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Hypertension Predisposing Middle-aged Indians to Heart Diseases: Insights from NFHS-5 (2019-21)

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Abstract: Hypertension, the most important modifiable risk factor for cardiovascular diseases (CVDs), affects 1.13 billion people globally. The blood pressure levels of Indian men, aged between 40-55 years, have been found to be the highest among their counterparts from 20 other developing countries. Systolic hypertension is a common risk factor in heart failure. It has also been established that substantial stroke and ischemic heart disease mortality are attributable to hypertension. There is limited data available from Asian countries like India regarding these linkages. The present paper attempts to bridge the gap by focusing on the risk factors of hypertension and its linkages with heart disease. National Family Health Survey-5 (2019-21) data has been used for the present study. Bivariate analysis and ordinal logistic regression, have been employed to assess the factors associated with hypertension. Logistic regression is used to assess the linkage of hypertension with heart diseases. Approximately, 1.2 percent of Indian males are currently affected by heart diseases, out of which 12.7 percent of the males affected are hypertensive, too. Hypertension has been found to be associated with increased odds of heart diseases among both men and women. The differences in the prevalence of hypertension among men and women, its linkages with heart diseases, as well as the ways to control elevated blood pressure levels are important from a policy-making perspective concerning public health.

Keywords: Cardiovascular Diseases; India; Risk Factors; Logistic Models; Public health; hypertension.

Introduction

An increase in life expectancy worldwide has put into sharp focus health issues of the middle-aged and the elderly population. The epidemiological transition entails substitution of deaths caused by communicable diseases by chronic non-communicable diseases such as heart diseases, cardiovascular diseases (CVDs), and cancers (Lim, et al., 2010). There has been a concomitant rise in life expectancy from 40 years in most Asian countries in the 1950s to over 70 years in 2020 (Worldometer, 2020). Large-scale epidemiological studies have shown that hypertension and the related risk of CVDs has shifted from high-income countries to low-and middle-income countries (Nephrol, 2020). Out of the 1.13 billion people affected by CVDs worldwide, two-thirds of the individuals live in low and middle-income countries in Asia, mostly in India and China (WHO, 2021). The fact that the low-and middle-income countries in Asia contribute more to the global share of the CVD burden as compared to the high-income countries is not widely acknowledged (Murray and Lopez, 1994). There have been drastic dietary and lifestyle changes in Asian countries in the past few decades owing to economic

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development. Economic development has contributed to the increase in life expectancy due to greater control over the spread of bacterial diseases and greater awareness about health. However, diet and lifestyle related morbidity have counteracted the gains from increase in life expectancy. Rise in diet-related chronic diseases, usually making their presence felt in middle life, effectively counteract any gains in life expectancy achieved. The Covid-19 pandemic further brought into focus the need to emphasise a healthy lifestyle because the effects of a Covid infection were found to be more pronounced among those with underlying chronic morbidities such as diabetes, hypertension and CHDs.

Hypertension was ranked as the third most important risk factor for the attributable burden of morbidity in South Asia (Lim, et al., 2010). The prevalence of hypertension varies between and within regions in low- and middle-income countries (Damasceno, et al., 2009). A study of risk factors of hypertension can help explain the reason for some populations facing a higher risk of developing heart diseases as compared to others. Risk factors may be genetic, nutritional, behavioural, or of an environmental origin, or may occur as the result of a medical disorder and they may be reversible, irreversible, or may occur in combination with other diseases (Bodin, et al., 2009). Genetic inclination to develop hypertension is aided by biosocial factors like weight gain, high salt intake, anxiety, depression, psychosocial stress, and a disposition to drink alcohol in excess (Saunders, 1991). Till the 1990s, isolated systolic hypertension was thought as a compensatory and benign consequence of aging (Fuchs, et al., 2020). Studies have also linked high sodium intake with elevated levels of blood pressure (Fuchs, et al., 2020). An assessment of the global burden of hypertension found that 20.6 percent of Indian men and 20.9 percent of Indian women suffer from hypertension, the rates of which have been projected to reach 22.9 percent and 23.6 percent respectively for men and women by 2025 (Kearney, et al., 2005).

According to a WHO study (Nissinen, et al., 1988), the blood pressure levels of Indian men aged 40-55 years, was the highest among their counterparts from 20 other developing countries. South Asians may be inclined to higher blood pressure levels as well as more susceptible to Coronary Heart Diseases (CHDs), possibly by virtue of insulin resistance (Singh, et al., 1997; Singh, et al., 1999). A striking feature of the CVD epidemiology in India is the combination of high mortality rates, premature development of CHDs, and a progressively increasing burden of heart diseases (Gupta, et al., 2012). CHDs are the most common heart disease as well as the most common cause of death among both men and women worldwide. CHD mortality has been declining in the high-income countries, but it is increasing rapidly in the low- and middle-income countries (Kelly & Fuster, 2010). Studies have documented regional variations in the prevalence of CHD and stroke mortality in India with southern India having higher CHD mortality and eastern India having higher stroke rates (Kelly & Fuster, 2010). Similar variations exist in CHD prevalence among the rural and urban parts of India (Kelly & Fuster, 2010). However, it is a matter of concern that around 57 percent of all stroke deaths and 24 percent of all CHD deaths could be attributed to hypertension (Gupta, 2004).

Hypertension is a major risk factor for CHD (Dawber, et al., 2015). Hypertension is the most prevalent risk factor for stroke in Asia, with systolic blood pressure, diastolic blood pressure, as well as variability in blood pressure all found to have a positive association with stroke incidence (Turana, et al., 2021). Clinical trials have demonstrated that control of systolic hypertension prevents the development of heart failure (Kostis, et al., 1997). This study examines the prevalence and risk factors associated with hypertension in India, as well as its association with heart diseases. A sizeable proportion of the population aged 35 years and above is found to be affected by age-related disease burden and co-morbidities. The conditions are seen to increase monotonically across time (Atella, et al., 2019). Hence, the corresponding age-groups in the Indian population have been assessed in the present study.

Methods

National Family Health Survey-5 (NFHS-5 2019-21) data has been used for the present study. The National Family Health Survey is a large-scale, multi-round survey conducted in a representative sample of households throughout India. The 2019-21 National Family Health Survey (NFHS-5), the fifth in the NFHS series, provides information on population, health, and nutrition for India and each state and union territory. The clinical, anthropometric, and biochemical (CAB) component of NFHS-5 is designed to provide vital estimates of the prevalence of malnutrition, anaemia, hypertension, HIV, and high blood glucose levels through a series of biomarker tests and measurements. NFHS 5 gathered information from 636,699 households from 707 districts across six regions in India, comprising of 10,69,885 women aged 15 and over, and 10,12,886 men aged 15 and over, presented in the person file. However, for analysing the spatial variation in the prevalence of hypertension, data on 524,363 men (aged 35 and over) and 545,866 women (aged 35 and over) were used. For further analysis, the individual questionnaire module was selected, and the basic information (age, gender, caste, religion, place of residence, wealth quintile) and information on non-communicable morbidities such as the presence of hypertension and heart diseases have been examined. JNC-7 criteria were used for categorising individuals normotensive, pre-hypertensive or hypertensive. The original sample size of 788,973 age eligible individuals (i.e., 93,266 men and 695,707 women) from the survey was reduced to 296,689 (41,054 men aged 35-54 and 255,635 women aged 35-49) for this analysis.

Bivariate analysis has been used for studying the demographic, socio-economic, and behavioural characteristics of the population as categorized by their blood pressure status. To understand the linkages between hypertension and heart diseases, a set of predictor variables that include demographic-socioeconomic and behavioural variables have been used. Ordinal regression analysis has been used to ascertain the factors linking levels of blood pressure (normotensive, pre-hypertensive and hypertensive) to the different variables. In the current study, we have tried to assess the role of each predictor in pushing a subject from one to the next higher category of blood pressure status (normotensive, pre-hypertensive, and hypertensive).

The proportional odds model is a class of generalised linear model used to model the dependence of an ordinal response on discrete or continuous covariates (Singh, et. al., 2020; Ananth & Kleinbaum, 1997). Let Y denote the response category in the range 1,2,….k, with k>2 , and let $\gamma_j = pr(Y< j|x)$ be the cumulative response probability when the covariate is held at x. The most general form of linear logistic model for the jth cumulative response probability $logit(\gamma_j) = \alpha_j - \beta_j T_x$. The one in which both the intercept α and the regression co-efficient β depend on the category j, but the slopes are all equal. Thus, we arrive at the model

$$logit(\gamma_j) = \alpha_j - \beta T_x$$

where, j is the level of an ordered category with j levels and i corresponds to independent variables.

In this case,

- j = 1 refers to 'Normotensive', j = 2 refers to 'Pre-hypertensive', j = 3 refers to 'Hypertensive'
- i = 1 refers to 'age', i = 2 refers to 'sex', i = 3 refers to 'religion', i = 4 refers to 'educational level', i = 5 refers to 'gender and so on and so forth (McCullagh 1980)

Results

It is evident from Figure 1 that there is a larger concentration of hypertensive women aged 35 years and above in the districts from Southern and Northern regions. This prevalence of hypertension across various districts cuts across proportion of women having 10 or more years of schooling. On the other hand, women from most of districts from Eastern and North-eastern regions have relatively lower prevalence of hypertension. The spatial variation in the prevalence of hypertension among men aged 35 years and above in different districts of the country across six regions, remains by and large the same, except in a few districts in the North-eastern regions (Figure 2). The bubble diagrams portray that the districts having larger proportion women and men aged 35 and above have higher prevalence of hypertension. Larger bubbles indicate a higher prevalence of hypertension in those specific areas and among women with 10 or more years of schooling.

The key drivers of hypertension among age eligible women (35-49 years) and men (35-54 years) and its implications for CHD have been analysed and presented in this section (Tables 1-3). Age-adjusted prevalence of blood pressure status (Table 1) among males aged 35-54 years shows 26.5 percent of hypertensive males and 49.9 percent of pre-hypertensive males in India in 2019-21. The corresponding figures for the women population are 21.5 percent of hypertensive and 43.5 percent of pre-hypertensive women. According to proportional odds results (Table 2) for the women, it has been found that for a woman who belongs to the 45-49 year age-group, as compared to a woman from the 35-39 year age-group, her odds of belonging to the hypertensive category versus the combined normotensive and pre-hypertensive categories are 1.72 times higher (OR=1.72, $p<0.01$), given the other

variables in the model are held constant. For males aged between 50-54 years as compared to males aged between 35-39 years, their odds of being placed into the hypertensive category versus the combined normotensive and pre-hypertensive categories are 1.43 times higher (OR=1.43, p<0.01), given the other variables in the model are held constant.

Figure 1: Prevalence of hypertension among women aged 35 years and above in 707 districts across six regions of India by the proportion having 10 or more years of schooling, NFHS-5 (2019-21)

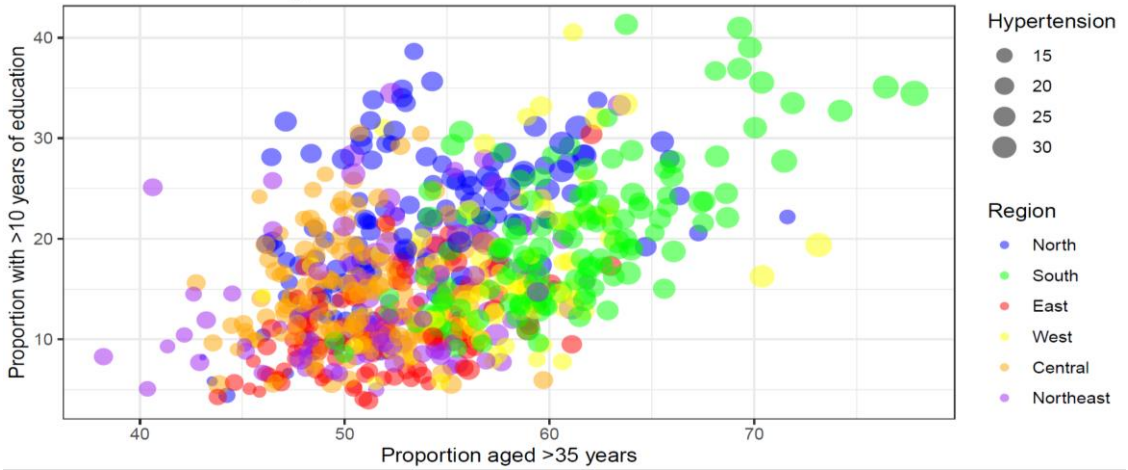
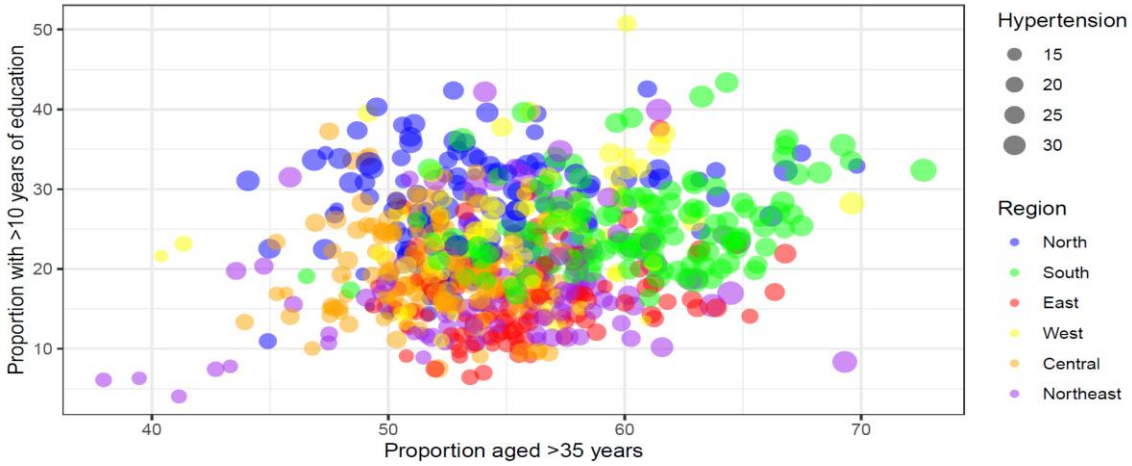


Figure 2: Prevalence of hypertension among men aged 35 years and above in 707 districts across six regions of India by the proportion having 10 or more years of schooling, NFHS-5 (2019-21)



Classification of the Indian population on the place of residence shows a higher prevalence of hypertension among urban residents for both men and women. But, proportional odds ratios show that for rural residents as compared to urban residents, the likelihood of being placed into the hypertensive category versus the combined odds of being placed into the normotensive and pre-hypertensive categories is lower (OR=0.97, p<0.01 for women and OR=0.91, p<0.01 for men), given the other variables in the model are held constant. Educated men have been found to have a higher prevalence of hypertension, as compared to those without any formal education (Table 1). Proportional odds show gradually increasing odds of individuals with higher levels of educational attainment of being placed in

the hypertensive category, as compared to normotensive and pre-hypertensive categories. Educated women (secondary and higher) have lesser odds of being hypertensive than women with no formal education.

As compared to individuals from lower wealth quintiles, individuals from higher wealth quintiles are at a higher likelihood of being placed into the hypertensive category versus combined odds of being placed into the normotensive and pre-hypertensive categories. Around 27 percent of the male population, which smokes tobacco in some form, is found to be hypertensive, as compared to 20 percent of the corresponding female population. Around 32 percent of males and 26 percent of females who consume alcohol are hypertensive. For a woman who consumes alcohol as compared to someone who does not, her odds of being hypertensive are 1.40 times higher (OR=1.40, $p<0.01$) as compared to the combined normotensive and pre-hypertensive categories, when all the other variables in the model are held constant. Likewise, the odds of being hypertensive as compared to normotensive/ or pre-hypertensive are 1.29 times higher for men (OR=1.29, $p<0.01$), when the other variables in the model are held constant. The odds of being hypertensive versus normotensive or pre-hypertensive for a man who consumes poultry daily as compared to someone who never consumes poultry are 1.09 times higher (OR=1.09, $p<0.01$), when other variables are held constant.

Forty-five percent of the hypertensive females aged 35-49 are taking medicines for keeping their BP in check as prescribed by a doctor, as compared to 54 percent of their hypertensive male counterparts aged 35-54. Around 1.9 percent of the total male population is currently affected by heart diseases, out of which 17 percent of the males are hypertensive. Approximately 2.6 percent of females have heart diseases currently, while the percentage for hypertensive females among those with heart diseases is approximately 15 percent (NFHS-5).

Logistic regression results (Table 3) portray the association between hypertension and heart diseases for males aged 35-54 years and females aged 35-49 years. Results reflecting the unadjusted odds of suffering from heart diseases among males aged 35 years and above when hypertension is a predictor gives results for those who are hypertensive being almost 1.45 times more likely (OR = 1.45, $p<0.05$) to have heart diseases as compared to those who are non-hypertensive. Even when the odds are adjusted for socio-economic and demographic variables, hypertensives are approximately 1.44 times more likely (OR = 1.44, $p<0.05$) to have heart disease as compared to non-hypertensive. The unadjusted odds of suffering from heart diseases among females aged 35 years and above when hypertension is a predictor gives results for those who are hypertensive being 1.51 times more likely (OR = 1.51, $p<0.01$) to have heart diseases as compared to those who are non-hypertensive. Even when the odds are adjusted for socio-economic and demographic variables, hypertensives are found to be almost 1.42 times more likely (OR = 1.42, $p<0.01$) to have heart diseases as compared to non- hypertensives.

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Table 1: Socio-demographic characteristics of Indian population classified by blood pressure level, NFHS-5 (2019-21)

	Demographic/ Socio-economic/ Behavioural Characteristics	Male (aged 35-54)				Female (aged 35-49)			
		Levels of Blood Pressure							
		Normal	Pre-hypertensive	Hypertensive	Total	Normal	Pre-hypertensive	Hypertensive	Total
Age	35-39	26.0	53.1	20.8	12874	41.8	42.9	15.3	98068
	40-44	24.7	49.5	25.8	10838	33.9	44.1	21.9	81380
	45-49	22.6	48.6	28.8	10833	28.2	43.6	28.2	84059
	50-54 (Only for Males)	20.2	47.1	32.7	8572	-	-	-	-
Place of Residence	Urban	19.8	51.2	28.9	11319	32.6	44.0	23.4	69190
	Rural	25.7	49.2	25.2	31798	36.2	43.3	20.6	194317
Educational level	No education	28.3	48.8	23.0	8332	35.9	43.7	20.5	107945
	Primary	25.3	49.6	25.1	6970	34.2	43.3	22.5	41630
	Secondary	22.3	49.5	28.2	22273	34.1	43.2	22.7	95081
	Higher	20.2	53.4	26.4	5542	35.3	44.5	20.2	18851
Religion	Hindus	23.5	49.7	26.8	32971	35.7	43.5	20.8	200840
	Muslims	25.8	50.9	23.3	4672	30.6	44.3	25.1	29147
	Others	20.9	50.4	28.8	5474	32.4	42.5	25.1	33520
Wealth Index	Poorest	31.1	48.7	20.2	8430	38.8	42.6	18.6	51967
	Poorer	26.6	49.3	24.1	9296	37.4	42.8	19.8	56323
	Middle	24.5	48.0	27.5	9147	35.5	42.7	21.8	55119
	Richer	19.5	50.8	29.7	8606	32.8	44.0	23.2	51550
	Richest	18.4	52.4	29.2	7638	31.4	45.2	23.4	48548
Smoke	No	24.1	49.6	26.4	36320	35.0	43.5	21.5	262815
	Yes	21.3	51.8	26.9	6797	34.2	45.3	20.4	692
Drinks alcohol	No	24.7	51.2	24.2	28689	35.0	43.5	21.5	255806
	Yes	21.3	46.9	31.9	14428	31.8	42.1	26.1	7701
Poultry consumption frequency	Never	21.1	48.2	30.7	9847	34.6	44.9	20.6	82051
	Daily/weekly	19.6	48.6	31.8	17719	34.8	42.5	22.7	91095
	Occasionally	18.7	46.3	34.9	15551	35.5	43.3	21.2	90361
Fried food consumption frequency	Never	21.5	47.9	30.6	3904	34.0	42.1	23.9	13779
	Daily/weekly	24.6	50.2	25.2	17946	34.6	43.7	21.6	108896
	Occasionally	23.2	50.0	26.8	21267	35.3	43.5	21.2	140832
Taking medicine as prescribed by doctor	No	24.5	50.7	24.8	39175	36.9	46.1	17.0	242671
	Yes	8.2	37.9	53.9	1879	19.4	35.8	44.8	12964
	Total Age-adjusted Prevalence	**23.7**	**49.9**	**26.5**	**41054**	**35.0**	**43.5**	**21.5**	**255635**

Table 2: Proportional Odds Ratios of ordinal regression analysis for different levels of blood pressure of the Indian population by Socio-demographic characteristics, NFHS-5 (2019-21)

	Males (aged 35-54)				Females (aged 35-49)			
Demographic Indicators	**Odds Ratio**	**P>z**	**[95% Conf.**	**Interval]**	**Odds Ratio**	**P>z**	**[95% Conf.**	**Interval]**
Age group								
35-39	1				1			
40-44	1.13***	0.00	1.04	1.20	1.34***	0.00	1.31	1.37
45-49	1.25***	0.00	1.13	1.30	1.72***	0.00	1.68	1.75
50-54	1.43***	0.00	1.32	1.53	-	-	-	
Place of Residence								
Urban	1				1			
Rural	0.91**	0.00	0.85	0.97	0.97***	0.00	0.95	0.99
Highest level of education attained								
None	1				1			
Primary	1.06	0.78	0.92	1.11	1.03**	0.02	1.01	1.06
Secondary	1.19***	0.00	1.09	1.28	0.98	0.13	0.96	1.00
Higher	1.26***	0.00	1.14	1.40	0.84***	0.00	0.81	0.87
Caste								
SC/ST	1				1			
OBC	0.86***	0.00	0.81	0.92	0.88***	0.00	0.87	0.90
Others	0.93**	0.04	0.86	1.00	0.96***	0.00	0.93	0.98
Religion								
Hinduism	1				1			
Islam	1.02	0.74	0.93	1.11	1.33***	0.00	1.29	1.37
Others	1.31***	0.00	1.20	1.43	1.20***	0.00	1.17	1.24
Wealth Quintile								
Poorest	1				1			
Poorer	1.14***	0.00	1.06	1.23	1.09***	0.00	4	1.12
Middle	1.29***	0.00	1.19	1.39	1.17***	0.00	1.14	1.21
Richer	1.58***	0.00	1.45	1.72	1.29***	0.00	1.26	1.33
Richest	1.94***	0.00	1.75	2.15	1.42***	0.00	1.37	1.47
Smoke								
No	1				1			
Yes	0.95	0.19	0.89	1.02	0.84**	0.04	0.71	0.99
Poultry Consumption Frequency								
Never	1				1			
Daily	1.09**	0.02	1.01	1.17	0.96***	0.00	0.94	0.99
Weekly/Occasionally	1.07	0.04	1.00	1.15	0.98	0.17	0.96	1.01
Fried Food Consumption Frequency								
Never	1				1			
Daily	0.95	0.25	0.86	1.04	0.96**	0.04	0.92	1.00
Weekly/Occasionally	0.97	0.57	0.89	1.07	0.96**	0.02	0.92	0.99
Consume Alcohol								
No	1				1			
Yes	1.29***	0.00	1.22	1.37	1.40***	0.00	1.33	1.48

Table 3: Odds ratios of having CHD for Indian population on the basis of socio-demographic and behavioural characteristics, NFHS-5 (2019-21)

Demographic Indicators	Males (aged 35-54)				Females (aged 35-49)			
	Model 1 (Unadjusted)		Model 2 (Adjusted)		Model 1 (Unadjusted)		Model 2 (Adjusted)	
	Odds Ratio	P>z	Odds Ratio	P>z	Odds Ratio	P>z	Odds Ratio	P>z
Having hypertension								
No	1		1		1		1	
Yes	**1.45*** **	0.00	**1.44*** **	0.00	**1.51*** **	0.00	**1.42*** **	0.00
Age								
35-39			1				1	
40-44			1.42**	0.01			1.18***	0.00
45-49			1.68***	0.00			1.44***	0.00
50-54			2.41***	0.00			-	-
Place of Residence								
Urban			1				1	
Rural			1.34	0.06			1.02	0.32
Highest educational level								
No education			1				1	
Primary			1.07	0.70			1.18**	0.00
Secondary			0.99	0.94			1.14**	0.01
Higher							0.74**	0.00
Caste								
SC/ST			1				1	
OBC			0.98	0.81			0.99	0.82
Others			1.04	0.90			1.32***	0.00
Religion								
Hindus			1				1	
Muslims			1.45**	0.03			1.88***	0.00
Others			0.71	0.09			1.24***	0.00
Wealth Index								
Poorest			1				1	
Poorer			0.95	0.51			1.23**	0.00
Middle			0.83	0.31			1.11	0.10
Richer			0.81	0.28			1.12	0.10
Richest			0.81	0.76			0.97	0.74
Smoke								
No			1				1	
Yes			0.98	0.90			3.65***	0.00
Drinks alcohol								
No			1				1	
Yes			1.03	0.83			0.94	0.62
Poultry consumption frequency								
Never			1				1	
Daily			0.96	0.83			0.93	0.18
Occasionally/weekly			1.34	0.09			1.06	0.96
Fried food consumption frequency								
Never			1				1	
Daily			0.48***	0.00			0.67***	0.00
Occasionally/weekly			0.45***	0.00			0.63***	0.00

Discussion

It has been found that the prevalence of hypertension is higher among men than women in the age group 35-54 years. The burden becomes more equally distributed once women pass through the menopause. Our under study population comprises men aged 35-54 years and women aged 35-49 years. Around 23 percent of urban women and 17 percent of the urban men suffering from hypertension are on medical treatment for the same, which is quite low as compared to the enormous proportion of the population suffering from pre-hypertension. A striking observation from the present study is that 22 percent of men and 29 percent of women have their blood pressure in control after being on medical treatment for hypertension. This analysis can help identify regional variations in hypertension prevalence among educated women aged 35-49 years and educated men aged 35-54 years.

Even in studies conducted in Europe, almost 55 percent of women deaths are caused by CVDs, with CHD and stroke as the major contributors (WHO, 2003). But, the risk of heart diseases among women are often underestimated because of the notion that women are 'protected' against ischaemic heart diseases (Stramba-Badiale, et al., 2006). But the fact that women have a lower predisposition to cardiac events during the fertile age, and this protection fades only once menopause sets in, is largely ignored. This phenomenon leaves them vulnerable to untreated risk factors largely till menopause, myocardial infarctions, heart failure, and sudden cardiac deaths. Following the absence of sex-specific risk factors for CVD detection among women (e.g., a history of early menopause, preterm delivery, or gestational hypertensive disorders possibly increasing cardiovascular risk later in life, hence, and needing recognition to adjust preventive measures) from GBD studies, some overarching recommendations by the Lancet Women and Cardiovascular Disease Commission include closing of knowledge gaps by initiating research studies exploring potential pathways of underpinning sex as important determinant of cardiovascular health, targeting under-recognised risk factors, and strengthening healthcare systems and engaging health-care professionals who are sensitive to the specificities of CVD among women (Gao, et al., 2019; Labarthe, 1999).

NFHS-5 data shows that compared to urban women, rural women aged between 35-49 years are less likely to be hypertensive, as compared to the combined odds of being placed in the normotensive or pre-hypertensive category. A Chinese study found that subjects in rural areas were more likely to have hypertension because rapid economic growth and urbanisation gave rise to urbanised rural areas sharing the same environmental factors of cities (e.g. water and air pollution), but without the advantage of recreational resources, and easy accessibility of healthcare services. Subjects from rural areas have also been found to have a higher prevalence of risk factors like alcohol consumption, smoking, and hypertension (Opoku, et al., 2019), which have been associated with an increased likelihood of developing CHDs (Jee, et al., 2014). Another study conducted in central India reported a higher dyslipidaemia prevalence in rural areas, as compared to urban areas (Joshi, et al., 2013). However, rural areas still have the advantage to accessing fresh produce and greater physically challenging lifestyles.

The last 2.5 decades have seen the prevalence increase by almost 30 times in the urban and 10 times in the rural populace in India (Nissinen, et al., 1988).

NFHS-5 data shows women aged between 35-49 years, who have a secondary level or a higher educational level as compared to no formal education, having lesser likelihood of being placed in the hypertensive category versus combined normotensive and pre-hypertensive categories, while for men aged between 35-54 years with secondary or higher education, they are more likely to be placed in the hypertensive category versus combined normotensive and pre-hypertensive categories. This difference between men and women can be understood in terms of men and women being gainfully employed due to their educational status. While women's level of awareness pushes her towards a healthier lifestyle, more educated men are stressed to find employment that befits their education. However, this needs more a more exploratory study than we have done here.

Other factors found to be associated with hypertension are being in a higher wealth quintile, daily poultry consumption and alcohol consumption among men and being in a higher wealth quintile and alcohol consumption among women aged 35-49 years. In the case of women, eating poultry and fried food daily are protective factors. However, since these findings are based upon a cross-sectional survey, self-reporting bias cannot be ruled out. It is also difficult to ascertain the level and method of consumption whether it be regarding smoking tobacco, alcohol or poultry. Economic prosperity leading to diet and lifestyle diseases is a serious concern that needs to be tackled aggressively by marketing healthier lifestyles and spreading awareness regarding the long-term harm of chronic morbidities.

Fragmented investigation has masked the overall picture for causes of CVD. Among the risk factors for CVD, elevated blood pressure is associated with the strongest evidence for causation and it has a high prevalence of exposure. CHDs are the most common of the heart diseases as well as the most common cause of death among both men and women worldwide. CHD mortality has been declining in the developed nations, but it is increasing rapidly in the developing world (Wamala, et al., 2001). Hypertension, in turn, is a major risk factor for coronary heart diseases, which is the foremost cause of morbidity and mortality in hypertensive patients. This study shows that the odds of suffering from heart disease among hypertensive individuals are higher as compared to their non-hypertensive counterparts. The higher likelihood of suffering from heart diseases in the presence of hypertension is supported by similar findings in studies conducted by Wamala et al., where both early and later exposures to socioeconomic disadvantage have been linked to increased CHD risk (Wamala, et al., 2001). Our study shows the link between economic prosperity and hypertension. The risk of heart disease increases with increase in age for both men and women. While smoking was a

protective factor for hypertension, women were nearly four times more likely to have CHD in the presence of smoking. Higher education was a protective factor against having CHD. These are important findings that need wider dissemination.

Conclusions

Hypertension is a modifiable risk factor for heart diseases, which, in turn, is a precursor of angina, heart attack, heart failure, and cardiac arrhythmia. Our study reveals that heart diseases are more prevalent among men aged 50-54 years, and women in their late-reproductive ages (45-49 years). A higher likelihood of having heart diseases is apparent across both the sexes in the presence of hypertension. The findings of the study shed light on the high prevalence of hypertensive middle-aged population, and an even higher prevalence of pre-hypertensive population in India. These findings are important in the context of cardiovascular health of the nation where risk factor management is just as important as primary and secondary prevention strategies. Strategies to promote cardiovascular health can introduce primordial tools to prevent occurrence of risk factors by lifestyles and behaviours associated with suitable levels of blood pressure, cholesterol, glucose, and body weight, in combination with tobacco avoidance (Labarthe, 1999). Although India has sanctioned the WHO framework Convention on Tobacco Control earlier than most countries by enacting the Cigarettes and Other Tobacco Products Act, implementation remains a challenge with only half of the states having provisions to monitor the implementation. Mandating pictorial warning on cigarette packets has been an advance in this regard. Cost–effective interventions with the maximum impact include higher tobacco taxes, advertisement bans for tobacco control, and decreasing excessive dietary salt and fat intake, banning trans fats and taxation of sugar-sweetened beverages (Prabhakaran, et al., 2018). To this effect, the Food Safety and Standards Authority of India can be pro-active in mandating Front of Package Labelling to include the constituents of each food product and the associated calorific information (Singh, et al., 2022).

Awareness regarding the CVD epidemic has not gained the requisite public attention, which can be tackled by creating NCD awareness and urging the population of India to make lifestyle changes to delay the onset of symptoms. Hence, research of these kinds which are performing risk factor analyses and assessing the CVD burden of the country should be taken into consideration while forecasting the CVD situation of India. Ayushmaan Bharat, a national public health insurance fund of the Government of India, has been a significant step towards a pan-Indian approach to health coverage, aiming to provide free access to health insurance coverage for low-income earning sections of the country. Knowledge and awareness gaps existing in the large and diverse Indian population are challenges which the schemes must overcome for their proper implementation.

There are a few limitations of the study, primarily related to the age-groups being covered in the survey. So, the key drivers of hypertension prevalence obtained in this study are not for the whole

population, but only for the adult population aged 35-49 years for women and 35-54 years for men. The key strength of this study is that the estimates are reliable as the blood pressure categories are constructed on the basis of biomarker measures.

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Author contributions

The authors confirm contribution to the paper as follows: study conception and design: SKS, AB; data collection: AB, KC: analysis and interpretation of results: SKS, AB, KC; draft manuscript preparation: SKS, AB, VT, KC, G; Critical Review of Manuscript: SKS, VT, G. All authors reviewed the results and approved the final version of the manuscript.

Conflict of interest and funding

The author would like to declare no competing interests whatsoever with regards to this study.

Ethics and consent

The secondary data used for the study does not contain any identifiable information on the study subjects. Thus, no ethical approval was required. The dataset analysed during the current study is available in the data repository on the Demographic Health Survey website and can be obtained on furnishing a data request form. In order to obtain the data, following link can be used. https://dhsprogram.com/data/availabledatasets.cfm.

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Paper context

Hypertension remains one of the most important preventable contributors to adult mortality and morbidity, and a known risk factor for heart diseases. The present paper assesses socio-demographic and behavioural risk factors for the occurrence of hypertension and assesses its linkages with heart diseases in the Indian population. Some important steps to control the hypertension epidemic in India are the use of mass information and awareness campaigns, and primary and secondary strategies to battle the oncoming CVD pandemic.

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