

# Assessment of cardiovascular risk using WHO CVD risk prediction chart with respect to hypertension status among Indian population: A secondary analysis of National Family Health Survey (2015–16)

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## ABSTRACT

**Background:** Hypertension, is a crucial risk factor for the development of cardiovascular disease (CVD). Studies assessing the risk of developing CVD among high-risk groups like hypertensives is limited. **Aim:** The purpose of this study was to find the distribution of CVD risk with respect to hypertension status among Indian adults. **Material and Methods:** This was a secondary data analysis of NFHS-4 survey data. The distribution of CVD risk among hypertensive participants using 2019 WHO CVD risk prediction charts was compared with normotensive participants among women aged 40–49 years and men in the age group of 40–54 years. **Results:** The proportion of hypertension was higher among women who consumed alcohol (31.5%) than those who did not (24.3%). The proportion of hypertensives increased with increasing BMI, with maximum proportion among obese women (37.3%). Among women, majority (95.7%) had low CVD risk (<5%) while 4.2% had 5% to <10% CVD risk, and only 0.1% had >10% risk. Among men, those with low CVD risk (<5%) was 65%, those with 5% to <10% CVD risk was 32.3%, 10% to <20% was 2.7%, and a meagre 0.03% had 20 to <30% risk. **Conclusion:** In the current study, prevalence of hypertension was seen to be increasing with age and was higher in urban residents than rural among both men and women. Both high blood pressure reading during the survey and self-reported hypertension was found to be higher among richest wealth index category. Although risk was higher among hypertensives, self-reported hypertensives who had their blood pressure controlled, had risk similar to normotensives indicating the importance of management of hypertension.

**Keywords:** Cardiovascular risk, hypertension, India, WHO-CVD risk

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Received: 21-01-2022

Revised: 05-02-2022

Accepted: 08-03-2022

Published: 14-10-2022

## Introduction

Non-communicable diseases (NCDs) are the leading cause of morbidity and mortality worldwide. They accounted for 73.4% of deaths in 2017, with three-fourth deaths occurring in low- and middle-income countries.<sup>[1]</sup> In 2013, 49.2% of the

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**How to cite this article:** Jaiswal A, Selva Das PA, Singh G, Sathiyamoorthy R, Deori TJ, Dwarakanathan V, *et al.* Assessment of cardiovascular risk using WHO CVD risk prediction chart with respect to hypertension status among Indian population: A secondary analysis of National Family Health Survey (2015–16). *J Family Med Prim Care* 2022;11:5757-65.

### Access this article online

#### Quick Response Code:



Website:  
www.jfmpc.com

DOI:  
10.4103/jfmpc.jfmpc\_158\_22

total deaths in India were due to NCDs.<sup>[2]</sup> In India, prevalent cases of cardiovascular diseases (CVDs) increased from 25.7 million in 1990 to 54.5 million in 2016.<sup>[3]</sup> CVDs, diabetes, cancer, and chronic respiratory diseases are the major diseases which constitute most of the burden by NCDs. CVDs alone contributes 37.8% of total deaths due to NCDs globally and 28.1% of the all-cause mortality in India.<sup>[1,3]</sup> Ischemic heart disease and stroke account for >80% of all CVD deaths in India.<sup>[3]</sup>

CVD risk factors can be divided into non-modifiable such as age, sex, family history/heredity and ethnicity/race, and major modifiable such as tobacco use, physical inactivity, alcohol use, unhealthy diet, abnormal blood lipids, obesity, high blood pressure and high blood glucose. Among these, multiple risk factors can exist in a single individual and increase the risk of developing cardiovascular events. CVDs can be prevented by identifying individuals at risk of developing CVDs and providing healthy lifestyle modifications and timely drug interactions. Thus, risk prediction charts help identify these people at risk of developing CVD who will benefit from preventive interventions.<sup>[4,5]</sup> Although many risks prediction charts have been developed, most of these are based on the studies in high-income countries and hence not applicable to low- and middle-income countries. World Health Organization (WHO) in association with International Society of Hypertension (ISH) developed 2007 WHO/ISH risk prediction charts which are applicable to 14 WHO epidemiological sub-regions. This has been updated by the WHO using individual-participant data from 85 prospective cohort studies and are applicable to 21 global regions, defined by Global Burden of Diseases (GBD) study.<sup>[4]</sup>

Among the risk factors, high blood pressure plays an important role in the development of CVD. Even a modest rise in blood pressure carries a substantial risk and risk depends on the degree of raised blood pressure.<sup>[6,7]</sup> High blood pressure is attributed to 54% of stroke and 47% of ischemic heart disease occurring worldwide.<sup>[8]</sup> Other risk factors present in hypertensive individuals profoundly increase the risk of CVD.<sup>[6]</sup> Thus, a complete risk assessment and risk reduction interventions are needed to prevent cardiovascular diseases for individuals with hypertension. Also, there is no study assessing the cardiovascular risk for a nationally representative sample with respect to hypertensive status using the updated WHO CVD risk charts in India. Therefore, we aimed to study the distribution of CVD risk with respect to hypertension status among adults aged 40 years and above in the nationally representative NFHS-4 survey using 2019 WHO CVD risk prediction charts.

## Materials and Methods

**Data source:** This was a secondary data analysis of NFHS-4 data. NFHS surveys are nationally representative, large-scale surveys conducted in multiple rounds. NFHS-4 was conducted by the International Institute of Population Sciences (IIPS) and Ministry of Health and Family Welfare, India from January 2015 to December 2016, covering approximately 6 lakh households. It was a cross-sectional survey covering 29 states and 7 union territories of India. It involved two-stage cluster random sampling

using population proportionate to size sampling methodology.<sup>[9]</sup> NFHS-4 was representative at the level of districts. A total of approximately 7 lakh women and about 1.1 lakh men were interviewed using a structured tool. Data on blood pressure mainly comes from household member dataset. Piloting of NFHS-4 was conducted prior to the survey which included 147 household interviews (including blood pressure measurement in 181 adults). Along with this, three ToTs (training of trainers) were conducted by IIPS. The trainers who participated were responsible for training of all field workers throughout India.<sup>[10]</sup>

**Sample selection:** The present study included women in the age group of 40–49 years consisting of 149,296 participants and men in the age group of 40–54 years consisting of 31,722 participants. We used household member dataset from NFHS-4 survey.<sup>[9]</sup> Figure 1, shows the study flow chart depicting the sample selection process. We have used 146,017 female individuals, 30,763 male individuals' dataset having valid blood pressure, and height and weight measurements.

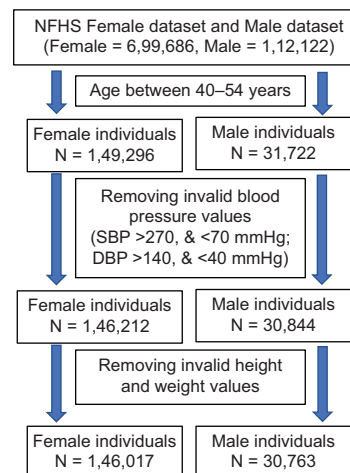
## Study variables

### Dependent variable

Cardiovascular risk was our primary dependent variable. CVD risk was estimated using the 2019 WHO CVD risk charts in which the following variables were considered from NFHS-4 survey, age, sex, systolic blood pressure, smoking status and body mass index. The risk charts provide the risk of developing CVD in percentages. This has been further categorized into five groups: <5%, 5% to <10%, 10% to <20%, 20% to <30%, and ≥30%. The maximum risk score in the risk charts for women in the age group studied (40–49 years) was 17% while among men (40–54 years), it was 26%. (Annexure 1)

### Independent variables

Blood pressure was our primary independent variable. Prior to measuring, arm circumference was measured to use appropriate size cuff. Systolic and diastolic blood pressures were measured thrice using a standard digital sphygmomanometer (Portable



**Figure 1:** Flowchart depicting the sample selection process

Table 1: Socio-demographic characteristics according to hypertension status

Variables	Female			Male		
	Total n (%)	High blood pressure (%) 22.79% overall	Self-reported Hypertensive (%) 16.11% overall	Total n (%)	High blood pressure (%) 28.35% overall	Self-reported Hypertensive (%) 12.89% overall
Age group						
40-44	74847 (51.4%)	20.5	14.6	11576 (37.4%)	26.5	10.8
45-49	70696 (48.6%)	25.2	17.7	10991 (35.6%)	28.3	13.4
50-54	-	-	-	8338 (27.0%)	30.9	15.2
Residence						
Urban	48293 (33.2%)	24.5	20.6	11645 (37.7%)	31.4	16.5
Rural	97249 (66.8%)	21.9	13.9	19260 (62.3%)	26.5	10.7
Education						
No schooling	73011 (50.2%)	21.2	13.0	7195 (23.3%)	24.1	9.8
<5 years	10803 (7.4%)	24.2	15.6	2951 (9.5%)	29.1	10.0
5-7 years	19488 (13.4%)	24.3	18.3	4995 (16.2%)	28.3	12.9
8-9 years	15353 (10.5%)	25.6	19.8	4859 (15.7%)	27.6	12.3
10-11 years	12024 (8.3%)	24.6	20.9	4457 (14.4%)	30.5	15.4
>12 years	14863 (10.2%)	23.3	21.2	6447 (20.9%)	31.8	16.4
Religion						
Hindu	111368 (76.5%)	21.6	15.0	26503 (82.5%)	28.4	12.7
Muslim	16845 (11.6%)	26.2	20.6	3556 (11.5%)	25.5	13.6
Christian	10394 (7.1%)	26.3	17.2	864 (2.8%)	27.0	14.3
Others	6936 (4.8%)	29.1	21.6	982 (3.2%)	37.8	14.6
Marital status						
Unmarried	1869 (1.3%)	28.2	13.9	599 (1.9%)	25.0	10.4
Married	128798 (88.5%)	22.6	16.2	29393 (95.1%)	28.6	13.0
Widow/separated/divorced	14875 (10.2%)	23.4	16.0	913 (3.0%)	23.6	11.4
Caste						
SC	25247 (18.1%)	21.3	15.2	5852 (19.8%)	27.3	12.4
ST	22484 (16.2%)	25.2	12.4	2712 (9.1%)	29.6	6.6
OBC	57171 (41.1%)	21.0	15.8	13498 (45.5%)	28.1	14.2
Others	34189 (24.6%)	24.3	18.5	7576 (25.6%)	30.0	12.9
Health insurance						
Yes	31003 (21.3%)	23.0	16.0	8978 (29.1%)	29.8	15.2
No	114540 (78.7%)	22.8	16.5	21926 (70.9%)	27.8	11.9
Wealth index						
Poorest	25236 (17.4%)	20.1	10.5	4584 (14.8%)	21.1	5.9
Poorer	27813 (19.1%)	21.5	13.4	5551 (18.0%)	23.1	9.1
Middle	28874 (19.8%)	22.3	15.4	6168 (20.0%)	28.9	13.1
Richer	29897 (20.5%)	24.3	17.7	6847 (22.1%)	33.0	15.7
Richest	33722 (23.2%)	25.0	21.6	7756 (25.1%)	31.8	17.1

Omron BP monitor, model HEM-8712) on the same arm, with interval of at least five minutes between each BP measurement. Participants were asked to sit and relax for at five minutes before taking the first reading.<sup>[10]</sup> First, second, and third systolic and diastolic readings were recorded at equated time intervals. The mean of all three readings was taken as the final reading for our study.

High blood pressure was defined by JNC-7 criteria (Systolic blood pressure  $\geq 140$  mmHg and diastolic blood pressure  $\geq 90$  mmHg). However, those with systolic blood pressure more than 270 mmHg or less than 70 mmHg, and diastolic blood pressure more than 140 mmHg or less than 40 mmHg were omitted from analysis. Individuals having blood pressure more than 140/90 mmHg on two or more occasions or on medication for

hypertension were considered as self-reported hypertensives. Hypertension status was further sub-grouped as controlled and uncontrolled on the basis of the mean systolic and diastolic blood pressure at the time of survey.

### Covariates

CVD risk estimated using the non-laboratory-based charts used information of age and sex among the non-modifiable risk factors and systolic blood pressure, smoking status, and body mass index among the modifiable risk factors.

### Data analysis

Data was analyzed in STATA 16 (Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC).<sup>[11]</sup> We used

WHO CVD risk (non-laboratory-based) charts for calculating risk scores. Sampling weights and clustering were taken into account. Appropriate sampling weights (SV005 and HV005) were considered for men and women, respectively. Primary sampling unit and strata were defined as provided in the DHS (Demographic and Health Survey) website.<sup>[12]</sup> Stata command “svyset” was used. All the results are presented in weighted counts and percentages.

### Ethical statement

The study was ethically approved by the Institute’s Ethical Committee, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh (PGI/IEC/2021/001139).

## Results

### Sociodemographic characteristics

Women were almost equally distributed among the age groups of 40–44 years (51.4%) and 45–49 years (48.6%) while in men, the age-wise distribution was as follows: 37.4%, 35.6%, and 27% were in 40–44, 45–49, and 50–54-years age group respectively. 33.2% of women were residing in urban and 66.8% in rural, and 37.7% of men were residing in urban and 62.3% in rural. One half (50.2%) of women had no schooling, 7.4% had completed less than five years of schooling, 13.4% had 5–7 years, 10.5% had 8–9 years, 8.3% and 10.2% had 10–11 years and >12 years of schooling respectively. More than one-fifth of men (23.3%) had no schooling, 9.5% had less than five years, 16.2% had 5–7 years, 15.7% had 8–9 years, 14.4% and 20.9% had completed 10–11 years and >12 years of schooling. Majority of women belonged to Hindu religion (76.5%), followed by Muslim (11.6%), Christianity (7.1%) and 4.8% belonged to others. Similarly, majority of men belonged to Hindu (82.5%), followed by Muslim (11.5%), 2.8% and 3.2% to Christianity and others, respectively. Majority of women (88.5%) in the study population were married while 10.2% were widowed or separated or divorced, and only 1.3% were unmarried. Similarly, most of the men (95.1%) in the study population were married and 3% were either widowed or separated or divorced whereas 1.9% were unmarried. 41.1% of women belonged to OBC category, 18.1% and 16.2% to SC and ST category, respectively. 45.5% of men belonged to OBC category, 19.7% and 9.1% to SC and ST category respectively. Women covered by health insurance was 21.3% while 29.1% of men had health insurance. According to the wealth index, most of the women (23.4%) belonged to the richest category while least (17.4%) came under the poorest category. Following similar trend, in men as well, most (25.1%) belonged to richest category while least (14.8%) to poorest category [Table 1].

### High blood pressure reading and self-reported hypertension

The prevalence of self-reported hypertension among men and women were 12.9% and 16.1% while those who had high BP reading during the survey was 28.4% and 22.8% among men and women respectively.

A total of 10,005 men (28.4%) and 36,550 women (22.8%) in the study population had high BP reading during the survey while only 4,009 men (12.9%) and 23,600 women (16.1%) were told they had high BP on two or more occasions by a doctor or on medication for hypertension.

The proportion of women with high BP reading in urban area was 24.5% while in rural, the proportion was 21.9%. The proportion of self-reported hypertension in urban and rural areas was 20.6% and 13.9%, respectively. Among men, the proportion with high BP reading in rural area was 26.5% while self-reported hypertension was only 10.7% and in urban area, the proportion with high BP and self-reported hypertension was 31.4% and 16.5%, respectively. Both proportions of high BP reading and self-reported hypertension increased with increasing age in both genders. Among women in 40–44 age group, 20.5% had high BP reading and those with self-reported hypertension was only 14.6% while high BP reading was 25.2% and self-reported hypertension was 17.7% in 45–49 years women. Similar trend was seen even in men, high BP reading was 26.5% and self-reported hypertension was 10.8% in 40–44 age group, high BP was seen in 28.3% and self-reported hypertension in 13.4% in 45–49 age group and 30.9% and 1% with high BP and self-reported hypertension, respectively, in 50–54 years age group.

### Distribution of various factors

The prevalence of smoking and smokeless tobacco users among women was 4.1% and 14.2% respectively. Higher proportion of women had blood pressure at the time of survey in hypertensive range among non-smokers (22.9%) compared to smokers (20.5%) ( $P < 0.0001$ , z-test of proportion). It was higher among users of smokeless tobacco (23.7%) compared to non-users (22.6%) ( $P = 0.001$ , z-test of proportion). Although 57% women had secondhand smoke exposure, the proportion of hypertensive was found to be lower among those exposed to secondhand smoke (22.2%) in household compared to those not exposed to secondary smoke (23.6%) ( $P < 0.0001$ , z-test of proportion). The prevalence of alcohol use among women was 3.3%. The proportion of hypertension was seen to be more among women who consumed alcohol (30.1%) than those who did not (22.6%) ( $P < 0.0001$ , z-test of proportion). Prevalence of overweight was 23.8% and obesity was 8.8%. The proportion of hypertensives were observed to be increasing with increasing BMI, with the maximum proportion being among obese women (36.9%). Prevalence of diabetes mellitus was 3.9% among women and heart disease was 2.8%. Almost one-third of the women with diabetes had raised blood pressure at the time of survey (32.9%) which was more than those with heart disease (29.6%).

The prevalence of smoking and smokeless tobacco users among men was 35.2% and 32.8%, respectively. The proportion of men with raised blood pressure among non-smoker men (30%) was higher than smokers (25.3%) ( $P < 0.0001$ , z-test of proportion).

and similarly, higher proportion of hypertensives is seen in those not using smokeless tobacco (28.7%) than those who use smokeless tobacco (27.7%) (although statistically not significant,  $P = 0.0851$ , z-test of proportion). Men with secondhand smoke exposure were 70.2%, the proportion of men with raised blood pressure during the survey was higher among those not exposed to secondhand smoke (30.5%) in household compared to those exposed (27.4%) ( $P < 0.0001$ , z-test of proportion). The prevalence of alcohol use among men was 36%. The proportion of hypertension was seen to be more among men who consumed alcohol (31.4%) than those who did not (26.7%) ( $P < 0.0001$ , z-test of proportion). Prevalence of overweight was 23.4% and obesity was 4.9%. The proportion of hypertensives were observed to be increasing with increasing BMI with the maximum proportion being among obese men (46.2%). Prevalence of diabetes mellitus was 5.2% among men and heart disease was 2.2%. More than one-third of the men with diabetes had raised blood pressure during survey (39.9%) which was more than the proportion of hypertensives among those with heart disease (36.7%).

### WHO cardiovascular risk score

Among women, majority (95.7%) had low CVD risk (<5%) while 4.2% had 5% to <10% CVD risk, and only 0.1% had risk of >10% risk. On calculating the risk in women with high BP reading during the study, the proportion in 5% to <10% risk was increased to 13.3% and 86.2% had low risk (<5%) while in normotensives, the risk was alike all women in the study population.

Among men, those with low CVD risk (<5%) was 65%, 5% to <10% was 32.3%, 10% to < 20% was 2.7%, and a meagre 0.03% had 20% to <30% risk. In men with high BP reading, most (48.1%) belonged to 5% to <10% risk category followed 42.9% with low risk (<5%), 9% with 10% to <19% risk, and 0.1% had >20% CVD risk while in normotensives, 73.8%, 26.1% and 0.2% belonged to low risk (<5%), 5% to <10%, and >10% risk categories, respectively.

The distribution of risk score categories were significantly ( $P < 0.001$ , Chi-squared test) different among men versus women within their respective age categories. Also, within one gender, distribution of risk score categories were significantly ( $P < 0.001$ , Chi-squared test) different among the various age groups [Table 2].

Comparatively higher proportion of individuals were in higher risk group in self-reported hypertensive group compared to those who did not report ( $P < 0.001$ , Chi-squared test).

The risk was higher in males compared to females ( $P < 0.001$ , Chi-squared test), and in higher age group compared to lower age group ( $P < 0.001$ , Chi-squared test).

Among the normotensive group and the controlled self-reported hypertensive group, the distribution of risk scores was comparable among men and women [Table 3].

Overall risk score distribution was towards higher side in men compared to women in each age group category ( $P < 0.001$ , Chi-squared test). Also risk score distribution in men and women both, among those having high blood pressure during survey was higher compared to those having normal blood pressure (normotensives) ( $P < 0.001$ , Chi-squared test) [Table 4].

## Discussion

The prevalence of CVD is on a rise globally including in low- and middle-income countries like India. It is well documented that CVD risk is not precipitated by a single risk factor, and is instead precipitated by several risk factors present in a single individual. Although hypertension is an important CVD risk factor, the CVD risk in hypertensives also depend on other risk factors present in them. Thus, by estimating the CVD risk, we can provide a holistic management rather than focusing only on hypertension treatment. Thus, we conducted this study to (the difference/dissimilar/higher risk) estimate the CVD risk in hypertensives (than normotensive or general population) with non-laboratory-based WHO CVD risk charts using the NFHS-4 data among men and women aged >40 years.

In the current study, prevalence of hypertension was seen to be increasing with increasing age and was higher in urban residents than rural, among both men and women. High blood pressure readings both during the survey and in the cases of self-reported hypertension were found to be higher among the richest wealth index category compared to the poorest. Sarki M *et al.*<sup>[13]</sup> also reported similar findings in the meta-analysis of studies on prevalence of hypertension in LMIC, with rural prevalence lower compared to urban, elderly having higher prevalence compared to adults. Gupta R *et al.*<sup>[14]</sup> also reported similar findings in a

**Table 2: Cardiovascular risk among all participants**

Variables	Female					Male				
	Total	<5% (%)	5%-9% (%)	10%-19% (%)	20%-29% (%)	Total	<5% (%)	5%-9% (%)	10%-19% (%)	20%-29% (%)
Age category (in years)										
40-45	74847	98.1	1.9	0.04	0.0	11576	81.1	18.5	0.4	0.02
45-49	70696	93.2	6.6	0.2	0.0	10991	69.1	29.4	1.5	0.0
50-54	-	-	-	-	-	8338	37.3	55.4	7.2	0.09
Total	145543	95.7	4.2	0.1	0.0	30905	65.0	32.3	2.7	0.03

\*The distribution of risk score categories were significantly ( $P < 0.001$ , Chi-squared test) different among men versus women within their respective age categories. #Also, within one gender, distribution of risk score categories were significantly ( $P < 0.001$ , Chi-squared test) different among the various age groups. The maximum risk score among women in the age group studied (40-49 years) is 17% and among men (40-54 years), the maximum risk score is 26%

**Table 3: Cardiovascular risk (according to WHO CVD risk scores) among the participants according to their self-reported hypertension status**

Variables	Self-reported hypertension (Present)									
	Controlled					Uncontrolled				
	Total	<5% (%)	5%-9% (%)	10%-19% (%)	20%-29% (%)	Total	<5% (%)	5%-9% (%)	10%-19% (%)	20%-29% (%)
Age category (in years)										
Female										
40-45	6747	99.0	1.0	0.0	0.0	4162	91.6	8.2	0.2	0.0
45-49	6928	98.1	1.9	0.0	0.0	5612	72.6	26.7	0.6	0.0
Total	13675	98.6	1.4	0.0	0.0	9774	80.7	18.8	0.5	0.0
Male										
40-45	660	82.6	17.4	0.0	0.0	591	56.1	40.4	3.5	0.0
45-49	791	73.9	26.1	0.0	0.0	677	29.3	63.0	7.7	0.0
50-54	612	46.1	52.3	1.6	0.0	652	8.9	60.9	29.6	0.6
Total	2063	68.4	31.1	0.5	0.0	1920	30.6	55.3	13.9	0.2

Variables	Self-reported hypertension (Absent)									
	Normotensive					Blood pressure in Hypertensive range				
	Total	<5% (%)	5%-9% (%)	10%-19% (%)	20%-29% (%)	Total	<5% (%)	5%-9% (%)	10%-19% (%)	20%-29% (%)
Age category (in years)										
Female										
40-45	52757	99.1	0.9	0.0	0.0	11181	94.9	4.9	0.2	0.0
45-49	45937	97.7	2.3	0.0	0.0	12219	82.7	16.5	0.8	0.0
Total	98694	98.5	1.5	0.0	0.0	23399	88.6	10.9	0.5	0.0
Male										
40-45	7844	87.0	13.0	0.0	0.0	2481	67.9	30.9	1.1	0.1
45-49	7088	79.6	20.3	0.1	0.0	2434	47.9	47.5	4.6	0.0
50-54	5146	47.6	52.0	0.4	0.0	1928	16.6	63.5	19.8	0.1
Total	20079	74.3	25.6	0.1	0.0	6843	46.3	46.0	7.6	0.1

\*Comparatively higher proportion of individuals were in higher risk group in self-reported hypertensive group compared to those who did not report ( $P<0.001$ , Chi-squared test). <sup>a</sup>The risk was higher in males compared to females ( $P<0.001$ , Chi-squared test), and in higher age group compared to lower age group ( $P<0.001$ , Chi-squared test). <sup>‡</sup>Among the normotensive group and the controlled self-reported hypertensive group the distribution of risk scores was comparable among male and females. The maximum risk score among female in the age group studied (40-49 years) is 17% and among male (40-54 years), the maximum risk score is 26%

**Table 4: Cardiovascular risk among participants according to their blood pressure at the time of interview**

Variables	High blood pressure					Normotensive				
	Total	<5% (%)	5%-9% (%)	10%-19% (%)	20%-29% (%)	Total	<5% (%)	5%-9% (%)	10%-19% (%)	20%-29% (%)
Age category (in years)										
Female										
40-45	15342	94.0	5.8	0.2	0.0	59504	99.1	0.9	0.0	0.0
45-49	17831	79.6	19.7	0.7	0.0	52866	97.8	2.2	0.0	0.0
Total	33173	86.2	13.3	0.5	0.0	112370	98.5	1.5	0.0	0.0
Male										
40-45	3071	65.6	32.7	1.6	0.1	8505	86.7	13.3	0.0	0.0
45-49	3111	43.8	50.9	5.3	0.0	7879	79.1	20.9	0.1	0.0
50-54	2580	14.6	62.9	22.2	0.3	5758	47.4	52.1	0.5	0.0
Total	8763	42.9	48.0	9.0	0.1	22142	73.8	26.1	0.1	0.0

\*Risk score distribution was towards higher side in males compared to females ( $P<0.001$ , Chi-squared test). <sup>a</sup>Also risk score distribution in both men and women, among those having high blood pressure during the survey, was higher compared to those having normal blood pressure (normotensives) ( $P<0.001$ , Chi-squared test). The maximum risk score among women in the age group studied (40-49 years) is 17% and among men (40-54 years), the maximum risk score is 26%

study done among 150 communities of India, Pakistan, and Bangladesh.

Among all the women in the study, majority (95.7%) had low CVD risk and only 0.1% had higher CVD risk (10% to <20%) while among men, 65% had low CVD risk and 2.7% had higher CVD risk. CVD risk among hypertensives was higher than normotensives/study population. Higher proportion of hypertensives (13.3% in women and 48.1% in men) had risk of

5%–9% while the proportion was much smaller (4.2% in women and 32.3% in men) in the similar risk category among all study population. Thus, the purpose of management here should not be only/merely treating hypertension, integrated management of total CVD risk consisting of counselling on diet, physical activity, smoking cessation and avoiding harmful use of alcohol, drugs for management of blood pressure persistently high (>140/90) and follow-up every 3–6 months should be provided to reduce CVD risk.<sup>[15]</sup> Also, age being a risk factor for CVD, CVD risk

among men and women was seen to be increasing with increasing age. Although risk was higher in hypertensives, self-reported hypertensives who had their blood pressure below 140/90 had risk similar to normotensives, indicating the importance of management of hypertension.

Various studies assessing CVD risk in the general population had reported variable CVD risk level prevalence. Deoni TJ *et al.* reported that majority of participants (94.5%) in 40–49 years and 88% of normotensive women had low risk (<10%).<sup>[16]</sup> Study by Praveen *et al.*<sup>[17]</sup> had 63.9% of men aged 40 years and more in low CVD risk, using WHO/ISH risk prediction charts (without cholesterol levels). Khanal *et al.*<sup>[18]</sup> reported 98.6% of women had low CVD risk. Compared to these studies, the difference in CVD risk in the present study might be explained by use of the updated 2019 WHO CVD risk charts and younger age category included in our study.

The present study measuring CVD risk is one of the first studies which was conducted not only among the representative Indian population but also among hypertensives. Current research work also used the novel approach to measure CVD risk using updated WHO CVD 2019 risk chart.<sup>[5,19]</sup> According to their age and gender, stratified CVD risks were analyzed, and appropriate interpretations were made. This study was based on secondary data analysis of NFHS-4 dataset, which was a cross-sectional survey, assessing relationships at one point in time. Recall bias is associated with all surveys. Also, the NFHS-4 survey was conducted in adult women of age group 15–49 years and in adult men of age group 15–54 years, but in the present study women of age group 40–49 years and men of age group 40–54 years were included (as the WHO CVD risk prediction charts is for adults aged 40 years and more). JNC-7 criteria<sup>[20]</sup> for hypertension was used in this research; however if we would have used the newer AHA classification,<sup>[21]</sup> the proportion of hypertensives would have been higher.

**Conclusion:** Prevalence of hypertension was seen to be increasing with increasing age and was higher in urban residents than in rural, among both men and women. Also, age being a risk factor for CVD, CVD risk among men and women was seen to be increasing with increasing age. Although risk was higher in hypertensives, self-reported hypertensives who had their blood pressure below 140/90 had risk similar to normotensives, indicating the importance of management of hypertension. Frontline workers (AWW, ASHA and ANMs) working under NPCDCS program can be trained for the correct usage of WHO CVD charts along with population-based screening services for prevention of CVDs.

### Acknowledgements

The authors would like to acknowledge and thank Resource Center for Cardiovascular Health (RCCVH) established under 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.

### Financial support and sponsorship

Nil.

### Conflicts of interest

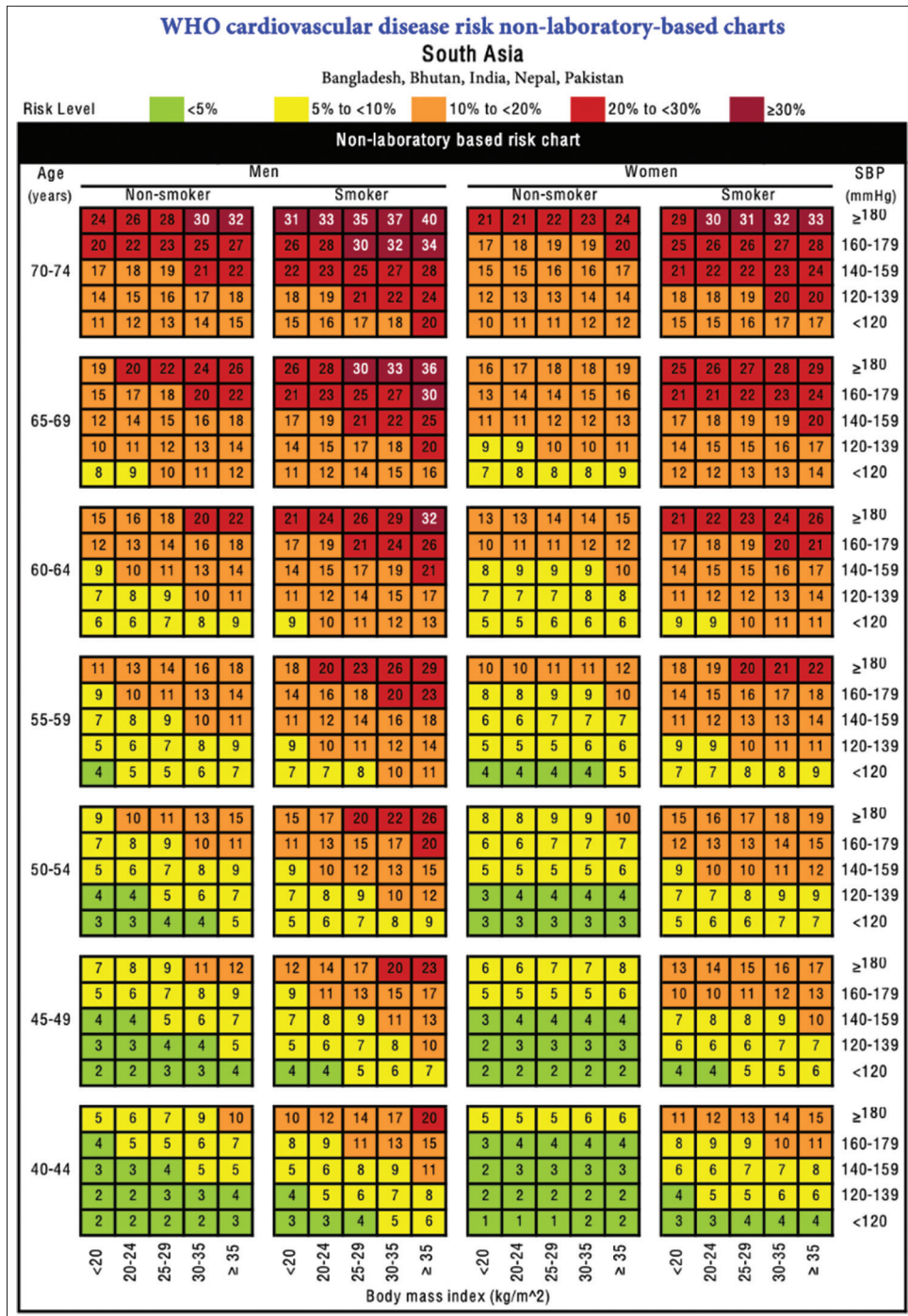
There are no conflicts of interest.

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Annexure: 2019 WHO CVD risk non-laboratory-based charts for South Asia