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Hypertension Stages and Their Associated Risk Factors among Adult Women in India

Enu Anand[1] and Jayakant Singh[2]

Abstract

We investigated the prevalence of different stages of hypertension and their association with selected sociodemographic factors among adult women in India. The study used data from the WHO Study on Global Aging and Adult Health (SAGE) Wave I (2007). The respondents included women ages 18-49 (N=6,555) who provided complete information on their systolic and diastolic blood pressure along with body weight and height. Different stages of hypertension were characterized based on the American Heart Association (AHA) criteria. Mean arterial pressure (MAP) was also calculated by sociodemographic characteristics and nutrition level of the respondent. Multinomial regression analysis was performed to assess the adjusted and unadjusted effects of BMI levels on hypertension. Overweight women compared to the other women were 60% more likely to have pre-hypertension and were at 82% and 83% higher risk to have Hypertension Stage 1 and Stage 2 respectively after controlling for confounding factors. The prevalence of hypertension was significantly higher in tribal, poor, Sikh and older women, as well as for those consuming alcohol and tobacco. The results of the study indicate that early diagnosis and treatment of hypertension must be encouraged particularly in low-income settings, and that information, education and communication (IEC) programs focusing on healthy diet and lifestyle should be promoted.

Keywords

Hypertension; obesity; mean arterial pressure; India, women's health

Introduction

The burden of hypertension is on the rise in both developing and developed countries (Ibrahim & Damasceno, 2012; Kearney et al., 2005). Globally, high blood pressure is expected to cause 7.1 million deaths, which is 13% of total deaths every year (Tesfaye et al., 2007). Hypertension is one of the leading causes of cardiovascular diseases (CVDs) and kidney infections with more than 70% of both men and women ages 60-70 years suspected to be hypertensive (Farag et al., 2014). An estimate suggests around three-quarters of people with hypertension (639 million) live in developing countries with inadequate health care facilities and low levels of awareness about hypertension (Ibrahim & Damasceno, 2012; WHO, 2002). About a third of all deaths in middle-income countries are caused by CVDs and this proportion is similar to that in many developed nations (Lawes, Hoorn & Rodgers, 2008).

In India, hypertension alone contributes to 57% of all stroke deaths and 24% of all coronary heart disease related deaths (Gupta, 2004). The prevalence of hypertension is on the rise among adults over the past few decades. Hypertension increased from 5% to 20-40% in urban

[1] International Institute for Population Sciences, Mumbai, India. Email: enuanand@hotmail.com
[2] School of Health Systems Studies, Tata Institute of Social Sciences, Mumbai, India.

areas and 12-17% in rural areas (Gupta, 2004) and the prevalence increased with increase in age. According to World Health Report 2002, CVDs are expected to be the leading cause of death and disability in India by 2020.
Both hypertension and obesity have become major public health problems in recent years. The percentage of obese and overweight people has drastically increased in India. The National Family Health Survey (NFHS) India revealed a high prevalence of obesity among women. Obesity among women increased from 12% to 15% within a period of seven years, from 1999 to 2006. Moreover, the prevalence of obesity was higher among women than in men (IIPS, 2007). Weight gain or excess fat accumulation is the major contributing factor of hypertension (Mandal, Kumar, Roy & Chatterjee, 1947). Worldwide, about 58% of diabetes mellitus and 21% of ischemic heart disease are attributable to Body Mass Index (BMI) above 21 $kg/m^{2.}$ Risk estimates suggest that 75% and 65% cases of hypertension in men and women respectively are attributable to high BMI levels (Naik, Dudekula & Reddy, 2012). Micro-level studies emphasize a positive association between BMI and high blood pressure in India (Chakraborty, Bose & Bisai, 2009; Hazarika, Biswas & Mahanta, 2003; Kumar, Sudhir, Srinivasan & Punith, 2008; Meshram et al., 2012). As is the case in most populations worldwide, the prevalence of obesity is higher among women as compared to men (Garawi, Devries, Thorogood & Uauy, 2014). Moreover, it was observed that hypertension was more prevalent among middle-aged and older women and they were at higher cardio metabolic risk of CVD than men in India (Gupta, 2013).

Not many studies have adequately focused on women as a risk group to understand the issue of hypertension although women are at a higher risk of hypertension and obesity which further aggravates blood pressure (Davy & Hall, 2004; Gupta, 2004; Moser, Agrawal, Davey Smith & Ebrahim, 2014). Additionally, preeclampsia — a condition in pregnancy characterized by high blood pressure — sometimes with fluid retention and proteinuria is a major disorder that poses a threat to the survival of both mother and child. Women who develop preeclampsia have high Mean Arterial Pressure (MAP) in first and second trimester and even before pregnancies than women with normal pregnancies (Kuc, Koster, Franx, Schielen & Visser, 2013; Nascente et al., 2009; Rang, Wolf, van Montfrans & Karemaker, 2004; Walsh & Baxi, 2008). Moreover, studies on hypertension in India are often limited to micro-level data and very little is known from a community-based sample survey with a representative sample.

There are few studies which have classified hypertension into different stages and examined its individual effect. Moreover, MAP defined as the average pressure in a person's arteries during one cardiac cycle, is a better indicator of perfusion to vital organs than systolic blood pressure (SBP). In India, hypertension is rarely studied using MAP, although it has proved to be a critical indicator of high blood pressure (Sesso et al., 2000) because women with high MAP are likely to develop preeclampsia (Cnossen et al., 2008). Therefore, this study examines the prevalence and risk factors of hypertension in Indian adult women and tests the association of BMI with hypertension from nationally representative community-based survey data. The specific objectives of this study are to (a) investigate the prevalence of hypertension stages in Indian women; (b) explore the differentials in MAP by overweight women and women with normal BMI; and (c) assess the independent effects of BMI on different hypertension stages.

Data & Methodology

The study uses data from the Study on Global Aging Adult Health (SAGE) Survey, Wave I for India (2013), which was conducted in 2007. Data were collected from six states of India as the representative sample of the country. The states were selected purposively in such a manner that one state was selected from each region as well as from each level of development category. These six states are Assam, Karnataka, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal. The World Health Survey (WHS) India 2003, which is also known as the SAGE Wave 0, was also carried out in these states. The primary sampling unit and the households covered in SAGE Wave 0 were the baseline sample for SAGE Wave 1 for calculating state-level estimates. This survey was conducted by the International Institute for Population Sciences, Mumbai in collaboration with the World Health Organization, Geneva.

In the survey, the age group 18-49 was considered as the comparative group and the age group 50 and older was considered as the older population. A detailed description of SAGE sampling methods and the study instruments is available elsewhere (WHO, 2013). Of the 12,198 total survey respondents ages 18-49, 7,481 were female, of which only 6,555 completed full interviews. This analysis uses the information available from the 6,555 women who completed full interviews and had complete measurements on hypertension. Hypertension data was considered complete if the respondent had all three blood pressure (BP) measurements done. A few variables such as household wealth index, caste, Body Mass Index (BMI), fruit intake and depression had missing information in 45, 44, 57, 127 and three cases respectively.

Blood pressure of the respondents was measured by using a Boso Medistar Wrist Blood Pressure Monitor Model S. Respondents were asked to remain seated with legs uncrossed, positioning their left arm level with their heart, taking three deep, slow breaths before measurement started and then remaining relaxed and still while their blood pressure was taken three times with at least a one minute gap between each measurement (WHO, 2013). In this study, mean systolic and diastolic BP were calculated using the average of three measurements. Hypertension was further classified according to the American Heart Association (AHA) guidelines. MAP was also considered as a measure of hypertension as the respondents were women in the reproductive age group and some of them were likely to be pregnant.

Statistical Analysis

This study employed bivariate and multivariate analyses. Cross tabulation was done to examine the prevalence of hypertension by various background characteristics. Chi-square test, z-test, and ANOVA test were conducted to check the statistical significance of the differences. The relationship between hypertension stages as classified by AHA and sociodemographic characteristics of the respondents were analyzed. Further, the analyses were performed to examine the differentials in MAP among overweight women (BMI >=25 kg/m^2) and malnourished or normal-weight women (BMI <25 kg/m^2). In the end, multinomial regression analysis was carried out to assess the adjusted and unadjusted effects of BMI levels on hypertension stages. Statistical analyses were performed using STATA 13 and SPSS 22. Appropriate sampling weight was used in the analysis.

Covariates

The socioeconomic and risk factors of hypertension examined in this study include age, place of residence (urban/rural), religion (Hindu/Muslim/others), caste (SC/ST/OBC/Others), educational status (no education/primary/secondary/higher), wealth index (poorest/poor/middle/rich/richest) as given in the dataset (computed using the WHO standard approach to estimate permanent income from survey data on household amenities), body mass index (BMI: <18.5, 18.5-24.99, 25-29.99, 30+ kg/m^2 (WHO, 2004)), alcohol consumption (yes/no), smoking/tobacco (yes/no), daily fruit intake (none/at least one/two or more) and depression level (none/mild-moderate/severe-extreme).

Outcome Variable: Computation of Hypertension

Blood pressure was classified based on the guidelines of American Heart Association (American Heart Association, n.d.). The four stages are normal blood pressure, pre-hypertension stage, Hypertension Stage 1 and Hypertension Stage 2. In the analysis, hypertensive crisis (Stage 3) is merged with Hypertension Stage 2 because of small sample. The classification used for computing hypertension stages is provided in the Appendix (Table A).

Computation of Mean Arterial Pressure

MAP was calculated by doubling diastolic blood pressure and further adding the sum to the systolic blood pressure, then dividing it by three. MAP was calculated using the equation 1/3(SBP) + 2/3(DBP) (Cnossen et al., 2008).

Computation of BMI

BMI was computed based on the WHO classification of underweight, normal weight, overweight and obesity in adults as per BMI level of the adults. BMI is defined as (weight/height^2). Women who had a BMI of less than 18.5 kg/m^2 were considered underweight, 18.5-24.9 were normal weight, 25.0-29.9 were overweight, and a BMI greater than 30 kg/m^2 was considered obese (WHO, 2004).

Ethical Clearance

Ethical approval for the survey was obtained from the institutional review board of the International Institute for Population Sciences, Mumbai, India. The respondents were asked for their consent prior to participating in the survey. A standard consent form, approved by the World Health Organization ethics review committee was read to the respondents' in the language they speak. If the respondent was literate, the form was provided to her to sign and was countersigned by the interviewer. In case of an illiterate participant the interviewer read out the consent form and the interviewer signed in the consent form after the participant verbally agreed to participate. The respondents were assured confidentiality of the information provided.

Results

Table 1 describes the sociodemographic characteristics of the respondents. Approximately 19% were in the age groups 15-29 and 30-39 respectively. Women in the age group 40-49 constituted 14% of the respondents. Around 23% of the women were in the age group 50-59 and the rest were aged 60 and older. Three-fourths of the women were from rural areas. More than half of the women were uneducated. Approximately 85% were Hindu followed by 12%

Muslim. More than half of the women were from higher caste (i.e., other than Scheduled Caste (ST), Scheduled Tribe (ST) and Other Backward Class (OBC)). Around 7% were from SC and 17% each from ST and OBC category. One-third of the women were underweight and approximately 16% percent overweight or obese. Roughly, half of the women had a normal BMI. Only 3% of the women ever consumed alcohol and 23% of the women smoked cigarettes/*bidis*/pipes. Daily fruit intake among the women was somewhat low. Around two-fifths of the women did not eat any fruit on a daily basis. Forty percent of women reported eating at least one piece of fruit a day and around 21% of women ate two or more pieces of fruit every day. Almost half of the women reported they never experienced depression, around 43% reported mild or moderate levels of depression and 8% reported severe or extreme depression.

Table 1: Characteristics of the study population, SAGE 2007, India

Variables	%	N
Age group		
18-29	19.5	1,278
30-39	19.2	1,258
40-49	14.5	951
50-59	22.7	1,487
60-69	15.5	1,015
70+	08.6	566
Place of residence		
Urban	26.4	1,729
Rural	73.6	4,826
Educational status		
No education	54.5	3,573
Primary	23.0	1,508
Secondary	10.3	674
Higher	12.2	800
Wealth status		
Poorer	18.0	1,174
Poor	19.0	1,234
Middle	19.2	1,252
Rich	21.0	1,366
Richest	22.8	1,484
Religion		
Hindu	84.5	5,541
Muslim	11.9	778
Other	03.6	236
Caste		
SC	07.0	454
ST	17.4	1,134
OBC	17.5	1,138
Others	58.1	3,785
BMI		
< 18.5 kg/m2	34.3	2,228
18.5-24.99	49.3	3,203
25-29.9	11.8	770
30+	04.6	297
Alcohol		
Yes	02.4	155
No	97.6	6,400
Smoking		
Yes	23.7	1,556
No	76.3	4,998
Fruit intake		
Not at all	39.0	2,507
At least one serving	39.5	2,541
Two or more servings	21.5	1,380

Depression		
None	47.9	3,139
Mild/Moderate	43.8	2,868
Severe/Extreme	08.3	545
Total	**100**	**6,555**

Note: Percentages are weighted; N refers to unweighted sample; In religion: Other category consist of Buddhist, Jain, Sikh and Christian.

Women in hypertension stages by their background characteristics, SAGE 2007

Table 2 describes the prevalence of different stages of hypertension by various background characteristics. The results indicate that 33% of the respondents were pre-hypertensive, around 15% were in Hypertension Stage 1 and 7% were in Hypertension Stage 2. Prevalence in all three stages of hypertension increased with the age ($p<0.001$). It is noteworthy to mention that the prevalence of hypertension was significantly high among the younger age group (18-29). Unsurprisingly, older respondents (60 and older) were at the highest risk of hypertension. Approximately 37% of the respondents aged 60-69 were pre-hypertensive, 20% were in Hypertension Stage 1 and 11% were in Hypertension Stage 2. The risk of hypertension was higher among respondents older than 70. Nearly three-fourths of this group were in any one stage of hypertension. Educational status of the respondents showed an inverse relationship with hypertension. Those with high education had low prevalence of hypertension in all the stages as compared to the respondents with low education ($p<0.001$). There was no significant difference between the prevalence of hypertension and place of residence. Mixed results were observed among the respondents from different wealth quintiles. Thirty-four percent of the poorest respondents were pre-hypertensive, and around 32% of the richest respondents were pre-hypertensive. The respondents from the richest wealth quintile were more likely to be in Hypertension Stage 1 whereas those from the poorest quintile were more likely to be in Hypertension stage 2 ($p<0.001$). Respondents from other religions such as Buddhism, Jain, Sikh and Christianity had high prevalence of hypertension as compared to those who were Muslim or Hindu ($p<0.001$). Among Hindus and Muslims, the latter recorded slightly higher levels of hypertension than the former.

The relationship between caste and hypertension stages was significant and revealing. ST women had high prevalence of hypertension than SC, OBC and other caste women ($p<0.001$). The prevalence of hypertension varied largely by BMI level. Overweight women had high prevalence of hypertension in each of the three stages as compared to women with normal BMI as well as underweight women ($p<0.001$). There were a few women who consumed alcohol, but those who consumed had a higher prevalence of hypertension. Roughly, 14% of women who consumed alcohol were in Hypertension Stage 2, compared to only 6% among those who did not consume alcohol ($p<0.001$). Smoking was associated with hypertension. Around 8% of women who smoked had Hypertension Stage 2, whereas those who never smoked had a prevalence of 5%.

Table 2: Percentage of women with hypertension stages by their background characteristics and risk factors, SAGE 2007, India

Characteristics	Normal	Pre-hypertension	Hypertension Stage 1	Hypertension Stage 2	N
Age group* **					
18-29	64.7	25.3	7.4	2.6	1278
30-39	52.3	32.5	11.0	4.1	1258
40-49	43.1	34.0	16.6	6.3	951
50-59	38.6	35.0	16.8	9.7	1487
60-69	30.9	37.5	20.2	11.3	1015
70+	28.1	36.6	19.7	15.5	566
Place of residence					
Urban	47.7	32.5	13.1	6.7	1729
Rural	50.0	31.4	13.0	5.6	4826
Education* **					
No education	45.1	34.4	14.1	6.4	3573
Primary	47.1	32.1	13.7	7.1	1508
Secondary	55.6	29.8	10.2	4.4	674
Higher	62.5	23.3	10.4	3.8	800
Wealth status* **					
Poorest	46.7	34.2	11.7	7.4	1174
Poor	50.1	30.8	13.7	5.4	1234
Middle	50.4	31.1	13.5	5.0	1252
Rich	51.0	30.3	12.7	6.0	1366
Richest	48.7	32.2	13.4	5.7	1484
Religion* **					
Hindu	50.1	31.5	12.8	5.6	5541
Muslim	45.8	33.9	13.9	6.4	778
Others ł	42.3	29.4	15.1	13.1	236
Caste* **					
ST	44.4	33.3	13.9	8.5	454
SC	51.2	29.6	13.6	5.7	1134
No caste/tribe	50.0	30.5	13.2	6.4	1138
Other	49.5	32.2	12.7	5.6	3785
BMI level* **					
Underweight	55.3	29.3	10.3	5.0	2228
Normal	48.2	32.3	13.5	5.9	3203
Overweight	34.0	39.1	18.7	8.1	770
Obese	47.6	30.1	15.0	7.3	297
Alcohol* **					
Yes	31.8	38.1	16.0	14.1	155
No	49.6	31.6	13.0	5.8	6400
Tobacco* **					
Yes	45.6	33.1	12.6	8.6	1556
No	50.3	31.4	13.1	5.2	4998
Fruit Intake* **					
None	49.7	30.7	13.2	6.4	2507
At least one serving	50.0	31.4	12.7	5.9	2541
Two or more servings	48.0	33.3	13.2	5.5	1380
Depression					
None	51.5	31.6	12.3	4.6	3139
Mild/moderate	47.1	31.0	14.3	7.6	2868
Severe/extreme	47.2	36.3	10.4	6.1	545
Total	**44.4(2910)**	**33.2(2174)**	**15.2 (994)**	**7.3(477)**	**6555**

Note: *** p<0.001;

ł *In religion: Other category consist of Buddhist, Jain, Sikh and Christian.*

Differentials in mean arterial pressure between overweight and normal-weight or underweight women

Table 3 reveals the difference in mean arterial pressure (MAP) between overweight women and women with normal BMI or underweight by some of the risk factors. The MAP was significantly higher among overweight women than women with normal BMI or underweight across all the risk factors. The MAP increased with age among overweight women, women with normal BMI and also those who were underweight. The differentials of MAP among the overweight, women with normal BMI, and underweight was significant by age group, education and smoking behavior. The other risk factors were not statistically significant.

Table 3: Differentials in mean arterial pressure between normal or underweight and overweight women, SAGE 2007, India

	Normal or underweight BMI <25 K.G/m²		Overweight BMI >=25 K.G/m²	
Characteristics	**Mean**	**SE**	**Mean**	**SE**
Age				
18-29	87.1+	0.34	87.1+	1.40
30-39	90.0+	0.38	93.2+	1.14
40-49	92.3+	0.47	95.4+	0.94
50-59	94.7+	0.41	98.8+	0.84
60-69	96.1+	0.61	100.1+	1.15
70+	97.1+	0.71	98.5+	2.29
Place of Residence				
Urban	92.2	0.41	96.1	0.73
Rural	92.3	0.22	95.9	0.64
Education				
No education	93.5+	0.27	97.0+	0.81
Primary	91.9+	0.39	98.2+	0.80
Secondary	90.3+	0.52	93.2+	1.24
Higher	88.2+	0.55	92.6+	1.17
Wealth Status				
Poorest	93.0	0.44	95.3	2.04
Poor	92.2	0.44	94.3	2.01
Middle	91.9	0.42	98.0	1.05
Rich	92.1	0.42	95.5	1.05
Richest	91.9	0.46	96.0	0.65
Religion				
Hindu	92.0+	0.21	95.7	0.53
Muslim	93.5+	0.55	97.1	1.42
Others ł	95.0+	1.31	100.0	2.04
Caste				
ST	93.4	0.72	99.0	2.55
SC	92.1	0.44	94.9	1.83
No caste/tribe	92.7	0.50	97.5	1.04
Other	92.0	0.25	95.6	0.57
Alcohol				
Yes	96.9*	1.47	99.5	3.40
No	92.1*	0.19	96.0	0.49
Smoking				
Yes	93.7*	0.41	99.0*	1.38
No	91.8*	0.22	95.4*	0.51
Fruit intake				
None	92.5	0.29	97.0	0.97
At least one serving	92.2	0.32	96.2	0.75
Two or more servings	91.7	0.44	95.1	0.85

	Normal or underweight		Overweight	
	BMI <25 K.G/m²		BMI >=25 K.G/m²	
Characteristics	**Mean**	**SE**	**Mean**	**SE**
Depression				
None	90.9+	0.28	95.6	0.66
Mild/moderate	93.6+	0.28	96.4	0.78
Severe/extreme	92.5+	0.72	96.9	1.48
Total	**92.5**	**0.17**	**96.3**	**0.46**

* *Significant at p<0.01 (two sample z-test),*

+ *Significant at p<0.01(ANOVA test)*

ɬ *In religion: Other category consist of Buddhist, Jain, Sikh and Christian.*

BMI is an important and significant predictor of hypertension among women (Table 4). Overweight women as compared to non-overweight women, were 60% more likely to have pre-hypertension, 82% and 83% higher risk of having Hypertension Stage 1 and Stage 2 respectively than being normotensive after controlling the effect of age, place of residence, education, wealth status, religion, caste, alcohol, smoking, fruit intake and stress level.

Table 4: Results of multinomial regression showing the effect of BMI on the hypertension stages

	Pre-hypertension	Hypertension Stage 1	Hypertension Stage 2
	Adjusted RR (CI)	Adjusted RR (CI)	Adjusted RR(CI)
Overweight women	1.60 (1.207-2.001)	1.82 (1.346-2.468)	1.83 (1.217-2.767)
Significance	*p*<0.001	0.000	0.004
	Unadjusted RR	Unadjusted RR	Unadjusted RR
Overweight women	1.57 (1.242-1.984)	1.94 (1.462-2.575)	1.90 (1.315-2.741)
(Significance)	0.001	0.000	0.000

Reference category: Normal Blood Pressure, N=6555

Significant at 95 % CI (Confidence Interval)

Pseudo R Square: 0.0459 (Adjusted), Pseudo R Square: 0.0041 (Unadjusted)

The model was adjusted for age of the women, place of residence, education, wealth status, religion, caste, alcohol and tobacco consumption, daily fruit intake and depression

Discussion

This study examines the prevalence of hypertension among women in India based on the American Heart Association criteria. It was important to assess the prevalence of various hypertensive stages because most of the studies conducted in the past focused either on mean systolic or diastolic blood pressure, which failed to provide more accurate picture of hypertension. Along with hypertension stages, the MAP among women is an important indicator examined in this study to understand the levels of MAP among women by their background characteristics stratified by BMI levels.

Level of education was one of the important correlates of hypertension. As the levels of education increased, the prevalence of hypertension decreased at all the three stages. Educational status and risk of hypertension have an inverse relationship (Reddy et al., 2007). An educated person is likely aware of their health and is therefore more likely to take protective measures for hypertension. Although previous studies indicate high levels of hypertension prevalence in urban areas (Anchala et al., 2014), we did not find a significant difference in this study. One of the reasons may be that we have used biomarkers information

while many other studies used self-reported information. However, the percentage of respondents with pre-hypertension and Hypertension Stage 2 from urban areas was slightly higher although, the difference was minimal. Such results may also be due to the influence of acculturation (Moran et al., 2007) and changing lifestyles in urban areas percolating in rural areas. Similar results were found by a study (Moser et al., 2014) among Indian women. This has an important implication for the future planning of health services in rural areas as well. Hypertension is not a problem among the affluent alone. Both poor and non-poor women were diagnosed with hypertension. In fact, the poorest women were more likely to be in Hypertension Stage 2 while the richest women were more likely to be in Hypertension Stage 1. The prevailing narrative that hypertension is confined to people with high socioeconomic status needs to be questioned because of an increasing burden on poor people in India. However, the factors associated with hypertension vary among rich and poor for example food habits and life style (Hajat, Kaufman, Rose, Siddiqi & Thomas, 2010; Subramanian, Corsi, Subramanyam & Smith, 2013).

A lower level of hypertension prevalence was observed among Hindu and Muslim women than women from other religions (Sikh/Jain/Christian). It may be noted that complete or partial abstinence from food due to religious reasons may reduce the levels of calorie intake (Trepanowski & Bloomer, 2010). Studies indicate that people attending religious services have lower risks of hypertension (Bell, Bowie & Thorpe, 2012; Levin & Vanderpool, 1989), but the data used in this study does not provide information on the respondents' fasting habits. The association between religion and hypertension should be explored.

Body mass index was a significant predictor of hypertension. A strong association was found in the results of multinomial regression independent of age, socioeconomic status and other demographic and lifestyle related predictors. Differentials in mean arterial pressure also showed higher MAP among overweight women irrespective of their background and behavioral characteristics. Since intake of saturated fatty acids is directly related with cardiovascular risk (WHO, 2003), abstaining from certain fatty acids that affect the population widely may ensure cardiovascular health. People should be educated to consume healthy food with proper fruit intake. A balanced diet recommended by AHA, known as the Dietary Approaches to Stop Hypertension (DASH) diet, emphasizes fruits, vegetables and low-fat dairy products. It includes whole grains, skinless poultry and fish, nuts and legumes, and non-tropical vegetable oils. It limits saturated and trans fats, sodium, read meat, sweets and sugar-sweetened beverages. Efforts must be made to promote and raise awareness about the benefits of the DASH diet.

The very first limitation of the study is that it cannot infer causality due to its cross-sectional design. The wrist monitor for blood pressure estimation is more prone to inaccuracy than brachial monitors. Previous studies have also stated that accurate measurement of blood pressure by automatic devices is possible for people who have atrial fibrillation (Stewart, Gough & Padfield, 1995), which was not screened among the subjects in this study. We considered reporting the average three blood pressure measures, which could have been problematic since some people experience cuff-triggered alerting responses or white coat reactions (Basu & Millett, 2013). Also, there are studies that define salt/sodium intake as an important predictor of hypertension and advocate reduction of dietary sodium intake to reduce blood pressure (Dumler, 2009; Skrabal, Auböck & Hortnagl, 1981) but dietary assessment was, however, not obtained in this study. In spite of the data limitations, SAGE collected information on depression, which is an important control variable to study hypertension.

Conclusion

The findings of this study are based on a nationally representative sample. The study shows the prevalence of each hypertension stage of women in India. BMI is closely associated with hypertension among women in India independent of all other background characteristics and risk factors of high blood pressure. Mean arterial pressure, a relatively less explored indicator of hypertension, was assessed. The study indicated that overweight women had high MAP irrespective of any background characteristic. Education was one of the most important predictors of hypertension. With increases in education, prevalence of hypertension decreased, thus education should be considered as having a potential role in controlling chronic diseases in India.

Current public health programs in India are doubly burdened with both communicable and non-communicable diseases. Early screening of hypertension at the community level needs to be promoted in the primary care level for prescribing treatment at an early stage of hypertension. The development of affordable screening programs for hypertension and other chronic diseases at the mass level is the need of the hour. The community level workers need to be trained and sensitized to diagnose and control chronic diseases. At the individual level, it is important to identify the target populations and provide treatment. Since BMI is strongly associated with hypertension among women, an effort should be made to decrease the consumption of fatty saturated acids and increase a healthy fiber rich diet. Community-based, large scale surveys are needed, as well, to employ more reliable methods to measure hypertension for effective diagnosis and treatment.

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Appendix

Table A: Classification of hypertension stages by the American Heart Association

Hypertension Stages	Systolic(mm/Hg)		Diastolic(mm/Hg)
Normal	less than 120	and	less than 80
Pre-hypertension	120 – 139	or	80 – 89
Hypertension Stage 1 (High Blood Pressure)	140 – 159	or	90 – 99
Hypertension Stage 2 (High Blood Pressure)	160 or higher	or	100 or higher
Hypertensive crisis (Emergency care needed)	Higher than 180	or	Higher than 110

Source: American Heart Association