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Association Between Abdominal Obesity, Body Mass Index, and Hypertension in India: Evidence From a Large Nationally Representative Data

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ABSTRACT

Hypertension prevalence is rising among individuals with abdominal obesity in Southeast Asia, including India, but the relationship between abdominal obesity, body mass index (BMI), and hypertension remains underexplored. This study examines the association between these factors in a nationally representative Indian population aged 20–54 years (males: $N = 78\,832$; females: $N = 559\,059$). We analyzed data from the National Family Health Survey 2019–21 (NFHS-5). Hypertension was defined as a systolic blood pressure (SBP) ≥ 140 mm Hg, diastolic blood pressure (DBP) ≥ 90 mm Hg, or use of blood pressure-lowering medication. Abdominal obesity was defined by waist–hip ratio (>0.90 for men, >0.85 for women). BMI categories were underweight (<18.5 kg/m^2), normal (18.5–<25.0 kg/m^2), overweight (25.0–<30.0 kg/m^2), and obese (≥30.0 kg/m^2). Multivariable logistic regression adjusted for demographic and lifestyle factors was used to assess the link between BMI, abdominal obesity, and hypertension. Individuals with both obesity and abdominal obesity had significantly higher odds of hypertension, with males having 3.3 times (95% confidence interval [CI]: 2.9–3.7) and females 2.8 times (95% CI: 2.6–2.9) odds compared to those with normal BMI and no abdominal obesity. Both genders showed increased SBP and DBP by 3.0–5.0 mm Hg when abdominal obesity was present, regardless of BMI. Indian health programs should emphasize the risks of high BMI and abdominal obesity to reduce hypertension.

Abbreviations: BMI, body mass index; CI, confidence interval; DBP, diastolic blood pressure; OR, odds ratio; SBP, systolic blood pressure.

1 | Introduction

Hypertension, or high blood pressure, is a major global health challenge, affecting over 1.28 billion people aged 30–79 [1–3]. It is a leading cause of heart disease, stroke, kidney problems, and early death [4–7], contributing to approximately 9.4 million deaths worldwide every year [8, 9]. The World Health Organization (WHO) highlights that while high-income countries are improving hypertension management, many developing nations, particularly in South Asia, continue to face rising prevalence and low awareness or control rates [10–12]. Hypertension prevalence in Southeast Asia is 25%, slightly above the global average of 22% [6]. In South Asia, nearly 30% are suffering from hypertension [6, 13], yet less than half are aware, contributing to approximately 1.5 million deaths annually from related complications [14]. India exemplifies the rising hypertension burden in Southeast Asia, with prevalence reaching 31.4% as the country shifts from infectious to chronic diseases [15–21]. Lifestyle factors, including alcohol consumption, smoking, poor diet, and physical inactivity, further exacerbate the issue [22].

The global obesity epidemic affects over two billion people, with a higher prevalence in women [23–25]. Rising abdominal obesity, which involves excess fat in the central abdomen area, driven by dietary and physical activity changes, is a major risk factor for metabolic syndrome, including hypertension, heart disease, and diabetes [26–29]. Abdominal obesity is a significant risk factor for hypertension, posing a major public health challenge, particularly in Asia [30–32]. Studies, including a meta-analysis of 2.3 million individuals, confirm that higher obesity levels directly increase hypertension risk, as demonstrated in both Asian and US populations [29, 33–35]. Despite the established relationship between obesity and hypertension, a significant gap exists in understanding the combined effects of abdominal obesity and high body mass index (BMI) on hypertension risk in South Asian populations, particularly in India. Existing research often focuses on specific demographic groups, potentially limiting the generalizability of findings across the entire population [21, 36, 37]. For example, a 2006 study highlighted an association between increased waist circumference and hypertension risk, but its findings could not be universally applied across diverse Indian populations [38].

To address this gap, our study aims to take a closer look at how abdominal obesity and BMI together affect the risk of hypertension. We will use data from the National Family Health Survey 2019–21, covering a wide range of individuals across India. Our goal is to provide clear insights that can help create targeted health strategies to combat obesity and hypertension in India and similar regions, hoping to make a real difference in public health. In particular, we intend to assess the risk of hypertension at the intersection of abdominal obesity status and BMI-based nutritional categories.

2 | Materials and Methods

2.1 | Data Source

A secondary analysis of the NFHS-5 2019–21 data was conducted. The aim of the survey was to update the indicators of maternal, neonatal, child and reproductive health, and other health related issues including non-communicable diseases. The detailed report of methods, sampling frame, sample size calculation, and preliminary findings were published previously [39].

2.2 | Data Collection and Measurement

NHFS-5 utilized four pretested and validated questionnaires (household, woman, man, and biomarker) for data collection. The height and weight were measured by the Seca 213 stadiometer and the Seca 874 digital scale. Waist and hip circumferences were measured by Gulick tapes. Omron Blood Pressure Monitor was used to measure blood pressure (BP). BP was measured three times at an interval of 5 min [39].

2.3 | Outcome of Interest

Hypertension was the main outcome of interest, which was dichotomized into (hypertensive/non-hypertensive). Hypertension was defined using the Joint National Committee 7 (JNC 7) guideline. A participant having an average systolic blood pressure (SBP) ≥140 mm Hg and/or an average diastolic blood pressure (DBP) ≥90 mm Hg or taking blood pressure-lowering medication during the time of the survey (irrespective of the BP level) was defined as hypertensive [40]. SBP and DBP were considered as secondary outcomes and continuous variables.

2.4 | Exposure of Interest

The exposure of interest was the intersection between abdominal obesity and BMI. At first, both abdominal obesity and BMI were categorized. Abdominal obesity was dichotomized into (i) "yes" (presence of abdominal obesity) and (ii) "no" (absence of abdominal obesity). The waist–hip ratio was used to measure abdominal obesity. A waist–hip ratio of >0.90 for men and >0.85 for women was defined as abdominal obesity [41]. WHO recommended BMI cutoff was used for categorization: underweight (<18.5 kg/m^2), normal BMI (18.5–<25.0 kg/m^2), overweight (25.0 kg/m^2–<30.0 kg/m^2), and obesity (≥30.0 kg/m^2) [42].

Then the exposure of interest was categorized into eight categories:

a. No abdominal obesity, normal BMI (reference category)
b. No abdominal obesity, underweight
c. No abdominal obesity, overweight
d. No abdominal obesity, obesity
e. Abdominal obesity, normal BMI
f. Abdominal obesity, underweight
g. Abdominal obesity, overweight
h. Abdominal obesity, obesity

For the sensitivity analyses, we used the Asia-specific BMI cutoff: underweight (<18.5 kg/m^2), normal BMI (18.5 kg/m^2–<23.0 kg/m^2), overweight (23.0–<27.5 kg/m^2), and obesity

(≥27.5 kg/m^2) [43]. This classification is particularly relevant for Asian populations, as research indicates that individuals of Asian descent tend to have higher body fat percentages and greater metabolic risks at lower BMI levels compared to Western populations [44, 45]. Studies have shown that at the same BMI, Asians, including Indians, exhibit a higher prevalence of insulin resistance, hypertension, and cardiovascular diseases [46]. By incorporating the Asia-specific BMI cutoff, we aimed to enhance the sensitivity of our analysis in identifying at-risk individuals within the study population while ensuring comparability with previous research in similar settings.

2.5 | Covariates

The following variables were considered as covariates based on the literature review: age in years (continuous), highest educational attainment (no formal schooling, up to primary, up to secondary, and college and higher), wealth index (poorest, poorer, middle, richer, richest), marital status (never married, currently married, and others [divorced/widowed/separated/don't know]), state of residence, place of residence (urban, rural), current tobacco use (did not consume tobacco, smoking only, smokeless only, dual use), current alcohol consumption (did not consume alcohol, less than once a week, about once a week, almost every day), random blood glucose level (≤140 mg/dL [normal], 141–160 mg/dL [high], >160 mg/dL [very high]) and religion (Hinduism, Islam, others [Christianity, Buddhism, Jainism, Sikhism, and others]).

Wealth index was calculated by principal component analysis based on possession of household assets including construction materials, source of water, health and sanitation facilities, and electricity use [39]. Wealth index was categorized into quintiles.

2.6 | Statistical Analysis

All the statistical analyses were conducted by Stata version 17.0 [47]. During the analyses, the survey weight of NHFS-5 was adjusted. As the men–women distribution at NFHS-5 was around 1:8, which is not similar to the sex ratio of the Indian population (1.02:1) [48], all the analysis conducted was gender stratified. At first, descriptive analyses of the NFHS-5 data were conducted. The findings were reported as unweighted frequencies and weighted percentages (for categorical variables) and as mean with standard deviation (for continuous variables). To find any differences among the categories, Rao–Scott Chi-square test was performed. To find out the association between abdominal obesity and BMI with hypertension, multivariable logistic regression was conducted with adjustment for the cluster effect and the complex hierarchical structure of DHS data. At first, we conducted the crude analyses and then we conducted the multivariable analyses. We also conducted multivariable linear regressions to find out the joint association of BMI and abdominal obesity with SBP and DBP, and the coefficients were reported. A multinomial logistic regression model was estimated with the following hypertension categories: (i) SBP ≤ 120 mm Hg and DBP ≤ 80 mm Hg (Base), (ii) SBP 120–139 mm Hg or DBP 80–89 mm Hg, (iii) SBP 140–159 mm Hg or DBP 90–99 mm Hg, (iv) SBP 160–179 mm Hg or DBP 100–109 mm Hg, and (v) SBP ≥ 180 mm Hg or DBP ≥110 mm Hg [39]. In the multinomial logistic regression model, anti-hypertensive medication use was adjusted along with other covariates. The association was reported in relative risk ratios (RRR). Unlike binary logistic regression, which only differentiates between hypertensive and non-hypertensive individuals, multinomial logistic regression provides a more granular assessment of risk across hypertension stages. This approach enables a better understanding of how the joint effects of BMI and abdominal obesity influence the progression of hypertension severity, offering clinically relevant insights for targeted intervention strategies.

2.7 | Ethical Considerations

The Institutional Review Board of the International Institute for Population Sciences (IIPS) and ICF provided ethical approval to the study protocol of NFHS-5. The protocol was also reviewed by the Centers for Disease Control and Prevention (CDC). Before data collection, written informed consent was obtained from the participants [39]. We obtained the permission to use the NFHS-5 dataset in August, 2022.

3 | Results

The final sample sizes for males and females were 78 832 and 559 059, respectively. The process of selecting a sample is shown in Figure 1. The prevalence of abdominal obesity was 53.4% among men and 58.8% among women. The prevalence of hypertension among men and women was 20.6% and 15.8%, respectively.

3.1 | Background Characteristics of the Participants and Prevalence of Hypertension According to Covariates

The background characteristics and prevalence of hypertension according to covariates are shown in Table 1. The majority of respondents were educated up to the secondary level (men: 53.0%; women: 43.8%), were currently married (men: 75.2%; women: 83.6%), belonged to the richer wealth group (men: 21.6%; women: 21.3%), and resided in rural areas (men: 67.4%; women: 67.7%). Among men, 21.7% were overweight, while 20.1% of women were overweight. The prevalence of obesity was 4.5% among men and 7.2% among women.

For men without abdominal obesity, the prevalence of overweight and obesity was 9.3% and 1.0%, respectively. However, when abdominal obesity was present, the prevalence of overweight and obesity increased to 12.3% and 3.5%, respectively. Among women, 3.3% were overweight and 0.4% were obese without abdominal obesity. When abdominal obesity was present, 16.9% were overweight and 6.9% were obese. The distribution of normotensive and hypertensive status among males and females, classified by abdominal obesity and BMI (Asian cutoff), is shown in Table S1.

Figures S1a,b and S2a,b showed the age-stratified prevalence of hypertension among males and females, showing that participants with abdominal obesity (Figure 1a,b) or overweight/obesity (Figure S2a,b) had a statistically significantly higher prevalence of

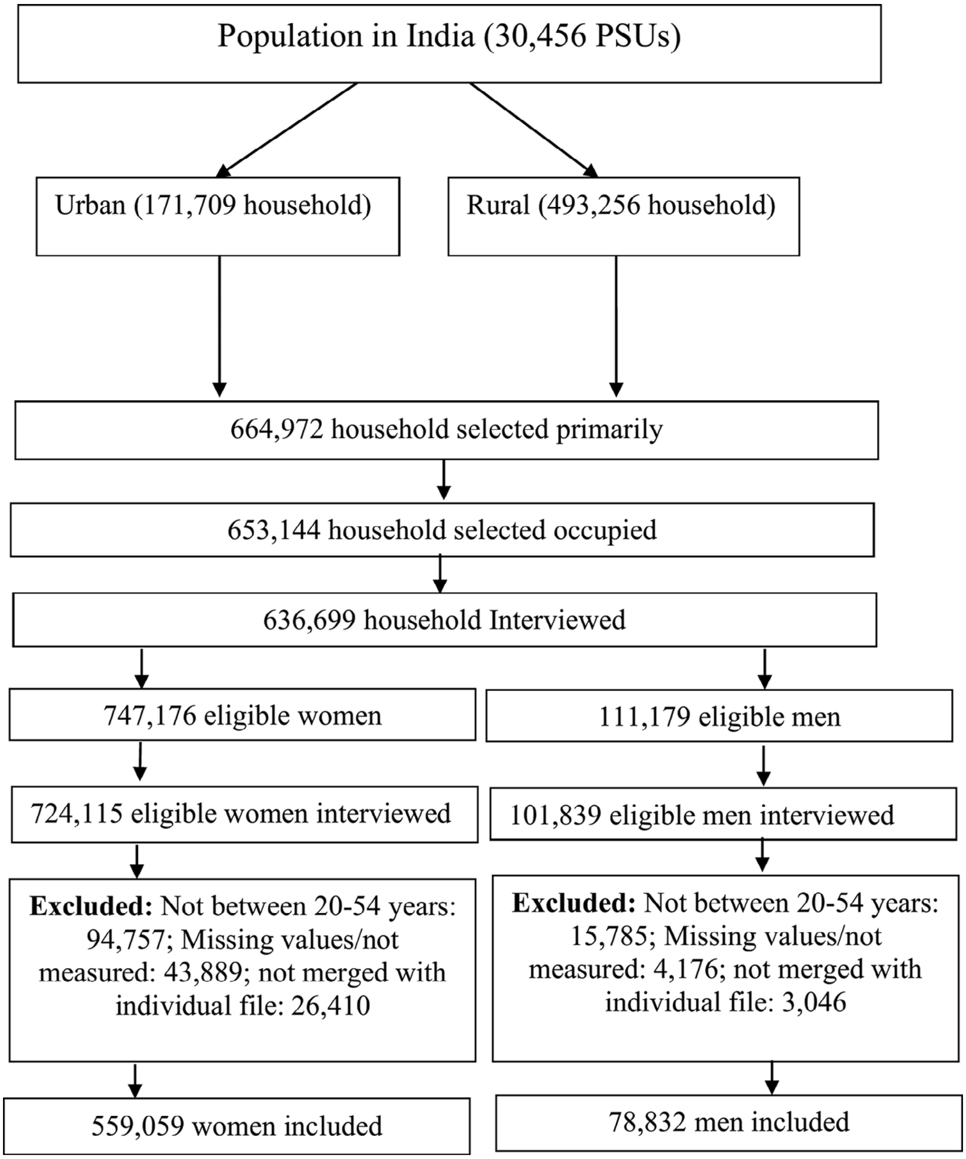

FIGURE 1 | Sample size selection process for the final analyses.

hypertension compared to those without these conditions across all age strata ($p < 0.001$). Figure S3a–d depict the BMI-stratified distribution of systolic (Figure S3a,c) and diastolic (Figure S3b,d) blood pressure according to abdominal obesity status among males and females. Across all BMI strata, participants with abdominal obesity had higher mean systolic and diastolic blood pressure compared to those without abdominal obesity.

3.2 | Joint Association of BMI and Abdominal Obesity With Hypertension: Findings From Logistic Regression

The logistic regression results showing the association between BMI and abdominal obesity with hypertension for males and females are displayed in Figures 2 and 3, respectively. After adjusting for all covariates, the odds of hypertension were higher among participants with overweight/obesity and/or abdominal obesity compared to those with normal BMI and without abdominal obesity. Specifically, the odds of hypertension among participants with both abdominal obesity and obesity were 3.3 times (95% confidence interval [CI]: 2.9–3.7) higher for males and 2.8 times (95% CI: 2.6–2.9) higher for females, compared to participants with normal BMI and without abdominal obesity.

3.3 | Joint Association of BMI and Abdominal Obesity With SBP and DBP: Results From Linear Regression

Table 2 presents the findings of linear regression models for both genders. In both genders, the average SBP and DBP were 3.0–5.0 mm Hg higher among participants with abdominal obesity and normal BMI/overweight/obesity compared to individuals with normal BMI without abdominal obesity.

Multinomial logistic regression also revealed similar findings, with the RRR of high blood pressure (SBP 120–139 mm Hg or DBP 80–89 mm Hg, SBP 140–159 mm Hg or DBP 90–99 mm Hg, SBP 160–179 mm Hg or DBP 100–109 mm Hg, SBP ≥180 mm

TABLE 1 | Background characteristics of the respondents according to blood pressure status and biological sex, National Family Health Survey (NFHS-5) 2019–21.

Background characteristics	Male (*N* = 78 832)	Female (*N* = 559 059)	Hypertensive (%)	
			Male	Female
Abdominal obesity, body mass index				
No, Normal	45 033 (55.3)	223 964 (37.7)	14.3	11.3
No, Underweight	7911 (10.6)	74 976 (13.6)	10.6	8.7
No, Overweight	8203 (9.3)	18 991 (3.3)	23.9	18.4
No, Obesity	803 (1.0)	2075 (0.4)	30.6	27.0
Yes, Normal	5649 (7.8)	113 963 (20.4)	19.8	14.8
Yes, Underweight	110 (0.2)	4973 (0.9)	14.0	11.2
Yes, Overweight	8729 (12.3)	87 625 (16.9)	32.8	23.4
Yes, Obesity	2394 (3.5)	32 492 (6.9)	42.6	31.2
Age (In years)				
Mean (±SD)	35.2 (9.8)	33.4 (8.6)	39.5 (9.4)	37.3 (8.4)
Education				
No formal schooling	9772 (12.2)	145 562 (25.4)	21.2	18.5
Up to primary	10 351 (13.6)	78 990 (14.3)	20.9	18.3
Up to secondary	43 120 (53.0)	249 442 (43.8)	20.9	15.0
College and higher	15 589 (21.3)	85 065 (16.6)	17.8	11.1
Marital status				
Never married	18 415 (23.0)	69 989 (11.1)	11.7	9.0
Currently married	58 986 (75.2)	461 261 (83.9)	22.8	16.2
Others (Divorced/Widowed/Separated/Don't Know)	1431 (1.8)	27 809 (5.0)	24.1	22.7
Wealth index				
Poorest	15 145 (16.9)	112 189 (17.9)	15.9	14.7
Poorer	17 326 (19.8)	121 817 (19.8)	18.2	15.4
Middle	16 918 (21.2)	117 752 (20.8)	20.7	16.1
Richer	15 908 (21.6)	110 251 (21.3)	21.9	16.2
Richest	13 535 (20.5)	97 050 (20.2)	23.7	16.1
Place of residence				
Urban	20 206 (32.6)	139 908 (32.3)	22.5	16.5
Rural	58 626 (67.4)	419 151 (67.7)	19.2	15.4
Current smoker/tobacco user				
Didn't consume tobacco	40 736 (54.0)	520 192 (95.6)	20.1	15.6
Smoking only	11 532 (14.0)	1797 (0.2)	21.3	17.8
Smokeless only	18 948 (23.6)	36 474 (4.1)	20.4	19.0
Dual use	7616 (8.4)	596 (0.0)	19.4	21.6
Current alcohol consumption				
None	55 306 (73.4)	546 880 (99.1)	18.5	15.7
Almost every day	3959 (4.1)	1653 (0.2)	30.2	25.6
About once a week	10 513 (11.6)	4884 (0.3)	27.2	22.3
Less than once a week	9054 (10.9)	5642 (0.4)	21.4	20.7
Religion				
Hinduism	59 605 (82.2)	423 426 (81.9)	20.5	15.1

(Continues)

TABLE 1 | (Continued)

Background characteristics	Male ($N = 78\,832$)	Female ($N = 559\,059$)	Hypertensive (%)	
			Male	Female
Islam	9155 (12.5)	66 817 (12.8)	16.9	18.9
Others	10 072 (5.3)	68 816 (5.3)	25.1	17.4
Random blood glucose				
≤140 mg/dL (normal)	69 501 (87.0)	512 494 (90.6)	18.4	14.6
141–160 mg/dL (high)	4787 (6.5)	24 342 (4.7)	28.0	21.6
>160 mg/dL (very high)	4544 (6.5)	22 223 (4.7)	37.8	31.9

Notes: Body Mass Index was categorized according to the World Health Organization cutoff.
All the variables were found to be statistically significant ($p < 0.001$) in the Chi-square test (between normotensive and hypertensive group), except for the "Current Smoker/Tobacco User" variable among males.
Abbreviation: SD, standard deviation.

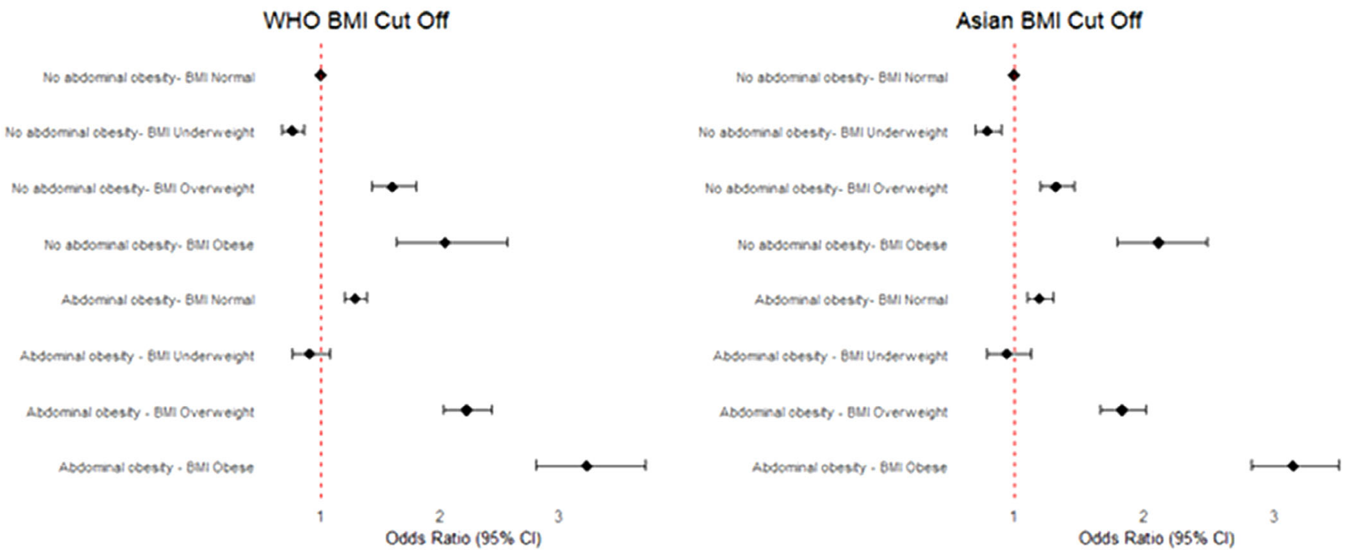

FIGURE 2 | Association between body mass index and abdominal obesity with hypertension in Indian males (CI = confidence interval).

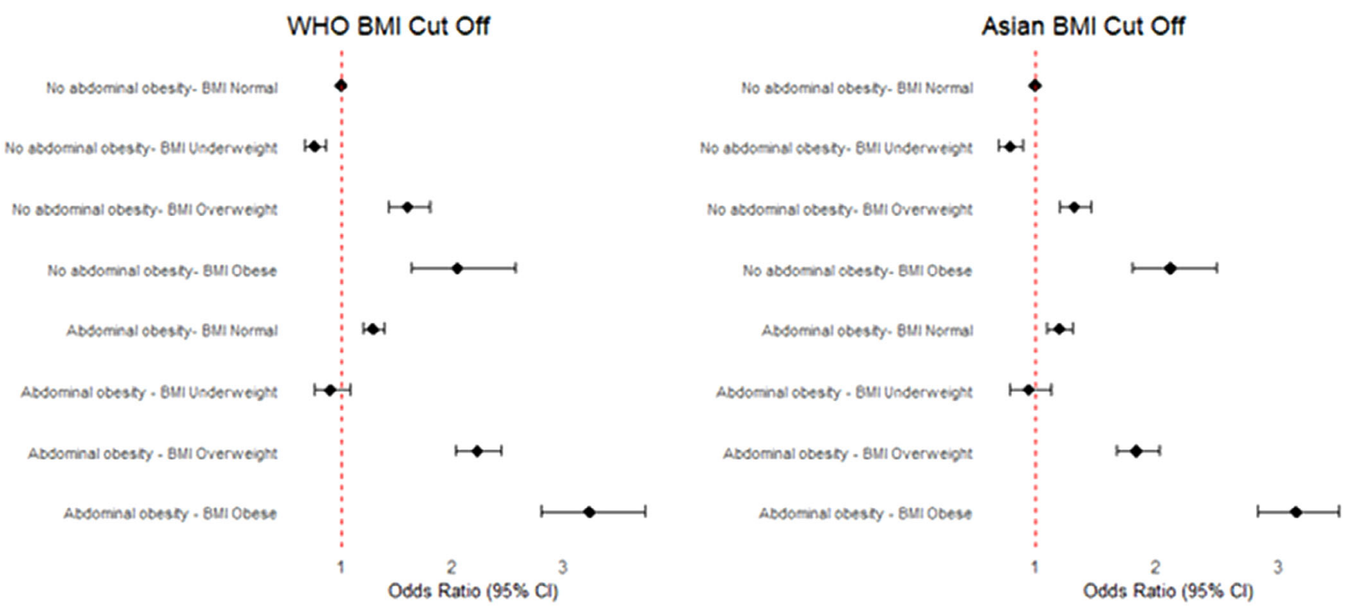

FIGURE 3 | Association between body mass index and abdominal obesity with hypertension in Indian females (CI = confidence interval).

TABLE 2 | Findings from linear regression model regarding the joint association between Body Mass Index and abdominal obesity with systolic and diastolic blood pressure.

Categories	Systolic blood pressure; Adjusted coefficient (95% CI)		Diastolic blood pressure; Adjusted coefficient (95% CI)	
	Male	**Female**	**Male**	**Female**
No, Normal	Ref	Ref	Ref	Ref
No, Underweight	−5.0* (−5.4 to −4.5)	−3.1* (−3.2 to −2.9)	−1.9* (−2.3 to −1.6)	−1.7* (−1.9 to −1.6)
No, Overweight	3.8* (3.3 to 4.4)	2.7* (2.5 to 3.0)	2.4* (2.0 to 2.8)	2.6* (2.4 to 2.8)
No, Obesity	3.6* (2.5 to 4.7)	3.1* (2.7 to 3.6)	2.0 * (1.1 to 2.8)	4.5* (4.2 to 4.8)
Yes, Normal	1.0 (0.7 to 1.3)	2.1* (2.0 to 2.3)	1.4* (1.2 to 1.6)	1.1* (1.0 to 1.2)
Yes, Underweight	−4.0* (−4.7 to −3.2)	−1.0* (−1.3 to −0.8)	−1.2* (−1.8 to −0.7)	−0.8* (−1.0 to −0.6)
Yes, Overweight	4.1* (3.6 to 4.5)	4.1* (3.9 to 4.3)	3.9 * (3.6 to 4.2)	3.4* (3.2 to 3.5)
Yes, Obesity	4.9* (4.1 to 5.8)	4.9* (4.6 to 5.2)	5.3* (4.7 to 5.9)	5.2* (5.0 to 5.4)

Notes: Adjusted for age group, highest educational attainment, wealth index, marital status, state of residence, place of residence, religion, current smoking/tobacco use, current alcohol consumption, and random blood glucose.
Body mass index was categorized according to the World Health Organization cutoff; "No" refers to not abdominally obese, and "Yes" refers to abdominally obese.
Abbreviation: CI, confidence interval.
*$p < 0.001$.

Hg or DBP ≥110 mm Hg, with SBP ≤120 mm Hg and DBP ≤80 mm Hg as the reference) being higher among participants with both abdominal obesity and overweight/obesity compared to those with normal BMI without abdominal obesity (Tables S2 and S3). The abdominal obesity–overweight and abdominal obesity–obesity categories in both males and females showed a progressive increase in hypertension risk across severity levels. Using the WHO cutoff, the highest ARRs were observed in the SBP 160–179 mm Hg or DBP 100–109 mm Hg category. Among males, the ARR for abdominal obesity–obesity increased from 2.084 (SBP ≤120 mm Hg and DBP ≤80 mm Hg) to 8.333 (SBP 160–179 mm Hg or DBP 100–109 mm Hg). In females, the ARR ranged from 2.297 (SBP ≤120 mm Hg and DBP ≤80 mm Hg) to 3.441 (SBP ≥180 mm Hg or DBP ≥110 mm Hg).

4 | Discussion

This study aimed to evaluate the combined association of BMI and abdominal obesity with hypertension in an Indian population. Utilizing data from a nationally representative sample in India, our findings revealed that hypertension affected 20.3% of male participants and 15.7% of female participants. In the multivariable analysis, after adjusting for covariates, both abdominal obesity and higher BMI (overweight/obesity) were positively associated with hypertension in both genders. Additionally, we found that abdominal obesity and overweight/obesity were linked to an average increase of 3.0–5.0 mm Hg in both SBP and DBP among both genders, compared to participants with normal BMI and without abdominal obesity.

These findings are consistent with previous studies. Zhou et al., in their meta-analysis of prospective studies, found that for every five-unit increase in BMI, the risk of hypertension increased by 50% (relative risk [RR]: 1.50; 95% CI: 1.40–1.59) [46]. The study also reported that for every 0.1 unit increase in the waist-to-hip ratio (WHR), the risk of hypertension increased by 27% (RR: 1.27; 95% CI: 1.18–1.37) [49]. Similar to our study, higher WHR was associated with an increase in both SBP and DBP [49]. Likewise, Jayedi et al., in their meta-analysis, found that the risk of hypertension increased by 49% (RR: 1.49; 95% CI: 1.41–1.58) for every five-unit increase in BMI, and by 74% (RR: 1.74; 95% CI: 1.35–2.13) for every 0.1 unit increase in WHR [35]. In our study, we observed that the combined effect of a high BMI and abdominal obesity significantly correlated with higher odds of developing hypertension. This pattern aligns with similar outcomes identified in research conducted in South Asian countries, including Afghanistan, Bangladesh, Bhutan, Nepal, and Sri Lanka [50], as well as studies from China [51, 52].

We found that even in normal BMI, the odds of hypertension increased among the participants with abdominal obesity. This is similar to the findings of the studies conducted in both developing and developed country contexts. Ostchega et al. reported that abdominal obesity increased the odds of hypertension by 51% (AOR:1.51; 95% CI: 1.27–1.81) among US adults [53]. Rhee et al. also observed an increased risk of hypertension with increased waist circumference among Korean adults [54]. A similar trend in increased risk of hypertension with increased waist circumference was observed in China [52, 55].

Several biological mechanisms have been implicated in the causal pathway of hypertension from obesity and abdominal obesity. First adiposity is a major risk factor for cardio-metabolic condition including metabolic syndrome and type-2 diabetes mellitus [56]. On the other hand, diabetes mellitus is a risk factor for developing hypertension [57]. Visceral fat is a risk factor of metabolic disease [58, 59]. Visceral fat also leads to insulin resistance and that, in turn, causes hypertension [60]. Also, adipose tissue causes systemic inflammation which in turn, activates sympathetic nervous system, and leads to hypertension [61]. In obese individuals, there is hyperactivity of renin–angiotensin–aldosterone system, which leads to hypertension [62].

India is suffering from an epidemic of NCDs. Currently, 62% of all deaths in India were attributable to NCDs and the proportion is increasing [63]. The cost of hypertension on Indian health care system cannot be overlooked also. A recent modeling study demonstrated that in India, the current physician-led public health system can treat only an estimated 8% of approximately 245 million adults with hypertension. This is attributed to constraints such as inadequate healthcare personnel and the necessity for frequent treatment visits [64]. The burden can be increased in the upcoming days given the high prevalence of abdominal obesity. Health promotion programs in India aiming to prevent hypertension should raise awareness against abdominal obesity.

The study has notable strengths. To the best of our knowledge, this is the first study to investigate the hypertension prevalence at the intersection of abdominal obesity and BMI-based nutritional categories using a nationally representative sample in the Indian population. The study utilized a nationally representative sample, so the findings can be generalized to the target group. Using validated questionnaires and calibrated instruments for data collection reduced the chance of measurement error. There are some limitations of the study. First, given the cross-sectional nature of this study, it was not possible to determine the causal relationship between the exposure and the outcome. Second, we could not adjust for the covariates which were risk factors of both abdominal obesity and hypertension including physical activity and dietary habit as the information was not present in the NFHS-5 dataset. Finally, although the men–women ratio in India is 1.02:1.00, in this study the male–female ratio was 1:8 [48]. As a result, we could not estimate the overall prevalence in the Indian population.

5 | Conclusion

Our study found a high prevalence of abdominal obesity in India. The combined effect of high BMI and abdominal obesity was associated with increased odds of hypertension among men and women. Health promotion programs in India should raise awareness among the general public regarding the harmful effects of abdominal obesity including hypertension.

Author Contributions

Rajat Das Gupta: Conceptualization, Methodology, Software, Formal Analysis, Investigation, Resources, Data Curation, Writing–Original Draft Preparation, Visualization, Project Administration; **Mohammad Rifat Haider**: Methodology, Validation, Investigation, Writing–Original Draft Preparation, Writing–Review & Editing, Visualization; **Simanta Roy**: Methodology, Validation, Investigation, Writing–Original Draft Preparation, Writing–Review & Editing, Visualization; **Mohammad Rashidul Hashan**: Investigation, Writing–Review & Editing; **Amrit Baral**: Investigation, Writing–Review & Editing; **Nowrin Tamanna**: Investigation, Writing–Review & Editing; **Ananna Mazumder**: Validation, Investigation, Writing–Review & Editing, Visualization; **Shams Shabab Haider**: Investigation, Writing–Review & Editing; **Biplab Datta**: Conceptualization, Validation, Investigation, Writing–Review & Editing, Supervision.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The de-identified data of NFHS-5 are available online: https://dhsprogram.com/methodology/survey/survey-display-541.cfm (accessed on August 2022) following proper procedure.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.