Original Article

Prevalence and determinants of hypertension and associated comorbidities in non-pregnant women of reproductive age group (15–49 years): Evidence from National Family Health Survey (NFHS-4), India

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Abstract

Background: Hypertension in women is generally underestimated and undiagnosed as women are considered to be at a lower risk of cardiovascular disease than men in addition to gender-related differences in healthcare seeking behaviour and access to healthcare. As hypertension extends a substantial impact on the cardiovascular health of women and can pose an enormous burden on the healthcare systems in India, identification of its risk factors along with co-morbidities becomes necessary for planning of cardiovascular risk prevention, reduction and mitigation interventions.**Aim:** This study aimed at estimating the prevalence and associated demographic and lifestyle risk factors of hypertension (HT) along with examining comorbidity patterns in women of reproductive age (15–49 years) in India. **Material and Methods:** We analyzed data of 667,258 non-pregnant women of the reproductive age group (15–49 years) from the National Family Health Survey (NFHS)-4 dataset. We used maps to present the spatial patterns of HT in women across states and union territories and logistic regression modelling to identify associated factors. **Results:** The overall prevalence of HT was 10.9% among women (15–49 years), with 60.7% of these having at least one comorbidity. While the prevalence of 'HT only' was higher in women 15-29 years of age (48.0%), the prevalence of HT with co-morbidities was higher in women aged ≥30 years (63.3%). Logistic regression analysis showed higher odds of 'HT and ≥ two comorbidities' with age ≥30 years (AOR 3.46, 95% CI 3.23–3.72), higher odds of 'HT only' with alcohol consumption (AOR 1.32, 95%CI 1.23–1.42), and higher odds of 'HT and one comorbidity' with BMI ≥23 Kg/m^2 (AOR 1.17, 95%CI 1.14–1.21). Also, region-wise, the prevalence of HT was highest in the states of Uttar Pradesh (11.6%), Madhya Pradesh (8.0%), and Assam (6.9%). **Conclusion:** The high prevalence of HT among women aged 15–49 years has serious medical, socio-economic, implications that warrant urgent and immediate gender-specific healthcare interventions. Along with lifestyle modifications, early and timely screening of HT, increasing awareness among young school-going girls, including rural areas, could flatten the HT population curve in India.

Keywords: Comorbidities, hypertension, non-pregnant, reproductive age group, women

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Received: 21-01-2022 **Revised:** 24-02-2022
Accepted: 08-03-2022 **Published:** 14-10-2022

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_162_22

Introduction

Hypertension (HT) is a major cause of premature deaths worldwide.[1] In 2008, almost 54% of strokes and 47% of ischemic

How to cite this article: Virk A, Samdarshi N, Saini P, Mohapatra A, Sahoo S, Goel S. Prevalence and determinants of hypertension and associated comorbidities in non-pregnant women of reproductive age group (15-49 years): Evidence from National Family Health Survey (NFHS-4), India. J Family Med Prim Care 2022;11:5865-73.

heart diseases were attributed to high blood pressure (BP).[2] As per WHO estimates, about 1.13 billion people worldwide have HT, with two-thirds living in low and middle-income countries. Almost one in four men and one in five women reported HT in 2015, with controlled HT accounting for less than 20% of hypertensives.[3]

Globally, the number of adults with HT has increased from 594 million in 1975 to 1.13 billion in 2015. South Asian countries like India, Bangladesh, Nepal, Sri Lanka, and Bhutan have experienced a three-fold increase in HT prevalence from 2004–05 to 2011–12.[4] Recent estimates suggest that in India, HT accounts for 5.1% of total deaths and 15% of all deaths due to cardiovascular diseases.[5]

The burden of HT in India has risen substantially in the last decade and is further expected to soar, as studies have projected an almost 80% increase in the number of hypertensives by 2025 due to the growing environmental and 'lifestyle' changes among the Indian population that is already passing through a phase of socio-economic and epidemiological transition. A recent nationally representative study among 1.3 million adults in India found 25% of adults with raised BP, with young adults aged 18–25 years reporting a prevalence of 12%.[6]

India, in its commitment towards the Sustainable Development Goal (SDG) 3.4, has set a target of reducing premature mortality from Non-Communicable Diseases (NCDs) by one-third by the year 2030.[7] Furthermore, the Global Action Plan for the prevention and control of NCDs, adopted by the World Health Assembly in 2013, aims to reduce the prevalence of HT by 25% between 2010 and 2025.[8]

The presence of comorbidities is more common among hypertensive individuals than among normotensive individuals. Comorbidities in hypertensive patients such as obesity, diabetes, cardiovascular diseases (atherosclerosis, ischemic heart disease, myocardial infarction, heart failure), and cerebro-vascular diseases present an increased risk of mortality and also require more complex management strategies.[9]

HT in women of reproductive age group (15–49 years) is often underestimated and undiagnosed as women are considered to be at a lower risk of cardiovascular disease than men, in addition to gender-related differences in healthcare-seeking behaviour and access to healthcare. In contrast, more women's lives are lost due to cardiovascular disease as hypertensive women have a significantly higher risk for vascular disease than men with similar BP levels.[10] The attainment of clinical blood pressure goals can markedly decrease cardiovascular morbidity and mortality. Better education and awareness on the importance of early diagnosis and treatment of HT in women is thus needed. Furthermore, the acknowledgement of risk factors unique to women could help lessen the number of HT-related events and complications in women.Besides, the presence of specific risk factors such as autonomic dysfunction and the effect of female sex hormones on arterial blood pressure that are unique to women need to be acknowledged for intervention in order to prevent adverse outcomes in women.[11]

Given that HT, as a single entity health condition, extends a substantial impact on the cardiovascular health of women and can pose an enormous burden on the healthcare systems in India; identification of its risk factors along with comorbidities becomes necessary for planning of cardiovascular risk prevention, reduction, and mitigation interventions. The present study aims to estimate the prevalence of HT and the pattern of comorbidities in hypertensive women of reproductive age (15–49 years) using a nationally representative sample from across the country.

Material and Methods

This study is based on secondary data obtained from the National Family Health Survey 2015–16 (NFHS-4), the fourth in the NFHS series, and provides information on household population and housing characteristics, basic demographic, and socio-economic characteristics, fertility, family planning, infant and child mortality, maternal and child health, nutrition and anaemia, morbidity and health care, women empowerment, and domestic violence for the entire country as well as for each State/Union territory of India. Additionally, for the first-time information on emerging health-related issues like diabetes mellitus (through blood glucose levels) and HT in the general population were obtained through this survey.

This is a large-scale, multi-round survey conducted in a representative sample of households throughout India and is part of a collaborative project of the International Institute of Population Sciences (IIPS), Mumbai, India; ICF, Calverton, Maryland, USA, and the East-West Centre, Honolulu, Hawaii, USA. The Ministry of Health and Family Welfare (MOHFW), Government of India has designated IIPS, Mumbai as the nodal agency to conduct NFHS-4. The main objective of each successive round of the NFHS is to provide essential data on health and family welfare indicators and any emerging issues of concern in the population.

Study Design and sample size: A two-stage stratified random sampling strategy is utilized by NFHS for selecting Primary Sampling Units, PSUs (villages in rural areas and Census Enumeration Blocks in urban areas) with probability proportional to population size for stage one and the same number of households from each of selected PSUs (through systematic random sampling) in the subsequent stages. The sampling design used for the survey is described in detail in the national report of NFHS-4.[12] Both male and female interviewers were recruited by field agencies to interview respondents of their respective sex. The data collection team was required to visit the household up to three times in case the eligible study participant was not available at the time of visit.

Four Survey Schedules-Household, Woman's, Man's, and

Biomarker-were used in the local language using Computer Assisted Personal Interviewing (CAPI) technique. Information on the woman's characteristics, marriage, fertility, children's immunizations and childcare, nutrition, contraception, reproductive health, sexual behaviour, HIV/AIDS, domestic violence, etc., was collected in the Woman's Schedule. The Biomarker Schedule was used to obtain vital information on BP measurement, height, weight, haemoglobin levels, and random blood glucose levels for women aged 15–49 years.

Other than HIV testing, the results of all measurements and tests were immediately notified to the respondents, and relevant information brochures were distributed among them. The trained health investigators who carried out the tests also explained the results to the respondents.

Anthropometry: Height (in cms) and weight (in kgs) were measured for women with Seca 213 stadiometer and Seca 874 digital scale, respectively.

Testing for haemoglobin: Blood specimens for haemoglobin testing were collected by health investigators from eligible women (age 15–49), after obtaining their consent for the test. Finger prick technique was used to draw blood samples that were collected in a microcuvette. Haemoglobin analysis was conducted on-site with a battery-operated portable HemoCue Hb t201 + analyser. Respondents found to have severe anaemia (a haemoglobin level ≤7 g/dl) were referred to a health facility for further evaluation and management.

Blood glucose testing: Random blood glucose was measured by collecting a finger-stick blood specimen of eligible women (age 15–49) using the FreeStyle Optium H glucometer with glucose test strips. Respondents with blood glucose levels ≥200 mg/dl were referred to a health facility for additional medical evaluation.

Blood pressure measurement: Blood pressure was measured for eligible women (age 15–49) using an Omron Blood Pressure Monitor. Blood pressure measurements for each respondent were taken three times with an interval of five minutes between readings. Respondents whose average systolic blood pressure (SBP) was >140 mm Hg or average diastolic blood pressure (DBP) was >90 mm Hg were considered to have elevated blood pressure readings, and they were encouraged to see a doctor for a full evaluation.

Comorbidity was defined as '*any distinct additional entity that existed at the time of the survey in a patient who has the index disease under study*'.[13] In this study, the index disease was HT, and the comorbidities included Diabetes Mellitus (Random blood glucose ≥200 mg/dl or on medications for high blood sugar were considered to have diabetes mellitus), Obesity (BMI ≥27 Kg/m2 were considered as Obese) Anaemia (Haemoglobin (Hb) levels <12.0 g/dL was considered as anaemia), heart disease, bronchial asthma, thyroid-related condition, and cancer, on the basis of history given by the respondent.

In the interviewed households, 723,875 eligible women aged 15–49 years were identified for individual women's interviews. Interviews were completed with 699,686 (response rate of 97.0%). Analysis in this study was restricted to non-pregnant women aged 15–49 years of age, *N* = 667,258 [Figure 1].

Predictor variables

Socio-demographic characteristics of all women, i.e., age, marital status, education, and place of residence, were considered as covariates for the regression modelling for HT. Age was categorised as 15–29 years and ≥30 years. The education categories were based on the number of years of education completed by an individual: 0 years as 'no education'; 1–5 years of education as 'primary education'; 6–12 years of education as 'secondary education'; and more than 12 years of educational attainment was categorised as 'higher education'. Besides socio-demographic variables, Body Mass Index (BMI), the current status of smoking, and alcohol consumption were included to represent behavioural factors. Obesity and overweight were classified as per the WHO criteria for Asians (Overweight was defined as BMI of >23 kg/m2 and obesity as BMI of >27 kg/m2). Co-existing morbidities (diabetes mellitus, heart disease, thyroid, bronchial asthma, cancer, anaemia and obesity) were also noted for all study participants.

Ethics approval

This study was approved by Institute Ethics Committee, PGIMER, Chandigarh (PGI/IEC/2021/001139)

Statistical analysis

HT was considered as the outcome variable of this study. Data were presented as numbers (*n*), and percentages (%) for categorical variables, and for continuous data, median and inter-quartile range (IQR) were mentioned as per distribution. Kolmogorov Smirnov test was done to check the normality of data distribution. Between-group comparison of continuous and categorical variables was done using the Mann-Whitney *U* test and Chi-square test, respectively. Adjusted odds ratio (OR) and 95% CI were calculated using binary/multivariate logistic

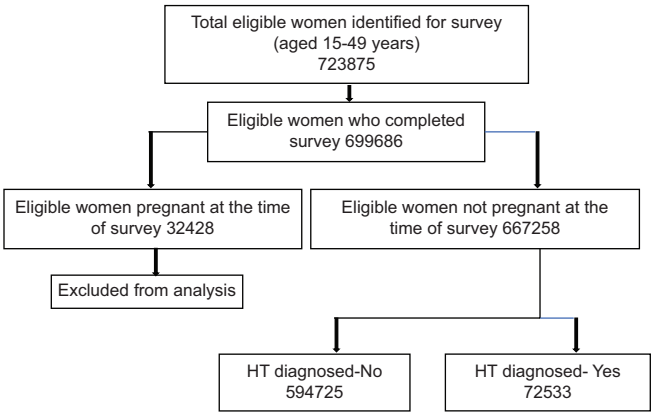

Figure 1: Flowchart showing the derivation of the samples of women aged 15–49 years with HT from NFHS-4 data. Prevalence of HT: 10.9%

regression analyses. Statistical significance was considered at $P < 0.05$. All statistical analyses were performed using SPSS version 27. (IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp)

Results

A total of 699,686 women in the reproductive age group (15–49 years) were surveyed in NFHS-4. Of them, 32,428 were pregnant and hence were excluded from the study. Out of the remaining eligible women aged 15–49 years (667,258), 72,533 (10.9%) women were diagnosed with HT. Table 1 depicts the socio-demographic characteristics of hypertensive women in the 15–49 years age group. The majority of women belonged to the age group of 30–49 years (77.1%), while 22.9% of the hypertensive women were <30 years of age. Most of the hypertensive women resided in rural areas (69.2%). The majority of women belonged to the Hindu religion (69.6%), followed by Islam (14.6%) and Christianity (9.0%).

With regard to education level of sampled women, 40.0% women had received secondary education and 15.0% had received primary education. Among the co-existent morbidities, the hypertensive women often had anaemia (42.5%; 95%CI, 42.2–42.9), followed by obesity (23.9%; 95% CI, 23.6–24.2), diabetes mellitus (3.3%; 95% CI, 3.1–3.4), thyroid disorders (3.0%; 95%CI, 2.9–3.2), heart disease (2.6%; 95%CI, 2.5–2.7), bronchial asthma (2.4%; 95%CI, 2.3–2.5), and cancer (0.2%; 95%CI, 0.1–0.2). Only 0.4% of the studied women were smokers, and 4.6% of the women reported current consumption of alcohol.

Merely 2.9% (n = 2075) of the hypertensive women were currently taking treatment for lowering their blood pressure. As regards the eating habits, green leafy vegetables and fruits were taken on a daily basis by 38.7% and 9.6% of women respectively. The median BMI among hypertensive women was 23.4 Kg/m^2 (20.5–26.8 Kg/m^2). [Table 1]

The age-wise distribution of hypertension and comorbidities is shown in Table 2. The prevalence of HT was more among 30–49 years old women (17.4%) as compared to 15–29 years old women (4.8%). 4.3% (28,501) women had HT only, while 6.6% reported co-existent morbidities. A single comorbidity was observed in 5.03% of the women, while ≥ two comorbidities were observed in 1.57% of the women. Single and multiple comorbidities were more in hypertensive women aged 30–49 years as compared to hypertensive women younger than 30 years (8.07% vs. 2.2% and 2.95% vs. 0.29%, respectively). The most frequent single comorbidity combination was HT + Anaemia (42.3% and 42.6%), followed by HT + Obesity (11.9% and 23.5%) in women aged 15–29 years and 30–49 years, respectively. The most frequent combination of ≥2 comorbidities observed was HT + Anemia + Obesity (9.1%). This too was more in hypertensive women aged 30–49 years as compared to hypertensive women younger than 30 years (10.7% vs. 3.9%).

Table 1: Socio-demographic characteristics of Hypertensive women

Socio-demographic characteristics	*n* (%) (*n*=72533)
Age Group	
15-29 years	16622 (22.9)
30-49 years	55911 (77.1)
Place of residence	
Urban	22334 (30.8)
Rural	50199 (69.2)
Religion	
Hindu	50493 (69.6)
Muslim	10555 (14.6)
Christian	6549 (9.0)
Sikh	2323 (3.2)
Others	2613 (3.6)
Highest educational level	
Illiterate	26705 (36.8)
Upto Primary education	10850 (15.0)
Upto Secondary education	29036 (40.0)
Higher education	5942 (8.2)
Marital Status	
Never married	7160 (9.9)
Currently married	60460 (83.4)
Married but not co-habiting	83 (0.1)
Widowed/Deserted	3952 (5.5)
Separated/Divorced	878 (1.1)
Current Cigarette Smoking[a]	301 (0.4)
Current Alcohol consumption[b]	3313 (4.6)
Currently taking treatment for lowering BP	2075 (2.9)
Eat fruits daily	6939 (9.6)
Eat dark green leafy vegetables daily	28062 (38.7)
BMI (kg/m^2)[c]	23.4 (20.5-26.8)

[a]Current smoker is defined as smoking in the last 30 days. [b]Current alcoholic is defined as one who has drunk alcohol in the last 12 months. [c]Expressed as Median (Interquartile range)

The socio-demographic determinants and risk factors by comorbid status in hypertensive women are shown in Table 3. The prevalence of HT only, single as well as ≥ two comorbidities was higher in women ≥30 years of age ($P < 0.001$) and in rural areas ($P < 0.05$). Higher educational status was inversely associated with the prevalence of HT and comorbid conditions ($P < 0.05$). Current alcohol consumption was significantly associated with HT only and ≥ two comorbid conditions. The median BMI levels were found to be significantly associated with HT only and ≥ two comorbid conditions ($P < 0.001$).

In order to investigate which of the socio-demographic and behavioural characteristics were major risk factors of HT and associated comorbid status in hypertensive women, a logistic regression model was performed. The adjusted odds ratios (AORs) from the regression model for hypertensive women are shown in Table 4. Results showed that women aged ≥30 years had higher odds of HT with two comorbidities (AOR: 3.46, $P < 0.001$) than women <30 years of age. As for the place of residence, the odds of HT alone and single comorbidity were higher in women residing in rural areas ($P < 0.05$), while HT with two comorbidities had higher odds in urban areas ($P < 0.05$). Increasing levels of education were associated with lower odds

Table 2: Age-wise distribution of hypertension in non-pregnant women aged 15-49 years

	Group A (15-29 years) *n* (%; 95%CI) *n*=346011	Group B (30-49 years) *n* (%; 95% CI) *n*=321247	Total (15-49 years) *n* (%; 95%CI) *n*=667258
HT in women (15-49 years)	16622 (4.8; 4.7-4.9)	55911 (17.4; 17.3-17.5)	72533 (10.9; 10.8-10.9)
HT only	7975 (2.3; 2.2-2.4)	20526 (6.4; 6.3-6.5)	28501 (4.3; 4.2-4.3)
HT plus other comorbidities	8647 (2.5; 2.4-2.5)	35385 (11.0; 10.9-11.1)	44032 (6.6; 6.5-6.7)
HT with only one comorbidity	7658 (2.2; 2.2-2.3)	25913 (8.1; 8.09-8.2)	33571 (5.0; 4.9-5.1)
HT with two or more comorbidities	989 (0.3; 0.2-0.3)	9472 (2.9; 2.9-3.0)	10461 (1.6; 1.5-1.6)
	Group A (15-29 years) *n* (%; 95%CI) *n*=16622	**Group B (30-49 years) *n* (%; 95%CI) *n*=55911**	**Total (15-49 years) *n* (%; 95%CI) *n*=72533**
Type of Comorbidities observed in Hypertensive women (15-49 years)			
HT + Anaemia + Obesity	656 (3.9; 3.7-4.3)	5978 (10.7; 10.4-10.9)	6634 (9.1; 8.9-9.4)
HT + DM + Obesity	25 (0.2; 0.1-0.2)	1062 (1.9; 1.8-2.0)	1087 (1.5; 1.4-1.6)
HT + Anaemia	7023 (42.3; 41.5-43.0)	23828 (42.6; 42.2-43.0)	30854 (42.5; 42.2-42.9)
HT + Obesity	1984 (11.9; 11.5-12.4)	15348 (27.5; 27.1-27.8)	17332 (23.9; 23.6-24.2)
HT + DM	116 (0.7; 0.6-0.8)	2259 (4.0; 3.9-4.2)	2375 (3.3; 3.1-3.4)
HT + Thyroid	260 (1.6; 1.4-1.8)	1945 (3.5; 3.3-3.6)	2205 (3.0; 2.9-3.2)
HT + HD	180 (1.1; 0.9-1.3)	1698 (3.0; 2.9-3.2)	1878 (2.6; 2.5-2.7)
HT + Asthma	176 (1.1; 0.9-1.2)	1561 (2.8; 2.7-2.9)	1737 (2.4; 2.3-2.5)
HT + Cancer	1.6 (0.1; 0.06-1.6)	105 (0.2; 0.16-2.3)	121 (0.2; 0.1-0.2)

Table 3: Socio-demographic determinants and risk factors by co-morbid status in hypertensive women (15-49 years)

	HT only (*n*=28501)	HT + 01 Comorbidity (*n*=33571)	HT + ≥02 Co-morbidities (*n*=10461)
Age (Year)			
15-29	7975 (28.0)	7658 (22.8)	989 (9.5)
30-49	20526 (72.0)	25912 (77.2)	9472 (90.5)
	P<0.001	*P*=0.532	*P*<0.001
Residence			
Rural	21006 (73.7)	23384 (69.7)	5809 (55.5)
Urban	7495 (26.3)	10187 (30.3)	4652 (44.5)
	P<0.001	*P*=0.016	*P*<0.001
Educational status			
Illiterate	10645 (37.3)	12868 (38.3)	3192 (30.5)
Primary	4268 (15.0)	4951 (14.7)	1631 (15.6)
Secondary	11305 (39.7)	13108 (39.0)	4623 (44.2)
Higher	2283 (8.0)	2644 (7.9)	1015 (9.7)
	P=0.069	*P*<0.001	*P*<0.001
Current Cigarette Smoking (*n*=301)	131 (0.5)	133 (0.4)	37 (0.4)
	P=0.132	*P*=0.465	*P*=0.292
Current alcohol consumption (*n*=3313)	1524 (5.3)	1553 (4.6)	236 (2.3)
	P<0.001	*P*=0.484	*P*<0.001
BMI (kg/m^2)*	22.3 (19.924.4)	23.3 (20.227.3)	28.9 (27.331.5)
	P<0.001	*P*=0.077	*P*<0.001

*Expressed as Median (Interquartile range)

of HT and single co-morbid condition, while odds of HT with two or more comorbidities were higher with increasing education levels.

The state-wise depiction of the prevalence of HT alone and HT with one and ≥ two can be seen in Figures 2–4. The high-ranking states as per prevalence of HT (alone, one comorbidity, and two or more comorbidities) in women 15–49 years of age were Uttar Pradesh (11.6%), followed by Madhya Pradesh (8.0%) and Assam (6.9%). As for prevalence of HT + DM + Obesity the high ranking states were Uttar Pradesh (133; 0.2%), Tamil Nadu (113; 0.16%), and Madhya Pradesh (97; 0.11%) and for HT + Aanemia + Obesity prevalence was highest in Uttar Pradesh (871; 1.2%), followed by Punjab (507; 0.7%) and Madhya Pradesh (465; 0.6%).

Discussion

This study outlines the prevalence of HT and the comorbidity pattern in women of reproductive age (15–49 years) across India using nationally representative data of NFHS 2015–2016. Furthermore, state-wise prevalence and distribution of hypertensive women and their comorbid status were also mapped in this study. Findings of the present study highlighted that the prevalence of HT in women is much higher in the age 30 years and above as compared to the 15–29 years age group, which is well-supported by previous literature.[5,14,15] The higher

Table 4: Association of risk factors with HT and co-morbid conditions

	HT only AOR (95% CI) *P*	HT + one Co-morbidity AOR (95% CI) *P*	HT + ≥2 Co-morbidities AOR (95% CI) *P*
Age (Year)			
15-29	1	1	1
30-49	0.6 (0.6-0.7)	(0.9-1.0)	3.5 (3.2-3.7)
	P<0.001	*P*=0.704	*P*<0.001
Residence			
Rural	1	1	1
Urban	0.7 (0.6-0.7)	0.9 (0.9-1.0)	1.7 (1.7-1.8)
	P<0.001	*P*=0.014	*P*<0.001
Educational status			
Illiterate	-	1	1
Primary		0.9 (0.8-0.9)	1.3 (1.2-1.4)
Secondary		*P*<0.001	*P*<0.001
Higher	-	0.9 (0.8-0.9)	1.5 (1.4-1.6)
		P<0.001	*P*<0.001
	-	0.9 (0.8-0.9)	1.5 (1.4-1.7)
		P<0.001	*P*<0.001
Current alcohol consumption (*n*=3313)			
No	1	1	1
Yes	1.3 (1.2-1.4)	(0.9-1.1)	0.5 (0.4-0.6)
	P<0.001	*P*=0.594	*P*<0.001
Overweight			
Normal	1	1	1
Overweight	0.8 (0.8-0.9)	1.2 (1.1-1.2)	1.0 (1.0-1.1)
	P<0.001	*P*<0.001	*P*=0.012

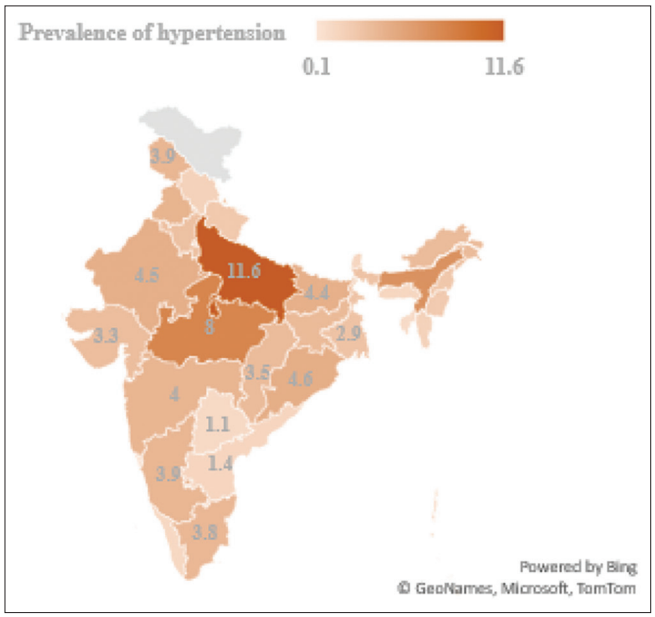

Figure 2: State-wise prevalence of hypertension (%) among women of age 15–49 years

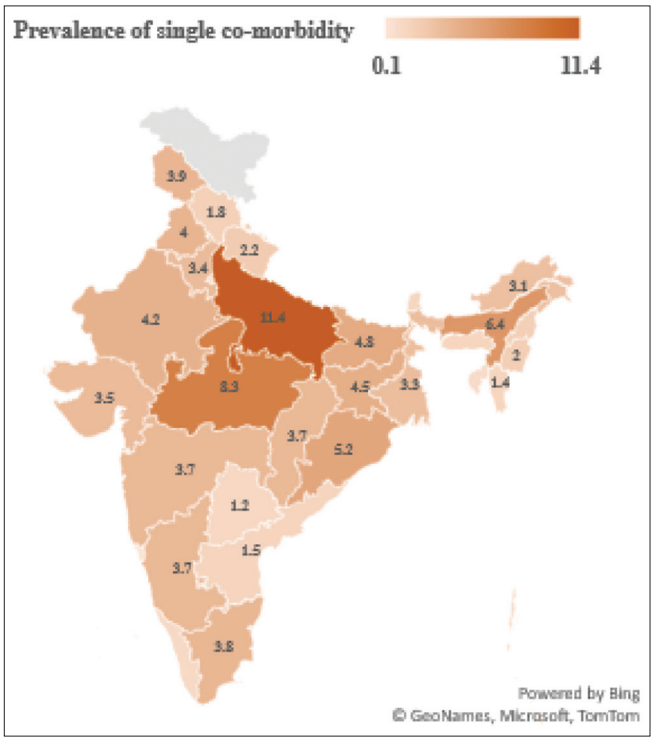

Figure 3: State-wise prevalence (%) of one comorbidity among hypertensive women of age 15–49 years

prevalence of HT among higher age groups may be attributed to age-related changes in the arterial walls, leading to a rise in blood pressure along with the absence of or reduced physical activity.[16] Our study documented a higher prevalence of HT among rural women implying rapid expansion of HT in the rural population.

A lower association of HT was observed among the higher educated women (HT with one comorbidity), possibly due to a better level of knowledge about the disease and its risk factors and better healthcare seeking behaviour. However, for HT with two or more comorbidities the association showed an increased gradient with higher levels of education. A higher prevalence of HT among literate people as compared with illiterate has

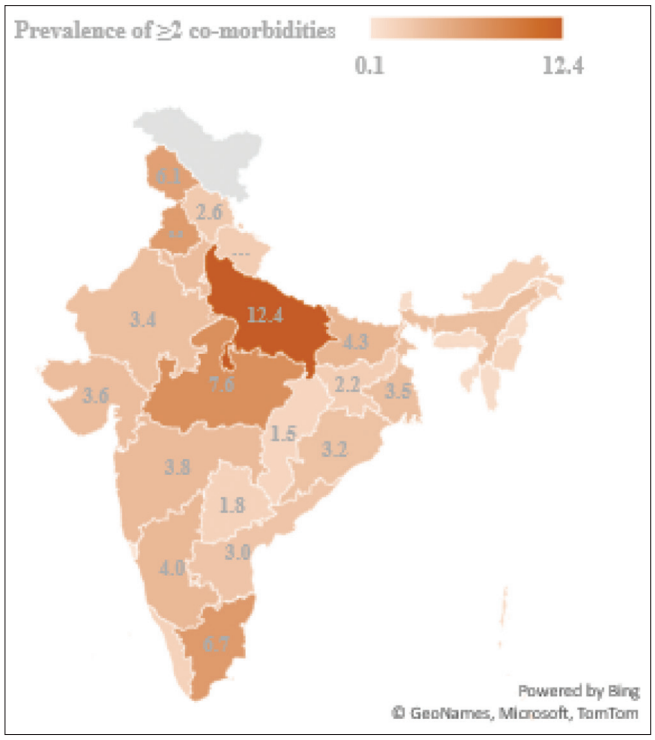

Figure 4: State-wise prevalence (%) of ≥ twocomorbidities among hypertensive women of age 15–49 years

been documented by previous studies as well.[17] Additionally, the prevalence of HT among married women was seen to be higher in this study which may be attributed to increased work and day-to-day stress of handling responsibilities aided further by lack of time for managing a healthy lifestyle conducive to preventing HT. Similar results have been reported by earlier studies.[18]

Co-existent morbidities were seen in 6.6% of women in the present study, with the commonest co-morbid condition being anaemia followed by obesity. Anaemia is a relatively familiar condition among non-pregnant Indian women (prevalence 53.2%, NFHS-4), which explains the common association. Obesity has been shown to be associated with HT in previous studies with considerable implications towards the attainment of treatment goals. Obesity comes across as a major risk factor for the management of BP and its complications, thereby necessitating lifestyle interventions like dietary regulations and regular physical activity to achieve ideal body weight and reduce high blood pressure.

The prevalence of single, as well as multiple co-morbid conditions was higher in hypertensive women in the age group 30–49 years. In this study, DM was seen in 3.3% of hypertensive women. Previous studies[1,9] have also reported frequent co-existence of DM, HTN, and Obesity. The co-existence of these co-morbid conditions presents an increased risk for the development of metabolic syndrome, atherosclerotic cardiovascular events and contributes to all-cause mortality.[19,20] HT and diabetes also share similar lifestyle etiological factors that can be controlled to a large extent by making behavioural modifications and interventions targeting diet and physical activity. Albeit, these interventions need to be made early in life to increase the likelihood of their adaptation as a way of life.

The higher prevalence of HT in women 15–49 years of age presents a considerable public health challenge. Considerable differences in the prevalence of HT were observed at the inter-state level. These geographic variations may be due to differences in risk exposure secondary to urbanisation, affluence related lifestyle changes, tobacco and alcohol consumption, reduced physical activity, dietary habits, obesogenic environment, social stress, and possibly, genetic factors. However, the higher prevalence rates in the north and north-eastern states are a cause of concern as it reflects a state of metabolic ill-health among the women who may, in the future present with a higher likelihood of unfavourable CVD events and mortality in later stages. Also, high blood pressure in the child-bearing age group may have adverse implications on their reproductive health, which in turn may compound the risk of adverse pregnancy outcomes. Earlier studies have attributed high intake of salt, tobacco, and alcohol consumption as a possible explanation for higher BP in north and north-eastern states.[21,22] The inter-state differences in the prevalence and risk of HT can also be linked to the diverse socio-cultural milieu and dietary practices prevalent across states.[23]

This study has allowed us to provide robust estimates of the prevalence of HT in a large representative sample of women across various geographical zones in India. Also, the analysis has helped in identifying the key risk determinants and the common comorbidities in hypertensive women of 15–49 years of age.

Nevertheless, this study is not bereft of a few limitations. First, the definition of HT in NFHS was based on three BP measurements taken during a single occasion, while a clinical diagnosis of HT mandates raised BP measurements on at least two different occasions.[24] This may have resulted in erroneous estimates for the prevalence of HT. Second, NFHS provides cross-sectional data, which limits a detailed exploration of the cause-effect relationship for the reported associations. Furthermore, the role of behavioural risk factors, physical activity and dietary intake details, family history of HT could not be investigated due to the non-availability of such data. Third, a few comorbid conditions presented in this study have been identified on the basis of history/self-reporting obtained from respondents and are not substantiated by a clinical diagnosis or laboratory investigation, such as thyroid conditions, asthma, heart disease, and cancer.

Conclusion

HT in women of reproductive age group in India is a cause of concern considering its serious medical, social, and economic implications. In the current scenario, where the world is reeling under the impact of Coronavirus disease 2019 (COVID-19 pandemic) and HT being recognised as a common risk factor for

severity and adverse clinical outcome among COVID-19 patients, it is imperative to take into consideration the contributing high-risk effect of HT singly as well as in combination with co-existing morbid conditions while formulating robust health programs and policies for control of HT in women. This mandates a coordinated horizontal integration of Reproductive and child health program with the NPCDCS program for improved and effective outcomes. In addition to lifestyle and dietary modifications, early screening and increasing awareness among young school-going girls, particularly in rural areas with limited health literacy and equitable access to quality healthcare services, could flatten the HT curve in India.

Acknowledgements

The authors would like to acknowledge and thank the Resource Center for Cardiovascular Health (RCCVH), established under the Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, for providing technical support towards writing the manuscript. We are also grateful to Global Health Advocacy Incubator (GHAI) for supporting the study (Grant number-INDIA-RIIR-20) and Demographic and Health Surveys (DHS) Program for providing the data set (survey ref no. 155509 downloaded on June 3, 2021), which helped in the development of the manuscript.

What is already known?	It is known that India is passing through a phase of socio-economic and epidemiological transition, and the burden of Hypertension is increasing in India.
What does this study add?	This study brings to the forefront the prevalence of Hypertension in non-pregnant women in the reproductive age group (15-49 years) and associated comorbidities which can serve to stimulate and help prioritize focused action to address this condition and the complications associated with it.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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