	1.128 (0.891,1.428)	0.316	0.961 (0.75,1.232)	0.755	1.071 (0.926,1.238)	0.355
Ever had cervical examination							Ref	
No			Ref				0.945 (0.898,0.994)	0.029
Yes			1.028 (0.96,1.101)	0.424				
Ever had breast examination							Ref	
No			Ref				1.133 (1.056,1.215)	<0.01
Yes			0.994 (0.906,1.091)	0.901				

their affordability to buy food items and undertake screening examination.

Previous studies have found that diets rich in fruit, vegetables, whole grains, legumes, seeds, nuts, fish and dairy products helped to lower blood pressure.[27,28] In urban areas, men who consumed milk/curd daily had 15% lower odds of being hypertensive as compared to those never consuming the same. Men consuming fruits occasionally had 8% lower odds than those never eating fruits. Men who had daily or weekly intake of eggs had 13 and 16% higher odds than those never consuming eggs, respectively. Women who consumed milk, pulses and fish had 7–10, 17–23 and 24% lower odds, respectively, than those who did not consume the same. Similarly, women in rural areas who consumed meat had 16–31% higher odds than those who did not consume meat, while urban men consuming meat daily or occasionally had 16 and 11% lower odds than those never consuming it, respectively. Women who drank aerated drinks daily had 19% higher odds than those who did not. Women who consumed green leafy vegetables daily, weekly or occasionally had 38, 41 and 48% lower odds, respectively, as compared to those who never consumed green leafy vegetables. All these findings are in concurrence with the currently available evidence.[27,28] A systematic review and meta-analysis of randomized controlled trials conducted by Ndanuko RN *et al.*[27] concluded that a diet low in meat, sweets and alcohol helped to maintain blood pressure. An association between consumption of aerated drinks and HT among adults has been noted amongst Indian adults previously too.[29] Interestingly, it was observed that women consuming fried foods had about 15–20% lower odds of developing HT.

The current study also observed an higher odds of HT among women drinking alcohol as compared to the nondrinkers, in both urban and rural settings. Alcohol consumption was noted to be associated with a relative risk of 1.5 (1.3–1.6) to develop HT amongst adults aged 15–49 years in Northeast India.[29] Reduced alcohol consumption has been proven to help maintain lower levels of blood pressure in existing literature.[27,29]

Women who had a breast examination previously also had 13% higher odds of having HT than those who never had a breast examination. Women who had diabetes had 87% higher odds of having HT, as compared to nondiabetic women. Women unaware of their diabetic status had 7% higher odds of having

HT than nondiabetic women. A home-based survey amongst 1,192 women of rural India showed that only 0.9 and 1.3% had a breast and cervical examination, respectively, in the past 5 years. The study also noted that that only 50% were aware with regard to HT, while only 3.3% were familiar with it. Poor levels of awareness in relation to HT, diabetes and cancer as major health threats and importance of their early detection were also recorded in the study.[30]

Most previous studies have shown urban–rural disparities in lifestyles risk factors in men more than women.[8-10] However, this study has shown light on similar disparities in female population also.

Strengths and limitations

This study is based on the NFHS-4 data, which is based on a sample of households that is representative at the national, state and district levels, hence providing true estimates of the prevalence of HT across the country. The study has a few limitations. The findings of this study are limited to the persons aged 15–49 years, whereas we presume higher cases of HT in older population, thus underestimates the prevalence. Further, NFHS provides cross-sectional data that does not allow exploration of causal pathways behind the observed associations. We were not able to investigate the role of factors like physical inactivity, genetic factors, anxiety and lipid profile in this analysis due to the nonavailability of such information in the data set. Furthermore, alcohol and tobacco use were self-reported by the survey participants; hence, there is a chance of under- or overreporting. Also, because of the NFHS-4's focus on maternal and child health, the survey sampled substantially fewer men than women.

Conclusion

This study has shown that the prevalence of HT is higher in urban areas as compared to rural despite the higher level of risk factors prevalent in rural populations. Factors like age, wealth index, marital status, alcohol intake and dietary patterns were found to be significant variates of HT in both urban and rural populations. Occupation, caste, screening for diseases and diabetic status were significant predictors of HT in urban populations. Alcohol consumption, tobacco usage and unfavourable dietary habits were noted to be higher in rural than urban populations. Nevertheless, this calls for a more robust screening and health education in rural areas for early detection of HT. With rapid rate of urbanization, it becomes utmost important to reduce the prevalence of risk factors of HT, more so in the rural areas.

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Conflicts of interest

There are no conflicts of interest.

References

1. Stanaway JD, Afshin A, Gakidou E, Lim SS, Abate D, Abate KH, *et al.* Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018;392:1923-94.
2. Ghosh S, Kumar M. Prevalence and associated risk factors of hypertension among persons aged 15–49 in India: A cross-sectional study. BMJ Open 2019;9:e029714.
3. Kearney PM, Whelton M, Reynolds K, Whelton PK, He J. Worldwide prevalence of hypertension: A systematic review. J Hypertens 2004;22:11-9.
4. Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension. [Last Accessed on 2021 Jul 03].
5. Mills KT, Bundy JD, Kelly TN, Reed JE, Kearney PM, Reynolds K, *et al.* Global disparities of hypertension prevalence and control: A systematic analysis of population-based studies from 90 countries. Circulation 2016;134:441-50.
6. Chow CK, Teo KK, Rangarajan S, Islam S, Gupta R, Avezum A, *et al.* Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. JAMA 2013;310:959-68.
7. Daştan İ, Erem A, Çetinkaya V. Urban and rural differences in hypertension risk factors in Turkey. Anatol J Cardiol 2017;18:39-47.
8. Farag YM, Mittal BV, Keithi-Reddy SR, Acharya VN, Almeida AF, C A, *et al.* Burden and predictors of hypertension in India: Results of SEEK (Screening and Early Evaluation of Kidney Disease) study. BMC Nephrol 2014;15:42.
9. Devi P, Rao M, Sigamani A, Faruqui A, Jose M, Gupta R, *et al.* Prevalence, risk factors and awareness of hypertension in India: A systematic review. J Hum Hypertens 2013;27:281-7.
10. Bhagat RB. "Emerging Pattern of Urbanisation in India." Economic and Political Weekly, vol. 46, no. 34, 2011, pp. 10–12. JSTOR, www.jstor.org/stable/23017782. [Last accessed on 2021 Jul 14].
11. Zhang Y, Moran AE. Trends in the prevalence, awareness, treatment and control of hypertension among adults in the United States 1999-2014. Hypertension 2017;70:736–42.
12. Wang Z, Chen Z, Zhang L, Wang X, Hao G, Zhang Z, *et al.* Status of hypertension in China: Results from the China Hypertension Survey, 2012-2015. Circulation 2018;137:2344–56.
13. Ramirez LA, Sullivan JC. Sex differences in hypertension: Where we have been and where we are going. Am J Hypertension 2018;31:1247–54.

14. Ramachandran A, Snehalatha C, Latha E, Manoharan M, Vijay V. Impacts of urbanisation on the lifestyle and on the prevalence of diabetes in native Asian Indian population. Diabetes Res Clin Pract 1999;44:207-13.
15. Ramachandra TV, Bharath AH, Sowmyashree MV. Monitoring urbanization and its implications in a mega city from space: Spatiotemporal patterns and its indicators. J Environ Manage 2015;148:67-81.
16. Yadav K, Krishnan A. Changing patterns of diet, physical activity and obesity among urban, rural and slum populations in north India Obes Rev 2008;9:400-8.
17. Guo X, Zou L, Zhang X, Li J, Zheng L, Sun Z, *et al*. Prehypertension: A meta-analysis of the epidemiology, risk factors, and predictors of progression. Tex Heart Inst J 2011;38:643–52.
18. Song JJ, Ma Z, Wang J, Chen LX, Zhong JC. Gender differences in hypertension. J Cardiovasc Transl Res 2020;13:47-54.
19. Bowen L, Ebrahim S, De Stavola B, Ness A, Kinra S, Bharathi AV, *et al*. Dietary intake and rural-urban migration in India: A cross-sectional study. PLoS One 2011;6:e14822.
20. Tripathy JP, Thakur JS, Jeet G, Chawla S, Jain S, Prasad R. Urban rural differences in diet, physical activity and obesity in India: Are we witnessing the great Indian equalisation? Results from a cross-sectional STEPS survey. BMC Public Health 2016;16:816.
21. Levine DA, Lewis CE, Williams OD, Safford MM, Liu K, Calhoun DA, *et al*. Geographic and demographic variability in 20-year hypertension incidence: The CARDIA study. Hypertension 2011;57:39–47.
22. Yajnik CS, Joglekar CV, Chinchwadkar MC, Sayyad MG, Deshpande SS, Naik SS, *et al*. Conventional and novel cardiovascular risk factors and markers of vascular damage in rural and urban Indian men. Int J Cardiol 2013;165:255-9.
23. Geldsetzer P, Manne-Goehler J, Theilmann M, Davies JI, Awasthi A, Vollmer S, *et al*. Diabetes and hypertension in India: A nationally representative study of 1.3 million adults. JAMA Intern Med 2018;178:363-72.
24. Ramezankhani A, Azizi F, Hadaegh F. Associations of marital status with diabetes, hypertension, cardiovascular disease and all-cause mortality: A long term follow-up study. PLoS One 2019;14:e0215593.
25. Guessous I, Bochud M, Theler JM, Gaspoz JM, Pechère-Bertschi A. 1999-2009 Trends in prevalence, unawareness, treatment and control of hypertension in Geneva, Switzerland. PLoS One 2012;7:e39877.
26. Anderson GH. Effect of age on hypertension: Analysis of over 4,800 referred hypertensive patients. Saudi J Kidney Dis Transpl 1999;10:286–97.
27. Ndanuko RN, Tapsell LC, Charlton KE, Neale EP, Batterham MJ. Dietary patterns and blood pressure in adults: A systematic review and meta-analysis of randomized controlled trials. Adv Nutr 2016;7:76-89.
28. Ortega Anta RM, Jiménez Ortega AI, Perea Sánchez JM, Cuadrado Soto E, López Sobaler AM. Nutritional patterns on prevention and control of hypertension. Nutr Hosp 2016;33(Suppl 4):347. Spanish.
29. Marbaniang SP, Lhungdim H, Chauhan S, Srivastava S. Interaction of multiple risk factors and population attributable fraction for type 2 diabetes and hypertension among adults aged 15-49 years in Northeast India. Diabetes Metab Syndr 2021;15:102227.
30. Mahajan M, Naik N, Jain K, Patira N, Prasad S, Mogri S, *et al*. Study of knowledge, attitudes, and practices toward risk factors and early detection of noncommunicable diseases among rural women in India. J Glob Oncol 2019;5:1-10.