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RESEARCH ARTICLE

Gender and rural-urban differences in hypertension among youth in India: Insights from a large scale survey, 2015-16

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Abstract

Hypertension is considered one of the most persistent public health issues and the single largest contributor to avoidable morbidity and mortality in India. This study aims to investigate the prevalence and risk factors of hypertension in youths (15-29 years) by gender and rural-urban place of residence. Data from the fourth round of the National Family and Health Survey – 2015-16 (n = 395,207) was utilised for the study. After estimation of the stratified prevalence of hypertension by various characteristics, multivariable logistic regression analysis was conducted to assess the correlates of hypertension. The results revealed that the prevalence of hypertension in youths at the national level varied from 9.16% (Meghalaya) to 3.34% (Delhi). The stratified analysis suggests pronounced gender differences in the prevalence of hypertension among youth with insignificant rural-urban differences, although the prevalence was higher in urban areas. Overall, the prevalence of hypertension was found higher for male youths living in urban areas (7.82%) and females in rural areas (5.08%). Concurrently, results from regression analysis also suggest higher odds of hypertension for males residing in urban areas for a variety of demographic, socioeconomic, and health-risk factors. Advancing age, having no education, living in the northeast region, being overweight/obese and high blood glucose level was significantly associated with a greater likelihood of hypertension for both the gender and place of residence. Public health awareness regarding blood pressure needs to be tailored differently for both males and females considering the place of residence. The study suggests that more research should focus on blood pressure/hypertension among children, adolescents and youth since they point towards adult blood pressure patterns.

Keywords: Hypertension; Gender; Rural-Urban

Introduction

Hypertension is considered one of the most persistent public health issues and has been recognised as an influential contributor to the global burden of diseases. It has become a major public health problem as 1 in 4 men, and 1 in 5 women had hypertension worldwide in 2015 (World Health Organization, 2021). The consequential association of hypertension with cardiovascular diseases (CVDs) and premature deaths makes it a global public health concern (Bauer *et al.*, 2014). Less than a quarter of the world population suffering from hypertension are aware of their condition, and a handful of those who are aware, are not treated at all or incompetently treated (Chockalingam, 2007).

According to the Global Burden of Disease Study (2019), high systolic blood pressure accounted for 10.8 million deaths worldwide (Murray *et al.*, 2020). There has been an alarming surge in the number of people having hypertension from 0.78 million in 1990 to 1.63 million in 2016. The Medical Certification of Causes of Death (MCCD) report revealed that hypertension can be aptly held responsible for 10.8% of all deaths resulting from circulatory diseases in India (10.3% among males and 11.6% among females) (Gulati *et al.*, 2015). Excessive sodium intake, regular consumption of alcohol and tobacco, stagnant work-life with long hours sitting in front of the computer being immobile, and insurmountable amount of stress from never-ceasing deadlines are among the major factors instrumental in the rising risk of undetected hypertension. A systematic review and meta-analysis of studies analysed the relationship between eSports or video-gaming and lifestyle behaviours. Out of the 3694 studies included in the study, significant associations were established between online video gaming and poor lifestyle outcomes including physical activity-related (for example, sedentary lifestyle behaviour and consequent increased body mass index (BMI)), nutrition-related (poor dietary habits and excessive sweetened beverage intake) and sleep-related outcomes (decreased quality/duration, increased sleepiness/sleep deprivation) (Chan *et al.*, 2022).

The youth population in India, defined as the age group of 15 to 29 years under the National Youth Policy (2014), consists of 28% of the population (Chandramouli and Registrar General, 2011) or otherwise put, every third individual in India is a youth. As per the WHO report (2011) on young people, nearly two-thirds of premature deaths and one-third of the total disease burden in adults are associated with conditions or behaviours initiated in their youth (*e.g.* tobacco use, physical inactivity, alcohol use, etc.). The behavioural patterns established during this developmental phase determine their current health status and the risk of developing some chronic diseases like hypertension in later years. Therefore, it is crucial to understand the prevalence and associated risk factors of hypertension in this population cohort for identifying interventions and strategic approaches that protect youth's health and to develop youth-specific policies and programs.

At the national level, a few recent studies have observed a rising prevalence of hypertension among young adults compared with the global level (Ghosh and Kumar, 2019; Ramakrishnan *et al.*, 2019; Kumar and Misra, 2021). Additionally, a study covering a sample of 25,000 school children belonging to the age group of 5–16 years reported an increased prevalence of hypertension among children who were overweight and obese when compared against their non-overweight counterparts (Raj *et al.*, 2007). Thus, hypertension should not only be perceived as an adult morbid condition, rather, it can be traced back from childhood to adolescence to youth. The lifestyle choices adopted during adolescence and youth turn out to affect their health and well-being. These habits, behaviour, and risk factors are preventable and reversible and if intervened at the right time during adolescence, one does not bear the toil of hypertension and its related CVD risks in later ages.

Previous literature has established significant variations in the prevalence of hypertension for male and female populations as well as for the rural and urban settings. The findings of a study conducted using the National Family Health Survey (NFHS)-4 data highlighted the gender gap in the prevalence of hypertension, pointing that it was higher in men than in women in most states and union territories, except Delhi, West Bengal, Meghalaya, and Jammu and Kashmir. It also emphasised the prevalence of hypertension in rural and urban settings of all states. The rate of hypertension was found to be higher in urban settings than in rural areas counterparts for most of the states, excepting a few like Punjab, Goa, and Kerala (Ghosh and Kumar, 2019). Drinking alcohol regularly, and being diabetic and/or obese was associated with hypertension in urban areas, whereas the association of hypertension with salt intake was found only in rural areas. Among respondents aged 18–24 years, male gender, urban residence, illiteracy, and obesity were found to be the factors associated with hypertension (Tripathy *et al.*, 2017). Kumar and Misra (2021) found a higher prevalence of hypertension among men than women in India in their

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cross-sectional study. Also, the urban residents had a higher propensity of hypertension compared to their rural counterparts. It is not an alienated concept that poor lifestyle habits directly affect the occurring of diseases. Results indicate that adults who consumed alcohol regularly, maintained a non-vegetarian diet and were diabetic had a higher prevalence of hypertension. A school-based study was conducted in the rural district of Kottayam in Kerala to measure the prevalence of hypertension and pre-hypertension among school-going adolescents. The prevalence of prehypertension was high (24.5%) when compared to the prevalence of hypertension, which is an alarming situation and demands urgent intervention among adolescents (Amma *et al*., 2015).

Since several factors may play a vital role in the prevalence of hypertension, stratification by gender and rural-urban residence may improve the existing strategies for the prevention of hypertension in the country. The estimate of the National Family Health Survey-4 shows that about five per cent and seven per cent respectively of female and male youths exhibit hypertension. In India where the youth population size is huge, 5-7% of hypertension prevalence is a matter of concern. Noting these percentages, we further proceed to the stratification of residence to reach out the possible determinants of hypertension in India. Further, it is also pivotal to understand the differences in the distribution of factors that could attribute to gender and rural-urban differences in hypertension. Although prior studies have examined the prevalence and associated risk factors in India (Abariga *et al*., 2020; Ghosh and Kumar, 2019; Ramakrishnan *et al*., 2019; Tripathy *et al*., 2017), no study has stratified and investigated the prevalence and determinants of hypertension for the youth population by gender and place of residence. Therefore, this study attempted to fill these existing research gaps by examining hypertension among the youth with a special focus on gender and rural-urban differences using the data from the recent round of NFHS (2015-16).

Methods

Data

The present study used nationally representative data from the National Family Health Survey (NFHS-4), 2015-16 also known as Indian Demographic and Health Survey. The NFHS is a representative population-based household survey, which follows a stratified two-stage sampling model. The fourth round of the survey has a sample of 628,900 households, of which 616,346 households were occupied. Of the occupied households, 601,509 were successfully interviewed, for a response rate of 98%. A total of 2,724,122 individuals stayed overnight in the 601,509 interviewed households (International Institute for Population Sciences and ICF, 2017). Of the total individuals, 777,573 were youth aged between 15-29 years. After excluding cases with missing information on any of the variables included in the analysis, our analytic sample consisted of 395,207 youths.

Outcome Variable

The NFHS-4 survey used standardised protocols and field-friendly technologies to test blood pressure (BP) (Garrett *et al*., 2011). Using the Omron Blood Pressure Monitor, BP was calculated three times at five-minute intervals. We averaged the second and third measurements to determine the systolic and diastolic BP. Finally, we defined hypertension as having an average systolic BP of $\geq$ 140 mmHg, and/or diastolic BP $\geq$ 90 mmHg, and/or self-reported use of any antihypertensive medication. This definition is considered as a case of stage-2 and severe hypertension under the guidelines of recent clinical practice (Carey and Whelton, 2018).

Key Explanatory Variables

The analysis controls for several socio-economic and demographic factors, health behaviours, and health conditions at household and individual levels. Socio-economic and demographic variables

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Table 1. Sample distribution of explanatory characteristics of the youth population in India, NFHS-4 (2015-16)

Characteristics	Sample (N)[1]	Percent Distribution[2]	Prevalence of hypertension[2]	χ^2 P value
Gender				
Male	48,642	12.22	7.14	<0.001
Female	3,46,565	87.78	5.01	
Residence				
Urban	1,11,664	32.28	5.24	0.027
Rural	2,83,543	67.72	5.28	

Note: 1. N's are unweighted, 2. Weighted percentages.

include the gender of youth (male and female), the current age of youth (15-19, 20-24 and 25-29 years), marital status (married, and unmarried), religion (Hindu, Muslim, and others), caste (scheduled caste, scheduled tribe, other backward class, and others) the region (north, central, east, northeast, west, and south) and the place of residence (rural and urban). At the household level variables such as sex of the household head (male, female), education level of household head (no education, primary, secondary, higher), consumption of vegetables (yes/no), fruits (yes/no) and fried food (yes/no) were also included in the analysis. Health behaviours and conditions include current smoking cigarettes (yes/no), alcohol consumption (yes/no), body mass index-BMI (underweight, normal, overweight, and obese), and blood glucose level (high and normal).

Statistical Analysis

The prevalence rates of hypertension are reported as percentages of the total population, and the Chi-squared (χ2) test was used to test the association of various risk factors and confounding variables with hypertension. Stratified multivariable logistic regression models were constructed to assess the influence of independent variables on hypertension among the youth population in the urban and rural areas, and for males and females in 95% C.I. The statistical analysis for this study was conducted using STATA 15.1 software. The spatial patterns of hypertension in Indian states and UTs were illustrated in maps using ArcMap 10.3.

Results

Table 1 shows the overall prevalence of hypertension among males and females in urban and rural settings. It shows that approximately 88% of youths were female with five percent hypertension prevalence, while 12% of youths were male with seven percent reporting hypertension. About 68% of the youth population were living in the rural as opposed to 32% of the youth population living in the urban area. The prevalence of hypertension was around five percent in both the places of residence, but slightly higher in the rural areas.

Figure 1 illustrates the inter-state and UTs variations in hypertension prevalence among males (a), females (b), and total youth population (c). Hypertension was significantly highly prevalent among young males in the majority of the states and UTs compared to females and overall estimates. The results show that the prevalence among men varied greatly between states and UTs, with a prevalence of 1.56% in Delhi to 17.2% in Sikkim. While for females, it ranged between 3.21% in Kerala to 9.59% in Assam. Interestingly, a clear picture of striking gender differences in hypertension prevalence across various states was evident (Figure 1). Overall, the prevalence of hypertension was highest in a majority of the north-eastern states, namely Meghalaya (9.16%),

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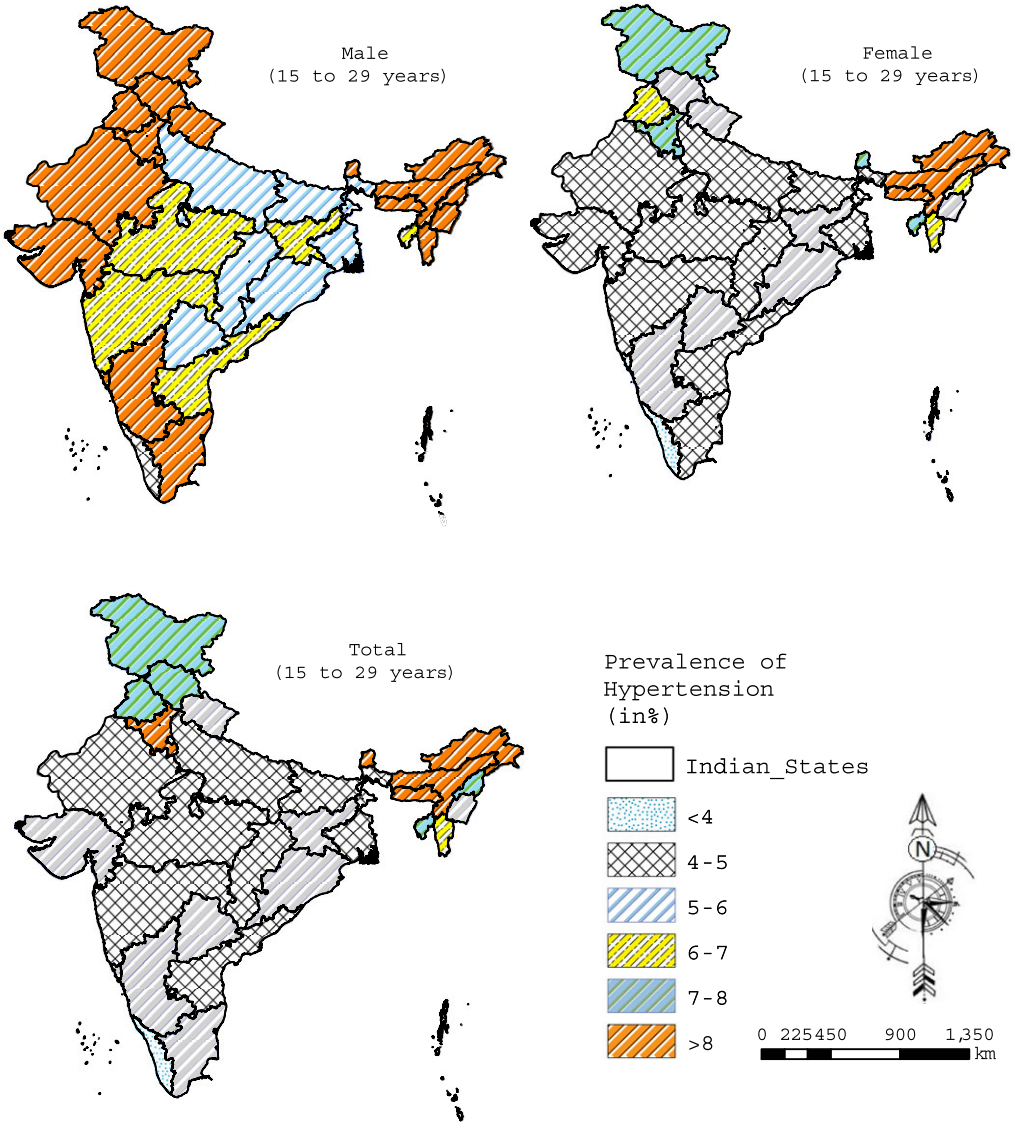

Figure 1. Prevalence of hypertension in male, female, and total youth population in Indian states and UTs.

Assam (8.98%), Sikkim (8.82%), Arunachal Pradesh (8.98%), and Haryana (8.51%) and the lowest in Kerala (3.34%) and Delhi (3.44%) (Figure 1c). Whereas the majority of the states had a prevalence rate of 4-5%.

Table 2 presents the prevalence of hypertension among youth by selected background characteristics stratified by gender and place of residence. Urban participants had a higher prevalence according to the majority of the characteristics in comparison with their rural counterparts. Overall, a remarkable difference was evident in the prevalence based on gender; being higher among males than females, in both urban and rural settings. The prevalence of hypertension increased with age for both males and females with no significant difference according to the rural-urban residence. A higher proportion of married males and females reported hypertension in both areas. Hindu urban males (8%) and Muslim urban females (5.45%) reported the highest

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Table 2. Sample distribution of hypertension among youth by place of residence and sex in India, NFHS-4 (2015-16)

	Urban				Rural			
	Male (15,120)		Female (96,544)		Male (33,522)		Female (250,021)	
Characteristics	N	%	N	%	N	%	N	%
Current age								
15-19	203	2.84	1,000	2.94	504	3.48	3,182	3.34
20-24	458	7.99	1,574	4.46	839	6.97	4,571	4.96
25-29	669	13.13	2,306	6.99	1,198	10.70	5,987	7.24
Marital Status								
Unmarried	859	6.33	2,029	3.62	1,484	5.70	4,458	3.77
Married	471	12.38	2,851	5.97	1,057	9.02	9,282	5.95
Religion								
Hindu	907	8.00	3,046	4.70	1,816	6.63	9,494	4.84
Muslim	235	7.14	1,082	5.44	301	6.19	2,156	6.16
Others	188	7.71	752	4.32	424	10.17	2,090	6.33
Caste								
SC	210	7.11	797	4.56	518	7.23	2,488	4.87
ST	174	6.15	713	4.68	582	6.72	3,254	5.43
OBC	524	8.33	1,893	4.97	847	6.34	4,638	4.80
Others	422	7.71	1,477	4.83	594	7.18	3,360	5.69
Education level								
No schooling	331	8.88	466	6.22	162	5.92	2,698	6.19
Primary	295	7.78	396	5.36	269	7.67	1,917	5.79
Secondary	103	6.71	2,745	4.57	1,586	6.07	7,715	4.65
Higher	208	10.13	1,273	4.87	524	9.58	1,410	4.97
Wealth quintile								
Poorest	35	5.89	162	4.94	438	5.23	3,398	5.22
Poorer	88	5.29	392	4.27	580	5.53	3,815	5.07
Middle	215	6.95	818	4.62	639	7.14	3,053	4.62
Richer	380	7.43	1,579	4.94	519	8.40	2,134	5.23
Richest	612	9.00	1,929	4.94	365	10.22	1,340	5.77
Vegetable consumption								
No	6	6.09	17	2.44	10	2.79	54	4.64
Yes	1,324	7.83	4,863	4.85	2,531	6.79	13,686	5.09
Fruits consumption								
No	12	4.30	53	4.32	50	7.64	352	5.42
Yes	1,318	7.86	4,827	4.84	2,491	6.75	13,388	5.08

(*Continued*)

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Table 2. (*Continued*)

	Urban				Rural			
	Male (15,120)		Female (96,544)		Male (33,522)		Female (250,021)	
Characteristics	N	%	N	%	N	%	N	%
Fried food consumption								
No	92	8.28	200	5.63	191	7.76	685	5.54
Yes	1,238	7.79	4,680	4.80	2,350	6.70	13,055	5.06
Sex of HH head								
Male	1,115	7.72	4,164	4.87	2,221	6.75	12,001	5.08
Female	215	8.45	716	4.64	320	6.90	1,739	5.14
Education level of HH head								
No schooling	269	8.48	967	4.41	840	6.02	4,849	5.02
Primary	227	7.31	826	5.11	513	6.67	2,754	5.06
Secondary	633	7.54	2,345	4.93	1,047	7.40	5,455	5.10
Higher	201	8.37	742	4.85	141	8.25	682	5.58
Region								
North	331	8.76	1,127	5.28	739	9.72	3,078	5.95
Central	295	7.27	1,166	4.30	523	5.42	3,316	4.62
East	103	6.37	514	4.35	308	5.21	2,582	5.06
Northeast	208	11.31	892	7.81	447	9.84	2,837	9.25
West	180	7.75	422	4.52	234	6.97	799	4.77
South	213	8.21	759	5.31	290	7.57	1,128	4.43
Smoking								
No	1,112	7.65	4,854	4.83	2,191	6.67	13,703	5.08
Yes	218	9.00	26	12.15	350	7.78	37	5.80
Alcohol consumption								
No	931	7.24	4,769	4.82	1,722	6.10	13,330	5.06
Yes	399	9.80	111	8.76	819	9.22	410	8.11
BMI								
Underweight	120	3.07	762	3.22	361	3.37	3,275	3.98
Normal	760	6.87	2,721	4.26	1,657	7.00	8,346	5.02
Overweight	365	17.43	964	8.33	433	17.27	1,652	9.34
Obese	85	23.24	433	12.12	90	22.77	467	13.32
Blood glucose level								
Normal	1,240	7.67	4,621	4.71	2,410	6.70	13,178	5.01
High	90	11.49	259	9.42	131	8.54	562	7.80
Total	**1,330**	7.82	**4,880**	4.84	**2,541**	6.77	**13,740**	5.08

Note: N is unweighted sample, % is weighted percentage.

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prevalence of hypertension whereas, in rural settings, participants from other religions showed a higher prevalence. In urban areas, hypertension was highly prevalent among males with higher schooling (10.13%) and no education (8.89%). Similarly, in rural areas, those with higher education reported greater prevalence (9.58%). Female respondents with no education reported a higher prevalence in both settings. Respondents from the richest quintile reported the highest prevalence, with 9% among men in urban areas and 5.77% among females in rural areas. The prevalence was highest in the northeast region for young males residing in urban (11.31%) and rural (9.84%) areas. In both urban and rural localities, hypertension was higher among male and female respondents who were smoking. Concurrently, a similar pattern was observed for alcohol consumption. Obese men from the rural (22.77%) and urban (23.24%) locality had greater prevalence as compared to other groups while obese females from rural areas (13.32%) reported the highest prevalence among females. Urban and rural respondents having high blood glucose levels are at greater risk of hypertension as compared to others for both males and females.

The results of logistic regression analysis by socioeconomic, demographic, and health-related variables are presented in Table 3. A strong positive association was noted between current age and hypertension. The risk of hypertension increased with increasing age for youths in urban-rural residences; however, males had a higher likelihood of being hypertensive than females in both urban and rural areas. Muslim females residing in urban areas were 1.43(95%CI 1.12, 1.82) times more likely to suffer from hypertension in comparison with others. Rural males with no education were 1.35 (95% CI 1.01, 1.80) times more likely at risk of hypertension compared to youths with higher education. However, females with primary and secondary levels of education were less likely to have hypertension in both urban and rural settings. No significant association was found between wealth and hypertension based on gender and place of residence; except, rural females from the poorer and middle wealth quintile were less likely to report hypertension compared to the females from the richest wealth group. Fruits and vegetable consumption did not show any significant association. The analysis shows that females in rural areas not consuming fried food had a lower risk of hypertension (OR = 0.89, 95% CI: 0.80, 0.99). Sex and educational level of the HH head did not play any significant role in the hypertension prevalence among youth in our analysis. Both young males and females from the northeast region were more likely to report hypertension in spite of the rural-urban settings. Also, individuals from the northern region were also more likely to report hypertension except urban males. Rural males (OR = 1.27, 95% CI: 1.11, 1.46) and females (OR = 1.29,95% CI: 1.07, 1.56) consuming alcohol were at higher risk of hypertension. As expected, the BMI of the respondents was strongly associated with hypertension among youths. A significant gender gap was observed in the odds of hypertension by body mass index in both rural and urban areas; however, higher odds were noted in urban areas in comparison with rural areas. Overweight (OR = 3.98, 95% CI: 2.83, 5.59) and obese (OR = 6.27, 95% CI: 3.7, 10.62) urban males were at higher risk of hypertension as compared to underweight young males. Obese and overweight females were more likely to report hypertension, irrespective of the place of residence. Moreover, young females from urban (OR = 1.61,95% CI: 1.29, 2.00) and rural areas (OR = 1.42, 95% CI: 1.26, 1.60), with high glucose levels, were more likely to report hypertension, which is quite a concern.

Discussion

The study analysed a nationally representative sample of the youth population (15-29 years) from India to investigate the prevalence of hypertension, and associated factors, by gender and rural-urban place of residence. Overall, the prevalence of hypertension was found higher for male youths living in urban areas and for females in rural areas. Concurrently, results from regression analysis also suggest higher odds of hypertension for males residing in urban areas for a variety of demographic, socioeconomic, and health-risk factors. The study findings suggest pronounced

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Table 3. Odds ratio of hypertension among youth by gender and place of residence in India, NFHS-4 (2015–16)

	Urban		Rural	
	Male	Female	Male	Female
Characteristics	OR (95% CI)	OR (95% CI)	OR (95% CI))	OR (95% CI)
Current age	1.13*(1.09,1.16)	1.08*(1.06,1.10)	1.09*(1.07,1.11)	1.08*(1.07,1.09)
Marital Status				
Unmarried #	1.00	1.00	1.00	1.00
Married	1.15(0.91,1.45)	1.04(0.90,1.20)	0.96(0.83,1.11)	1.03(0.96,1.10)
Religion				
Hindu	1.21(0.86,1.72)	1.21(0.98,1.49)	0.91(0.73,1.13)	0.92(0.84,1.02)
Muslim	1.14(0.76,1.72)	1.43*(1.12,1.82)	0.90(0.68,1.20)	1.10(0.98,1.24)
Others	1.00	1.00	1.00	1.00
Caste				
SC	0.92(0.71,1.19)	0.97(0.84,1.13)	1.15(0.99,1.33)	1.02(0.95,1.09)
ST	0.80(0.54,1.17)	0.93(0.74,1.16)	1.10(0.92,1.31)	1.05(0.97,1.14)
OBC	0.86(0.67,1.09)	0.94(0.83,1.07)	1.01(0.85,1.17)	1.04(0.97,1.11)
Others	1.00	1.00	1.00	1.00
Education level				
No schooling	0.97(0.6,1.58)	0.88(0.68,1.12)	1.35*(1.01,1.80)	0.97(0.90,1.06)
Primary	0.90(0.59,1.38)	0.82(0.66,1.04)	1.09(0.85,1.39)	0.93*(0.86,0.99)
Secondary	0.97(0.60,1.57)	0.74*(0.57,0.97)	1.29(0.97,1.71)	0.86*(0.78,0.96)
Higher	1.00	1.00	1.00	1.00
Wealth quintile				
Poorest	0.87(0.46,1.65)	0.80(0.59,1.08)	0.94(0.78,1.13)	0.94(0.88,1.01)
Poorer	1.13(0.65,1.98)	0.81(0.61,1.06)	1.09(0.90,1.32)	0.84*(0.78,0.91)
Middle	1.11(0.64,1.92)	0.83(0.63,1.09)	1.15(0.93,1.41)	0.91*(0.83,0.99)
Richer	1.24(0.71,2.18)	0.82(0.61,1.09)	1.17(0.93,1.49)	0.92(0.82,1.02)
Richest	1.00	1.00	1.00	1.00
Vegetable consumption				
No	1.08(0.41,2.82)	0.59(0.28,1.24)	0.49(0.23,1.03)	1.07(0.72,1.59)
Yes	1.00	1.00	1.00	1.00
Fruits consumption				
No	0.61(0.27,1.37)	0.86(0.60,1.24)	1.40(0.95,2.05)	1.02(0.88,1.18)
Yes	1.00	1.00	1.00	1.00
Fried food consumption				
No	0.95(0.66,1.36)	0.88(0.69,1.11)	0.95(0.77,1.17)	0.89*(0.80,0.99)
Yes	1.00	1.00	1.00	1.00

(*Continued*)

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Table 3. (*Continued*)

	Urban		Rural	
	Male	Female	Male	Female
Characteristics	OR (95% CI)	OR (95% CI)	OR (95% CI))	OR (95% CI)
Sex of HH head				
Male				
Female	1.14(0.89,1.46)	0.98(0.85,1.12)	1.11(0.94,1.31)	1.03(0.96,1.11)
Education level of HH head				
No schooling	1.00	1.00	1.00	1.00
Primary	0.84(0.61,1.15)	1.15(0.96,1.38)	1.06(0.90,1.25)	0.99(0.93,1.06)
Secondary	0.74(0.55,1.01)	1.11(0.96,1.27)	1.14(0.99,1.32)	0.99(0.93,1.05)
Higher	0.74(0.48,1.15)	1.09(0.89,1.34)	1.03(0.78,1.35)	1.08(0.96,1.21)
Region				
North	1.24(0.86,1.79)	1.27*(1.06,1.53)	1.68*(1.38,2.04)	1.20*(1.11,1.30)
Central	1.08(0.76,1.55)	1.02(0.87,1.20)	1.08(0.90,1.30)	0.97(0.91,1.04)
East	1.00	1.00	1.00	1.00
Northeast	2.01*(1.33,3.04)	1.95*(1.60,2.38)	1.79*(1.40,2.28)	1.81*(1.66,1.98)
West	1.05(0.69,1.59)	1.05(0.85,1.30)	1.27*(1.01,1.63)	0.98(0.88,1.10)
South	1.01(0.71,1.46)	1.14(0.96,1.37)	1.10(0.87,1.38)	0.84*(0.76,0.92)
Smoking				
No	1.00	1.00	1.00	1.00
Yes	0.95(0.72,1.27)	1.67(0.55,5.09)	0.91(0.75,1.10)	0.90(0.48,1.67)
Alcohol consumption				
No	1.00	1.00	1.00	1.00
Yes	0.99(0.78,1.26)	1.70(0.97,2.98)	1.27*(1.11,1.46)	1.29*(1.07,1.56)
BMI				
Underweight	1.00	1.00	1.00	1.00
Normal	1.65*(1.24,2.20)	1.16(0.99,1.34)	1.65*(1.4,1.93)	1.16*(1.10,1.23)
Overweight	3.98*(2.83,5.59)	2.08*(1.73,2.50)	3.70*(2.99,4.59)	2.04*(1.87,2.23)
Obese	6.27*(3.7,10.62)	2.99*(2.39,3.73)	5.53*(3.77,8.13)	3.07*(2.64,3.56)
Blood glucose level				
Normal	1.00	1.00	1.00	1.00
High	0.98(0.69,1.40)	1.61*(1.29,2.00)	1.16(0.89,1.51)	1.42*(1.26,1.60)

Note: * $p<0.05$, CI: Confidence Interval.
[#]Includes never married with Gauna not perform and don't know categories.

gender differences in the prevalence of hypertension among youth with insignificant rural-urban differences.

After stratifying the risk factors by gender, the study noted a striking gender difference and found that males were more likely to be hypertensive than females, which is in agreement with

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the findings of several previous studies (Abariga *et al.*, 2020; Ghosh and Kumar, 2019; Ramakrishnan *et al.*, 2019). While contrary to this, very few studies have noted a higher prevalence of hypertension in females (Al Kibria *et al.*, 2019; Peltzer and Pengpid, 2018). In addition to this, some literature found no gender disparity (Acharyya *et al.*, 2014; Gupta *et al.*, 2004). Interestingly, whilst the prevalence of hypertension was observed higher among urban and rural males, the gender difference in the prevalence rate was prominently greater in the urban areas compared to rural regions in our study. However, more research is warranted to explain this disparity.

Although the mechanism behind the gender differences in hypertension is not clear, it may be attributed to both biological and behavioural factors. A study by Everett and Zajacova (2015) suggests that biological factors are protective against hypertension in females. Few studies have shown that hormones, such as testosterone, play a significant role in explaining gender-associated differences in controlling higher blood pressure in younger age (Bachmann *et al.*, 1987; Reckelhoff 2001). The study by Bachmann *et al.*, (1987) has found that age is positively associated with hypertension in both sexes. However, after the onset of puberty, boys reported higher blood pressure than girls of the same age. The findings of the research explain that blood pressure is higher in boys than girls in adolescence and puberty, due to changes in hormone levels. Further, the behavioural risk factors for hypertension may include high BMI, sedentary lifestyles, poor eating habits, smoking, drinking alcohol, and lack of physical activity. In the present study, the gender differences can be explained by the higher prevalence rate of overweight/obesity, drinking alcohol, and smoking among males. However, regression results show a significant association for BMI and alcohol consumption for hypertension only. Another study by Thrift *et al.* (2011) revealed that men from relatively socioeconomically advantaged groups are at higher risk of hypertension than women.

Dong *et al.* (2012) researched urban Chinese adults in 33 communities and found that the prevalence of prehypertension was higher in males than females, which supports the findings of our study. Further, findings of research based on a selected group of the rural Indian population (aged 15 years and above) suggest that over 39% of the male and 25% of the females were prehypertensive and they further recommend that intervention programs focussing on men should be designed for lifestyle modification to reduce the prevalence of hypertension (Ghosh *et al.*, 2016).

In this study, the prevalence of hypertension was observed relatively higher in urban than in rural areas, but with a very marginal difference. This suggests that hypertension is spreading rapidly even in the rural population, which might lead to serious consequences due to a lack of public health awareness and management in the rural parts of the country. Our study findings are in line with a recent systematic review on hypertension in India that demonstrates that the prevalence of hypertension among rural-urban locations is nearly similar (Gupta, 2016). This systematic review-based study further elucidates that urban-rural convergence of hypertension in India is due to the urbanization of the rural population with subsequent changes in lifestyles (sedentariness, a greater consumption of unhealthy and high calorie-packed foods, etc.), changes from agriculture to non-agricultural occupations, and rising overweight and obesity. Additionally, affluence is also increasing in rural regions, thus leading to a rise in behavioural health risk factors adding to the burden of hypertension (Ghosh *et al.*, 2016).

The stratified analysis shows age, living in the northeast region, being overweight/obese, and high glucose level were the risk factors significantly associated with hypertension, which is concordant with the findings of some of the recent studies investigating the determinants of hypertension without stratification (Abariga *et al.*, 2020; Ghosh and Kumar, 2019). Like previous literature, our study also found prevalence and a higher likelihood of hypertension increasing with age, for both males and females in urban-rural regions (Abariga *et al.*, 2020). The study suggests that young Muslim females from urban areas were at higher risk of hypertension. This could be linked to the cultural belief and influence on the dietary patterns like consumption of meat etc. and a previous study (Lajous *et al.*, 2014) had shown significant relation between non-vegetarian

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food intake and hypertension. Females from rural areas without education and from a lower wealth quintile were less likely to be hypertensive. The plausible reason behind this could be the higher involvement in household work activities hence they become physically active compared to young rural males. Youths living in the northeast region, particularly males, were at a greater risk of hypertension. Mungreiphy *et al.* (2012) explain that the higher burden of hypertension in the northeast region could be traced back to their ethnicity and food habits. A significant association was found between alcohol consumption and a higher likelihood of hypertension in rural areas, which is in line with a recent study (Ghosh and Kumar, 2019). Moreover, the study found a higher prevalence and likelihood of hypertension among diabetic and overweight/obese individuals in both areas, with a very small rural-urban difference. This association of overweight/obesity and blood glucose level with hypertension is incontrovertible and has been well documented in a number of studies (Al Kibria *et al.*, 2019; Ayemang, 2006; Bhansali *et al.*, 2015; Ghosh and Kumar, 2019).

Substantial inter-state differences accompanied by gender differentials were also found in the prevalence of hypertension among youths. Overall prevalence was higher in the north-east states, Haryana, Jammu and Kashmir, Himachal Pradesh, and Punjab, and quite low in Delhi and Kerala. As argued by Ghosh and Kumar (2019), the inter-state differences might be due to differences in exposure to various risk factors such as changing dietary habits and lifestyle, obesity prevalence, educational status, increasing affluence, genetic factors, gender norms, and urbanization.

India's burden of non-communicable diseases is rising (Arokiasamy, 2018). As the Indian Council of Medical Research (ICMR) (2017) rightly pointed out that mortality from non-communicable diseases account nearly 65% of total deaths in India, and suggested that, over a period of time, the disease burden has shifted from communicable to non-communicable diseases (ICMR, 2017). Approximately 6.1 million deaths were accounted to non-communicable diseases in 2019 (Institute for Health Metrics and Evaluation and Global Burden of Diseases Study, 2019). Therefore, to strengthen the preventive and controlling strategies on NCDs, the government of India launched a National Action Plan for common NCDs such as Cancer, Diabetes, Cardiovascular Diseases, Stroke (2017-2022). It is also the first country to develop its own National Monitoring Framework for the prevention and control of NCDs, with specific targets for 2020 and 2025, which are aligned to the National Health Policy, 2017 (WHO, 2017). These time-bound targets aim to reduce premature mortality from NCDs and achieve universal health coverage (Mathur et al., 2021). Therefore, this study attempts to understand the prevalence of hypertension among the youth population to inform policy implications for this subgroup of the population to create awareness and promote healthy living since young age.

Our research corroborates the previous research by highlighting the gender and rural-urban differences in hypertension by various risk factors among the young population aged 15-29. The study revealed that while the prevalence of hypertension is widespread, what is more concerning is the rising prevalence among the youths. With a higher prevalence in urban settings and a narrowing rural-urban gap, the rising prevalence in rural areas need immediate attention. Because youths suffering from hypertension are more likely to be at greater risk of cardiovascular diseases at later ages. Some of the feasible reasons could be diffusion and adoption of modern lifestyles like an inclination of the young population towards smoking, drinking alcohol, unhealthy foods; physical inactivity, and rising levels of depression and stress due to competitive academic and work environment. Therefore, apart from regular check-ups and treatment since the beginning of the diagnosis, taking preventive measures like keeping a healthy weight, eating a nutritious diet, and engaging in physical activity can help in lowering the risk for hypertension in later life.

To the best of the authors' knowledge, this is the first study that provides a comprehensive picture of the gender and rural-urban differentials in hypertension among the growing youth population (15-29 years) in India. The weighted NFHS-4 sample covers all states as well as urban and

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rural areas of the country, which provides a nationally representative sample for the Indian population. Hence, the estimates can be generalised for the study population aged 15-29 years.

We acknowledge several limitations in this study. First, as our study utilised cross-sectional survey data, a causal relationship between risk factors and the development of hypertension could not be established. Future studies should apply longitudinal methods to account for change over time. Second, apart from anthropometric measures, all the other information used in the analysis was based on self-reporting. Hence, it may be possible that certain information was over or under-reported. Third, the study could not control for essential risk factors of hypertension like detailed dietary habits, genetic factors, sodium intake, psychological stress, and physical activity in the analysis, due to the unavailability of the information in the survey.

Conclusion

This study stratified the prevalence and determinants of hypertension among youths according to gender and rural-urban place of residence in India. We found that hypertension among the youth population is prevalent across both rural and urban settings. Although, the prevalence is higher among male youths from urban settings with a substantial gender difference. Public health awareness regarding blood pressure needs to be tailored differently for both males and females considering the rural-urban dimension. The study suggests a strong association of high glucose level and overweight/obese with a higher likelihood of hypertension. Therefore, if youths at higher risk of hypertension were to adopt a healthier and more active lifestyle to control glucose levels and body weight, this would be likely to help stem the rising prevalence of high blood pressure. Awareness regarding preventive measures as well as specific and effective ways of controlling blood pressure at a young age needs to be spread. We further suggest that more research should focus on blood pressure/hypertension among children, adolescents and youth since they point towards adult blood pressure patterns. There is a strong need to involve families, doctors, public health professionals, policymakers, and educational institutions in efforts to address hypertension in the young population that will help to promote healthy lifestyles of young people.

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Ethical Approval. The data used were from public resources that are anonymised. Such analysis is usually exempt from ethics review.

References

Abariga SA, Khachan H and Al Kibria GM (2020) Prevalence and determinants of hypertension in India based on the 2017 ACC/AHA guideline: evidence from the India national family health survey. *American journal of hypertension* **33**(3), 252–60.

Acharyya T, Kaur P and Murhekar MV (2014) Prevalence of behavioral risk factors, overweight and hypertension in the urban slums of North 24 Parganas District, West Bengal, India, 2010. *Indian journal of public health* **58**(3), 195.

Agyemang C (2006) Rural and urban differences in blood pressure and hypertension in Ghana, West Africa. *Public health* **120**(6), 525–533.

Al Kibria GM, Swasey K, Gupta RD, Choudhury A, Nayeem J, Sharmeen A and Burrowes V (2019) Differences in prevalence and determinants of hypertension according to rural–urban place of residence among adults in Bangladesh. *Journal of biosocial science* **51**(4), 578–590.

Amma GM, Vasudevan B and Akshayakumar S (2015) Prevalence and determinants of prehypertension and hypertension among adolescents: a school based study in a rural area of Kerala, India. *International Journal of Research in Medical Sciences* **3**(1), 58–64.

https://doi.org/10.1017/S0021932022000141 Published online by Cambridge University Press

Arokiasamy P (2018) India's escalating burden of non-communicable diseases. *The lancet global health*, **6**(12), e1262–e1263.

Bachmann H, Horacek U, Leowsky M and Hirche H (1987) Blood pressure in children and adolescents aged 4 to 18. Correlation of blood pressure values with age, sex, body height, body weight and skinfold thickness (Essen Blood Pressure Study). *Monatsschrift Kinderheilkunde* **135**(3), 128–134.

Bauer UE, Briss PA, Goodman RA and Bowman BA (2014) Prevention of chronic disease in the 21st century: elimination of the leading preventable causes of premature death and disability in the USA. *The Lancet* **384**(9937), 45–52.

Bhansali A, Dhandania VK, Deepa M, Anjana RM, Joshi SR, Joshi PP, Madhu SV, Rao PV, Subashini R, Sudha V and Unnikrishnan R (2015) Prevalence of and risk factors for hypertension in urban and rural India: the ICMR–INDIAB study. *Journal of human hypertension* **29**(3), 204–209.

Carey RM and Whelton PK (2018) Prevention, detection, evaluation, and management of high blood pressure in adults: synopsis of the 2017 American College of Cardiology/American Heart Association Hypertension Guideline. *Annals of internal medicine* **168**(5), 351–358.

Chan G, Huo Y, Kelly S, Leung J, Tisdale C, and Gullo M (2022) The impact of eSports and online video gaming on lifestyle behaviours in youth: A systematic review. *Computers in Human Behavior*, **126**, 106974. https://doi.org/10.1016/j.chb.2021.106974.

Chandramouli C and Registrar General (2011) *Census of India. Provisional Population Totals*. New Delhi: Government of India. URL: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/unpd_201510_egm-s2-chandramouli_presentation.pdf (accessed on 10th February 2020).

Chockalingam A (2007) Impact of world hypertension day. *Canadian Journal of Cardiology* **23**(7), 517–519.

Dong GH, Wang D, Liu MM, Liu YQ, Zhao Y, Yang M, Meng XJ, Tian S, Meng X and Zhang HY (2012) Sex difference of the prevalence and risk factors associated with prehypertension among urban Chinese adults from 33 communities of China: the CHPSNE study. *Journal of hypertension* **30**(3), 485–491.

Everett B and Zajacova A (2015) Gender differences in hypertension and hypertension awareness among young adults. *Biodemography and social biology* **61**(1), 1–17.

Garrett DA, Sangha JK, Kothari MT and Boyle D (2011) Field-friendly techniques for assessment of biomarkers of nutrition for development. *The American journal of clinical nutrition* **94**(2), 685S–690S.

Ghosh S and Kumar M (2019) Prevalence and associated risk factors of hypertension among persons aged 15–49 in India: a cross-sectional study. *BMJ open* **9**(12), e029714.

Ghosh S, Mukhopadhyay S and Barik A (2016) Sex differences in the risk profile of hypertension: a cross-sectional study. *BMJ open* **6**(7). e010085.

Gulati BK, Pandey A and Ubaidullah M (2015) Potential gain in life expectancy after partial and complete elimination of specified causes of death: An analysis of Medical Certification of Causes of Death data in India and its selected states. *International Journal of Multidisciplinary Research and Development* **2**(4), 508–512.

Gupta PC, Gupta R and Pednekar MS (2004) Hypertension prevalence and blood pressure trends in 88 653 subjects in Mumbai, India. *Journal of human hypertension* **18**(12), 907–910.

Gupta R (2016) Convergence in urban–rural prevalence of hypertension in India. *Journal of human hypertension* **30**(2), 79–82.

Indian Council of Medical Research (2017) Public Health Foundation of India, and Institute for Health metrics and Evaluation. India: Health of the Nation's States. The India State-Level Disease Burden Initiative. New Delhi, India: ICMR, PHFI, and IHME;2017.

Institute for Health Metrics and Evaluation and Global Burden of Diseases (2019) GBD compare–Viz Hub. Noncommunicable Diseases. Both sexes, all ages, 2019, total% of deaths. Available from: https://vizhub.healthdata.org/gbd-compare/

International Institute for Population Sciences and ICF (2017) *National Family Health Survey (NFHS-4), 2015-16: India*. Mumbai: International Institute for Population Sciences. URL: http://rchiips.org/nfhs/

Kumar K, Misra S (2021) Sex differences in prevalence and risk factors of hypertension in India: Evidence from the National Family Health Survey-4. *PLOS ONE* **16**(4): e0247956. https://doi.org/10.1371/journal.pone.0247956

Lajous M, Bijon A, Fagherazzi G, Rossignol E, Boutron-Ruault MC and Clavel-Chapelon F (2014) Processed and unprocessed red meat consumption and hypertension in women. *The American journal of clinical nutrition*, **100**(3), 948–952.

Mathur P, Kulothungan V, Leburu S, Krishnan A, Chaturvedi HK, Salve HR *et al.* (2021) National noncommunicable disease monitoring survey (NNMS) in India: Estimating risk factor prevalence in adult population. *PloS one*, **16**(3), e0246712.

Ministry of Youth Affairs and Sports (2014) *National Youth Policy 2014*. URL: https://yas.nic.in/sites/default/files/National-Youth-Policy-Document.pdf (accessed on 4th March 2020).

Mungreiphy NK, Dhall M, Tyagi R, Saluja K, Kumar A, Tungdim MG, Sinha R, Rongmei KS, Tandon K, Bhardwaj S and Kapoor AK (2012) Ethnicity, obesity and health pattern among Indian population. *Journal of natural science, biology, and medicine* **3**(1), 52.

Murray CJ, Aravkin AY, Zheng P, Abbafati C, Abbas KM, Abbasi-Kangevari M *et al.* (2020) Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet* **396**(10258), 1223–1249.

Peltzer K and Pengpid S (2018) The prevalence and social determinants of hypertension among adults in Indonesia: a cross-sectional population-based national survey. *International journal of hypertension*. doi: 10.1155/2018/5610725

Raj M, Sundaram KR, Paul M, Deepa AS and Kumar RK (2007) Obesity in Indian children: time trends and relationship with hypertension. *National Medical Journal of India* **20**(6), 288.

Ramakrishnan S, Zachariah G, Gupta K, Rao JS, Mohanan PP, Venugopal K, Sateesh S, Sethi R, Jain D, Bardolei N and Mani K (2019) Prevalence of hypertension among Indian adults: results from the great India blood pressure survey. *Indian heart journal* **71**(4), 309–313.

Reckelhoff JF (2001) Gender differences in the regulation of blood pressure. *Hypertension* **37**(5), 1199–1208.

Thrift AG, Evans RG, Kalyanram K, Kartik K, Fitzgerald SM and Srikanth V (2011) Gender-specific effects of caste and salt on hypertension in poverty: a population-based study. *Journal of hypertension* **29**(3), 443–450.

Tripathy JP, Thakur JS, Jeet G, Chawla S and Jain S (2017) Alarmingly high prevalence of hypertension and pre-hypertension in North India-results from a large cross-sectional STEPS survey. *PloS one* **12**(12), e0188619.

World Health Organization (2011) *Young people: health risks and solutions*. Geneva: WHO. URL: https://www.who.int/news-room/fact-sheets/detail/adolescents-health-risks-and-solutions

World Health Organization (2017) *National multisectoral action plan for prevention and control of noncommunicable diseases*. URL: https://www.who.int/india/news/detail/12-07-2017-national-multisectoral-action-plan-for-prevention-and-control-of-noncommunicable-diseases (accessed on 2nd February 2022).

World Health Organization (2021) *Hypertension*. URL: https://www.who.int/newsroom/factsheets/detail/hypertension (accessed on 15th January 2022).

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