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Moderate Waist Circumference and Hypertension Prevalence: The REGARDS Study

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Abstract

Background—High waist circumference (WC) (women: >88 cm; men: >102 cm) increases cardiovascular risk. Less is known about moderate WC (women: 80–88 cm; men: 94–102 cm). Therefore, we examined the association between moderate WC and hypertension prevalence, independent of body mass index (BMI).

Methods—Among 24,247 eligible adults 45–84 years old, when recruited from January 2003 to October 2007 in the population-based REasons for Geographic And Racial Differences in Stroke (REGARDS) cohort, we examined hypertension prevalence (systolic blood pressure (BP) ≥140 mm Hg, or diastolic BP ≥90 mm Hg, or self-reported antihypertensive medication use) by WC before and after stratification by BMI (normal: 18.5–24.9; overweight: 25–29.9; obese class I: 30–34.9). Logistic regression adjusted associations between WC, BMI, and hypertension prevalence for age, race, sex, region, income, education, cigarette smoking, glomerular filtration rate, alcohol use, and physical activity.

RESULTS—Overall, hypertension prevalence was 44% among those with low WC (n = 8,068), 55% with moderate WC (n = 6,488), and 66% with high WC (n = 9,691). After full adjustment, moderate WC was independently associated with hypertension prevalence among persons with normal BMI, (adjusted odds ratio (aOR), 1.49; 95% confidence interval (CI), 1.31–1.70), overweight BMI (aOR, 1.80; 95% CI, 1.64–1.98), and obese class I BMI (aOR, 2.28; 95%CI, 1.96–2.65) (referent: low WC-normal BMI). The moderate WC–hypertension association was observed in blacks and whites and in men and women.

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CONCLUSION—Moderate WC is associated with hypertension prevalence independent of BMI and several hypertension risk factors in middle-aged and older adults.

Keywords

blood pressure; clinical epidemiology; hypertension; obesity; race; waist circumference

Abdominal obesity prevalence is increasing rapidly in the United States, particularly among adults <50 years, whites and blacks, and those with higher educational levels.[1] More than half of all US adults had abdominal obesity in 2003–2004, a 40% increase from 1988 to1994.[1] Clinical practice guidelines define abdominal obesity based on sex-specific criteria for high waist circumference (WC) (>88 cm for women and >102 cm for men).[2-5] High WC is associated with an increased risk of hypertension, stroke, coronary heart disease, diabetes mellitus, and cardiovascular-related death, independent of body mass index (BMI).[6-11] Recognizing these important cardiovascular risks, the National Institutes of Health recommends screening for high WC in persons who are overweight (BMI 25–29.9) or obese class I (BMI 30–34.9) and to consider screening for high WC in persons with normal weight (BMI 18.5–24.9).[2,4] However, many adults have moderate WC (80–88 cm for women and 94–102 cm for men).[11-13] Less is known about the cardiovascular risks of moderate WC.

Although WC appears to increase the risk of obesity-related complications in a graded fashion rather than only at high WC thresholds, previous studies have examined different moderate-range WC values based on empirically defined categories making translation of these findings into clinical practice challenging.[8,9,14-15] Sex-specific WC cutoffs that predict obesity-related risk independent of BMI, that account for the graded relationship between WC and obesity-related risk, and that involve simple criteria (e.g., three strata) are needed for clinical practice and public health promotion. In 1995, Lean and colleagues identified two WC "action levels" associated with increased cardiovascular risk: (i) 80 cm in women and 94 cm in men, and (ii) 88 cm in women and 102 cm in men.[14,16] However, few studies have tested whether these action levels predict cardiovascular risk independent of BMI in blacks and whites. The inclusion of blacks is important because US data (all pre-1990) have not found a consistent association between abdominal obesity and cardiovascular risk for blacks, after controlling for BMI.[9,17,18]

Therefore, we examined hypertension prevalence which is positively associated with obesity and abdominal obesity,[2,6,19] by BMI and WC, with a focus on moderate WC, in a large biracial, national cohort of community-dwelling US adults aged 45–84 years. We tested the relationship between WC strata developed by Lean and colleagues and hypertension prevalence after adjusting for BMI and hypertension risk factors. We explored age variability because the relative proportion of lean body mass to fat mass may decrease with age[7] and the relationship between abdominal obesity and cardiovascular risk may not persist in older adults after controlling for BMI.[20] We hypothesized that moderate WC would be associated with prevalent hypertension among persons with normal, over-weight, or obese class I BMI.

METHODS

Study design, participants, and measurements

The REasons for Geographic And Racial Differences in Stroke (REGARDS) study is a national, population-based longitudinal study evaluating causes of the excess stroke mortality in the Southeastern United States and among blacks compared to whites.[21] From 25 January 2003 to 31 October 2007, black and white men and women aged ≥45 years were recruited by random selection of telephone numbers from a commercially available

nationwide list (Genesys, Daly City, CA). Only one participant per house-hold was recruited. The sampling scheme was to recruit 30,000 participants: 20% from the coastal plain of North Carolina, South Carolina, and Georgia (the “stroke buckle”), 30% from the remainder of North Carolina, South Carolina, Georgia, Tennessee, Mississippi, Alabama, Louisiana, and Arkansas (the “stroke belt”), and 50% from the remaining continental United States, and to achieve a balance within each region by race (black, white) and within each region-race stratum by sex. Exclusion criteria included race other than black or white, Hispanic ethnicity, active cancer treatment, medical conditions that would prevent long-term participation, cognitive impairment judged by the telephone interviewer, residence in or inclusion on a waiting list for a nursing home, or inability to communicate in English. The cooperation rate among households contacted with an eligible person was 45.3%, comparable to other studies.[22]

Data were obtained from each participant in a multi-step fashion

Participants were first contacted by mail followed by a telephone interview where verbal informed consent was obtained. A computer-assisted standardized telephone interview obtained demographic factors, medical history, and cardiovascular risk factors. Trained health professionals performed in-home examinations of fasting participants in the morning after written informed consent was obtained. Examinations included blood pressure (BP) and anthropometric measurements, inventory of prescription and nonprescription medications taken within the previous 2 weeks, phlebotomy, and urine collection. Blood and urine samples were shipped to and analyzed at the Laboratory for Clinical Biochemistry Research at the University of Vermont. Methods were approved by the institutional review boards of all participating institutions.

Of 30,239 REGARDS participants with completed in-home visits, we excluded 550 participants ≥85 years as body composition reference data for these individuals, particularly non-Hispanic blacks, are limited.[23] We excluded 4,851 participants with BMI ≥35 because their WCs exceeded study WC cutoffs thereby reducing the incremental predictive power of the cutoffs.[2] We further excluded participants with BMI <18.5 (n = 319) or who did not have data on hypertension prevalence (n = 34), age (n = 7), BMI (n = 220), or WC (n = 11), leaving 24,247 available for analysis.

Hypertension prevalence

Hypertension prevalence at baseline was defined as systolic BP ≥140 mm Hg, or diastolic BP ≥90 mm Hg, or self-reported antihypertensive medication use. Following a 5-min rest, BP was measured twice in the left arm using a standard aneroid sphygmomanometer with the participant seated in a chair and with 30 s between measurements. Systolic and diastolic BP measurements were recorded at the onset of phase I and phase V of Korotkoff sounds respectively. The average of the two BP measurements was used as the BP of record. If arm circumference was >13 inches, a large adult size BP cuff was used. BP quality control was monitored by central examination of digit preference and retraining health professionals when necessary.

Covariates

WC was measured over skin or lightweight clothing at the midpoint between the lowest rib on the right side and the top of the iliac crest using a cloth tape measure at the end of expiration. We used sex-specific WC criteria to assign participants to three categories: low (<80 cm for women, <94 cm for men), moderate (80–88 cm for women, 94–102 cm for men) based on Lean’s data[14,16] and international guidelines,[5] or high (>88 cm for women, >102 cm for men) based on the National Institutes of Health and international guidelines.[2-5] Height (without shoes) was measured using an 8-foot metal tape measure and a square.

Weight (without shoes) was measured using a standard 300-lb calibrated scale. We calculated BMI and categorized participants as normal (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), or obese class I (30–34.9 kg/m^2).[2]

Covariates were selected using a priori knowledge and literature review

Variables were self-reported and included age,[24] race (black, white),[24] sex,[24] cigarette smoking (smoked ≥100 cigarettes in their lifetime, categorized as smoked never, in the past, or currently),[6] physical activity level (how often each week a participant exercised enough to work up a sweat, categorized as never, 1–3, or ≥4),[6,24] education,[9] income (<$20,000, $20,000–$34,999, $35,000–$74,999, ≥$75,000, refused/missing) and region of residence (stroke belt vs. nonstroke belt). Alcohol intake was defined as none, moderate (1–14 drinks weekly for men or 1–7 drinks weekly for women) or heavy (>14 drinks weekly for men, >7 drinks weekly for women). Glomerular filtration rate was estimated using the four-variable Modification of Diet in Renal Disease study equation: (≥60, 30–59, <30 ml/min/1.73 m^2) using the single-determination of serum creatinine.[25]

Statistical analysis

Baseline characteristics were compared by WC group using ANOVA. Hypertension prevalence, before and after age-adjustment, was calculated for each WC, BMI, or WC-BMI group and compared in the overall cohort and in each race-sex group. Trends in hypertension prevalence were compared across low, moderate, and high WC groups or across normal, overweight, and obese class I BMI groups using χ^2-test for trend.

Multivariable logistic regression analyses were performed to examine adjusted associations between WC, BMI, and hypertension prevalence. We examined WC as a categorical variable (low, moderate, high) or as a continuous variable and BMI as a categorical variable (normal, overweight, obese class I) or as a continuous variable. Given the purpose of the parent study to examine reasons for geographic differences in stroke, we tested whether the association between WC and hypertension prevalence differed across region by introducing the WC × region interaction term into the logistic regression model. Because BMI and WC had a significant interaction ($P = 0.002$), we performed a series of logistic regression models stratified by BMI and/or WC for the overall group and within race-sex groups. To examine whether the relationship between obesity measures and hypertension prevalence varied by age, we repeated analyses stratified by age (45–54, 55–64, 65–74, and 75–84 years). To assess the robustness of the observed associations between obesity measures and hypertension prevalence, we examined the association of BMI (as a continuous variable) and hypertension prevalence within the three WC groups after adjustment for all covariates. All analyses used SAS software, ver 9.1 (Research Triangle Institute, Research Triangle Park, NC).

RESULTS

Characteristics of WC group are in Table 1. The moderate and high WC groups had higher proportions of black women. The proportions of low income or low education participants were higher in the high WC group than the other two groups. BMI, systolic and diastolic BP, and lack of physical activity increased with WC. The moderate WC group had the highest proportion of overweight subjects (62%); while, the high WC group had the highest proportion of obese class I subjects (55%). The prevalence of moderate WC was 20.7% in normal weight subjects, 37.3% in overweight subjects, and 15.5% in obese class I subjects.

Hypertension prevalence by Wc, overall, and by race-sex

Hypertension prevalence increased with WC, overall and within each race-sex group (Figure 1). Hypertension was present in 44% of those with low WC (*n* = 8,068), 55% of those with moderate WC (*n* = 6,488), and 66% of those with high WC (*n* = 9,691). Hypertension prevalence was highest for blacks in all WC groups (Figure 1). The absolute increase in hypertension prevalence from low to high WC was similar (20%) for each race-sex group.

Age-adjusted associations of Wc and hypertension prevalence

The age-adjusted odds ratios (aORs) and 95% confidence intervals (CIs) for hypertension prevalence by WC and BMI for each race-sex group are shown in Table 2. For whites and black women, moderate WC was associated with hypertension prevalence in each BMI group except for moderate WC in normal weight black women ($P = 0.06$). Hypertension prevalence increased with WC in all BMI categories for whites and black women. For black men, hypertension prevalence increased with WC in the overweight group only. For obese class I black men, we further explored the WC–hypertension association and found that hypertension prevalence did not differ between WC strata ($P = 0.60$). Within the moderate WC group, hypertension prevalence increased with BMI for all race-sex groups except black women where the age-adjusted odds of hypertension prevalence for overweight and obese class I BMI were higher than for normal-weight BMI but similar. There was no evidence of a significant WC × region interaction.

Effect of adjustment for hypertension risk factors

WC as a categorical variable. After full adjustment, moderate WC remained associated with hypertension prevalence among persons who were normal weight (aOR, 1.49; 95% CI, 1.31–1.70), overweight (aOR, 1.80; 1.64-1.98), or obese class I (aOR, 2.28; 1.96-2.65) (referent, low WC-normal BMI) (Figure 2). The odds of hypertension prevalence in the moderate WC-normal BMI group were similar to the odds (1.5) of hypertension prevalence in the low WC-overweight BMI group. For all BMI groups, high WC was associated with prevalent hypertension. Within each BMI group, the odds of hypertension prevalence increased with increasing WC. The model odds ratios by WC-BMI group are shown in Appendix A.

WC as a continuous variable. In fully adjusted models stratified by BMI group, the odds of hypertension prevalence increased with increasing WC for persons who were normal weight (aOR, 1.03 per cm; 95% CI, 1.02–1.03), overweight (aOR, 1.02; 1.01–1.03), or obese class I (aOR, 1.02; 1.02–1.03). However, age modified this WC–hypertension prevalence association. In each BMI group, WC, as a continuous variable, was associated with hypertension prevalence for adults aged 45–54 years, 55–64 years, or 65–74 years with similar magnitudes as in the overall cohort; however, WC was not associated with hypertension prevalence in subjects aged 75–84 years for any BMI group.

Sensitivity analyses

To assess the robustness of the observed associations between obesity measures and prevalent hypertension, we examined the association of BMI, as a continuous variable, and hypertension prevalence within the three WC groups after full adjustment. BMI was associated with hypertension prevalence among those with low WC (aOR, 1.10 per unit BMI increase; 95% CI, 1.08–1.12), moderate WC (aOR, 1.07; 1.04–1.09), and high WC (aOR, 1.07; 1.05–1.09).

DISCUSSION

We found that moderate WC was associated with hypertension prevalence independent of BMI in middle-aged and older adults. This association between moderate WC and prevalent hypertension was observed in normal weight, overweight, and obese class I persons, in blacks and whites, in men and women, and persisted after controlling for several hypertension risk factors. The moderate WC-normal BMI group had similar odds (1.5) of hypertension as the low WC-overweight BMI group. Within each BMI category, the odds of prevalent hypertension increased with increasing WC.

Although previous studies have demonstrated increased cardiovascular risk associated with moderate-range WC independent of BMI,[6-9,11,26] these studies frequently included predominantly white cohorts and used empirically derived categories of WC that differ from the strata by Lean and colleagues making direct comparisons to our study problematic. In contrast to this prior work, we tested the relationship between WC strata developed by Lean *et al*. and hypertension prevalence in black and white men and women after adjusting for BMI. Our study extends previous research by demonstrating an association between moderate WC and hypertension prevalence, independent of BMI and other hypertension risk factors, in a biracial population. Given that WC and BMI each increase the risk of hypertension prevalence at young ages,[27] our results suggest that the effects of WC and BMI on BP occur early in life and continue into middle-aged and older adulthood.

Consistent with previous research and changes in lean body mass with aging,[8,20] we observed that age modified the association between WC and prevalent hypertension with a consistent relationship in adults aged 45–74 years but not in adults aged 75–84 years. Similar to our results, waist-to-hip ratio was not associated with hypertension prevalence among the older, biracial participants (mean age 73 years) of the Charleston Heart Study after adjustment for BMI.[20] In the current REGARDS study, we found that WC was associated with hypertension prevalence for whites and black women but only overweight black men, consistent with prior research suggesting a stronger relationship between abdominal obesity and hypertension prevalence for whites or women among middle-aged or older adults.[9,18] In addition to cohort differences, our results may differ because we performed analyses stratified by BMI, we adjusted for additional hypertension risk factors (income, education, glomerular filtration rate and physical activity), and we were unable to adjust for family history. Geographic region did not modify the moderate WC–hypertension relationship in our REGARDS cohort with over-sampling of participants from the stroke belt.

Although the biological mechanisms responsible for the association between WC and metabolic or cardiovascular complications are not known, several factors have been hypothesized including genetic predisposition, activation of the sympathetic nervous system, insulin resistance, and metabolic products of intra-abdominal adipose tissue such as inflammatory adipokines, angiotensinogen, or cortisol.[24,28] We were unable to examine these biological factors and we did not adjust for glucose or dyslipidemia as they may be on the causal pathway.[26] Our findings of continuous relationships between hypertension prevalence and WC within BMI strata, or BMI within WC strata, after adjusting for several known hypertension risk factors suggests that obesity and abdominal obesity have strong, independent effects on cardiovascular risk, findings consistent with earlier studies.[12,29,30]

Although obese class I persons regardless of WC size merit treatment to reduce obesity-related risk,[2] our findings have important clinical implications for the substantial proportion of black and white middle-aged and older US adults who are normal weight or overweight and have moderate WC, ~20% of normal weight and 40% of overweight subjects in our

study. These persons have increased obesity-related risk of hypertension and can be easily identified at an office visit with simple waist measurement. Treatment interventions for overweight persons, currently recommended if ≥2 risk factors or a high WC are present,[2] may be warranted for those with moderate WC. Moreover, normal weight persons identified by moderate or high WC as having abdominal obesity, individuals who might not otherwise be identified as high risk for obesity-related morbidity, may benefit from behavioral and dietary interventions to prevent increases in weight and WC.[14,16,31] Physical activity may attenuate the mortality risk associated with elevated WC in middle-aged and elderly adults.[32,33]

Our study has limitations. Given the observational crosssectional design, we cannot infer causation from identified associations. Some study variables (income, education, tobacco, alcohol, physical activity, current hypertension treatment) were self-reported and subject to recall and reporting bias. However, research suggests that adults can accurately relate history of hypertension[34,35] and we also measured BP. Some physiologic variables (glomerular filtration rate, height, weight, WC) were based on single measurements, while BP was based on two measurements obtained on a single day. Although computed tomography and magnetic resonance imaging have improved accuracy in assessing abdominal fat than WC, WC is more accurate than waist-to-hip ratio and is more practical and inexpensive for routine clinical use.[36-38] The measurement of WC at the midpoint between the lowest rib and the iliac crest is reasonable given the high measurement reproducibility,[39] strong correlation with total body and abdominal adiposity in both sexes,[39] and lack of a standardized or recommended approach to measuring WC.[24] We were unable to examine dietary factors.[40] Our results may not be generalizable to other racial/ ethnic groups.[29] Large prospective studies with information on incident hypertension are needed to confirm our findings.

Our findings suggest that moderate WC may be a risk factor for hypertension. Taken together with previous research,[6,11,26] our data suggest that current obesity clinical practice guidelines may merit revision to include moderate WC and to recommend WC measurement in normal weight persons in order to improve cardiovascular risk assessment in middle-aged and older adults. Future research is needed to investigate potential biological, lifestyle, and genetic mechanisms of these findings. Given that measuring WC has not been widely adopted,[24] efforts to increase WC measurement are warranted.

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Appendix A

Appendix A

Adjusted odds ratios and 95% confidence intervals for hypertension prevalence by body mass index and waist circumference, the REGARDs study, 2003–2007

Waist Circumference	OR (95% CI) for hypertension prevalence[a]		
	Body mass index group		
	Normal	Overweight	Obese class I
Low	1.00	**1.47 (1.33, 1.63)**	**2.01 (1.49, 2.72)**
Moderate	**1.49 (1.31, 1.70)**	**1.80 (1.64, 1.98)**	**2.28 (1.96, 2.65)**
High	**1.98 (1.58, 2.47)**	**2.11 (1.91, 2.32)**	**3.10 (2.83, 3.39)**

Bolded figures indicate 95% confidence intervals not containing one.

CI, confidence interval; GFR, glomerular filtration rate; OR, odds ratio.

[a]Adjusted for age, race-sex, region, income, education, smoking status, GFR, alcohol use, and physical activity.

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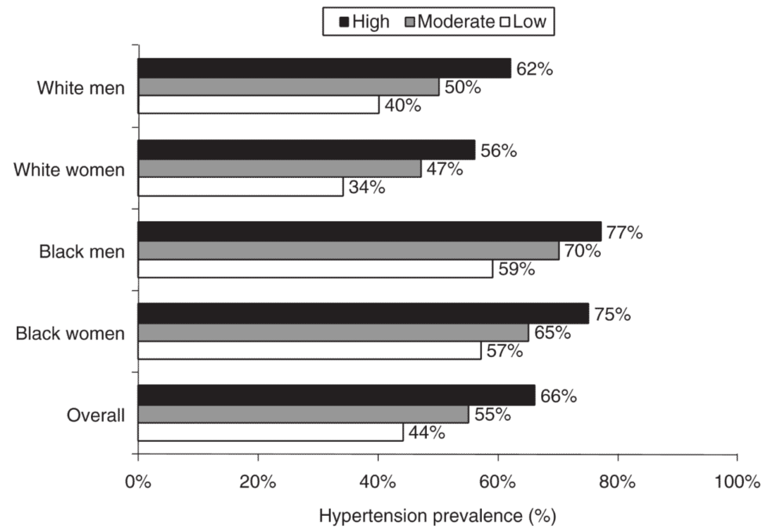

Figure 1.
Prevalence of hypertension by waist circumference, overall, and by race-sex, the REGARDS study, 2003–2007.

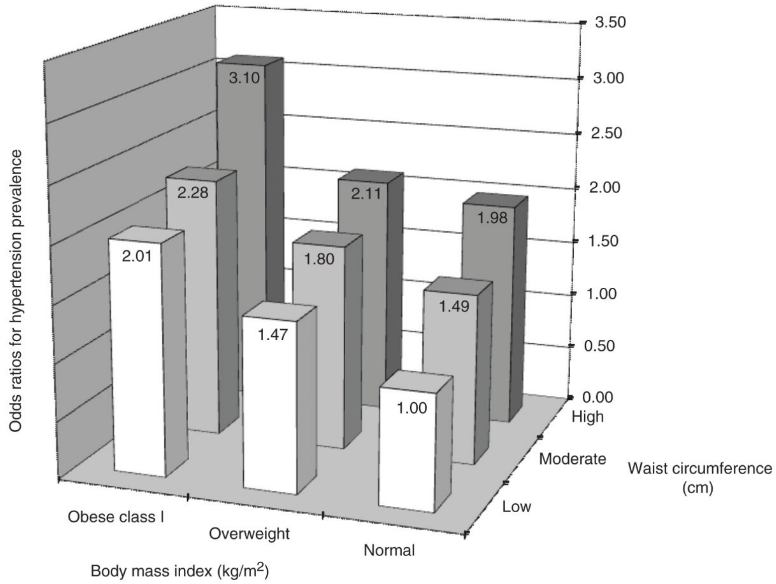

Figure 2.
Adjusted odds ratios for hypertension prevalence by body mass index and waist circumference, the REGARDS study, 2003–2007.

Table 1

Characteristics of 24,247 participants by waist circumference, the REGARDs study, 2003–2007

	Waist Circumference[a], [b]		
Variable	**Low (*n* = 8,068), *n* (%)**	**Moderate (*n* = 6,488), *n* (%)**	**High (*n* = 9,691), *n* (%)**
Age, years, mean (s.d.)	64.3 ± 9.3	65.1 ± 9.1	65.3 ± 8.7
Black women	908 (11)	1,246 (19)	3,142 (32)
Black men	1,803 (22)	1,069 (16)	1,088 (11)
White women	2,469 (31)	1,844 (28)	2,990 (31)
White men	2,888 (36)	2,329 (36)	2,471 (25)
Stroke belt residence[c]	4,555 (56)	3,515 (54)	5,388 (56)
Income			
<$20,000	1,080 (13)	938 (14)	1,957 (20)
$20,000–$34,999	1,784 (22)	1,505 (23)	2,490 (26)
$35,000–$74,999	2,567 (32)	2,073 (32)	2,756 (28)
≥$75,000	1,685 (21)	1,166 (18)	1,274 (13)
Refused/missing	952 (12)	806 (12)	1,214 (13)
Education			
<High school	735 (9)	684 (11)	1,360 (14)
High school graduate	1,932 (24)	1,614 (25)	2,633 (27)
Some college	2,042 (25)	1,776 (27)	2,627 (27)
College graduate	3,354 (42)	2,413 (37)	3,061 (32)
BMI, mean (s.d.)	24.3 ± 2.8	27.2 ± 2.8	30.2 ± 2.9
BMI category (kg/m^2)			
Normal (18.5–24.9)	4,991 (62)	1,422 (22)	426 (4)
Overweight (25–29.9)	2,860 (35)	4,045 (62)	3,930 (41)
Obese class I (30–34.9)	217 (3)	1,021 (16)	5,335 (55)
Current cigarette smoking	1,367 (17)	906 (14)	1,408 (15)
GFR[d](ml/min/1.73 m^2)			
≥60	7,141 (91)	5,650 (90)	8,105 (87)
30–59	613 (8)	596 (9)	1,058 (11)
<30	54 (1)	53 (1)	132 (1)
Alcohol use [e]			
Moderate	3,194 (40)	2,355 (37)	2,876 (30)
Heavy	431 (5)	277 (4)	356 (4)
Physical activity			
None	2,052 (26)	1,886 (29)	3,628 (38)
1–3 times per week	2,888 (36)	2,427 (38)	3,422 (36)

Variable	Waist Circumference[a,b]		
	Low (*n* = 8,068), *n* (%)	**Moderate (*n* = 6,488), *n* (%)**	**High (*n* = 9,691), *n* (%)**
≥4 times per week	3,019 (38)	2,086 (33)	2,515 (26)
Systolic BP, mm Hg, mean (s.d.)	123.7 ± 16.4	126.6 ± 16.2	129.2 ± 16.4
Diastolic BP, mm Hg, mean (s.d.)	74.8 ± 9.5	76.0 ± 9.2	77.1 ± 9.6

BMI, body mass index; BP, blood pressure; GFR, glomerular filtration rate.

[a]Waist circumference defined as low (women: <80 cm; men: <94 cm), moderate (women: 80–88 cm; men: 94–102 cm for men) or high (women: >88 cm; men: >102 cm).

[b]With the exception of the proportion of participants living in the stroke belt, all variables differed significantly between waist circumference strata at $P < 0.01$. The proportion of participants living in the stroke belt differed between waist circumference strata at $P = 0.02$.

[c]Stroke belt is North Carolina, South Carolina, Georgia, Tennessee, Mississippi, Alabama, Louisiana, and Arkansas.

[d]Glomerular filtration rate was estimated using the four-variable Modification of Diet in Renal Disease study equation using the single-determination of serum creatinine.

[e]Alcohol use defined as none, moderate (women: 1–7 drinks weekly; men: 1–14 drinks weekly) and heavy (women: >7 alcoholic drinks weekly; men: >14 alcoholic drinks weekly).

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Table 2

Age-adjusted odds ratios (95% CIs) for hypertension prevalence across body mass index and waist circumference strata by race-sex, the REGARDs study, 2003–2007

		Waist circumference[a]				
Race-sex	**Body mass index**	**All waist circumference**	**Low**	**Moderate**	**High**	***P* trend**
Black women (*n* = 5,296)	All body mass index		**1.0 (ref.)**	**1.39 (1.17, 1.67)**	**2.17 (1.86, 2.54)**	<0.01
	Normal	1.0 (ref.)	1.0 (ref.)	1.31 (0.99, 1.74)*	**1.73 (1.17, 2.57)**	<0.01
	Overweight	**1.46 (1.25, 1.71)**	1.12 (0.84, 1.50)	**1.56 (1.23, 1.96)**	**2.02 (1.64, 2.50)**	<0.01
	Obese class I	**2.04 (1.73, 2.40)**	1.42 (0.77, 2.64)	**1.47 (1.06, 2.06)**	**2.58 (2.11, 3.17)**	<0.01
	P trend	<0.01	0.16	0.41	<0.01	
Black men (*n* = 3,960)	All body mass index		1.0 (ref.)	**1.58 (1.34, 1.86)**	**2.21 (1.86, 2.62)**	<0.01
	Normal	1.0 (ref.)	1.0 (ref.)	1.36 (0.87, 2.12)	1.50 (0.60, 3.77)	0.14
	Overweight	**1.65 (1.41, 1.94)**	**1.48 (1.22, 1.80)**	**1.81 (1.46, 2.23)**	**2.31 (1.74, 3.08)**	<0.01
	Obese class I	**2.89 (2.39, 3.50)**	**3.53 (1.99, 6.29)**	**2.72 (2.03, 3.66)**	**3.05 (2.44, 3.80)**	0.80
	P trend	<0.01	<0.01	<0.01	0.09	
White women (*n* = 7,303)	All body mass index		1.0 (ref.)	**1.68 (1.48, 1.91)**	**2.42 (2.16, 2.72)**	<0.01
	Normal	1.0 (ref.)	1.0 (ref.)	**1.66 (1.37, 2.01)**	**1.93 (1.43, 2.62)**	<0.01
	Overweight	**1.56 (1.40, 1.74)**	**1.31 (1.06, 1.61)**	**1.79 (1.53, 2.11)**	**2.17 (1.87, 2.53)**	<0.01
	Obese class I	**2.57 (2.25, 2.92)**	1.73 (0.92, 3.24)	**2.46 (1.75, 3.44)**	**3.17 (2.73, 3.67)**	0.02
	P trend	<0.01	<0.01	0.09	<0.01	
White men (*n* = 7,688)	All body mass index		1.0 (ref.)	**1.51 (1.35, 1.69)**	**2.48 (2.22, 2.78)**	<0.01
	Normal	1.0 (ref.)	1.0 (ref.)	**1.54 (1.21, 1.97)**	**2.42 (1.31, 4.49)**	<0.01
	Overweight	**1.64 (1.46, 1.83)**	**1.48 (1.27, 1.73)**	**1.76 (1.52, 2.03)**	**2.32 (1.97, 2.74)**	<0.01
	Obese class I	**2.97 (2.59, 3.40)**	**1.76 (1.00, 3.10)**	**2.38 (1.88, 3.02)**	**3.59 (3.08, 4.19)**	<0.01
	P trend	<0.01	<0.01	<0.01	<0.01	

[a] Bolded figures indicate 95% confidence intervals not containing one.

* $P = 0.06$.