Published in final edited form as:
J Am Coll Cardiol. 2008 August 19; 52(8): 605–615. doi:10.1016/j.jacc.2008.03.066.

MEASURES OF OBESITY AND CARDIOVASCULAR RISK AMONG MEN AND WOMEN

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Abstract

Objectives—We examined associations between anthropometric measures (body mass index [BMI], waist circumference [WC], waist-to-hip ratio [WHR], waist-to-height ratio [WHtR]) and risk of incident cardiovascular disease (CVD, including nonfatal myocardial infarction, nonfatal ischemic stroke, cardiovascular death).

Background—Controversy exists regarding the optimal approach to measure adiposity, and the utility of BMI has been questioned.

Methods—Participants included 16,332 men in the Physicians' Health Study (mean age 61, 1991) and 32,700 women in the Women's Health Study (mean age 61, 1999). We used Cox proportional hazards models to determine relative risks (RR) and 95% confidence intervals (CI) for developing CVD according to self-reported anthropometric indices.

Results—A total of 1505 CVD cases occurred in men, and 414 occurred in women (median follow-up, 14.2 and 5.5 years, respectively). While WHtR demonstrated statistically the strongest associations with CVD and best model fit, CVD risk increased linearly and significantly with higher levels of all indices. Adjusting for confounders, the RR (CI) for CVD was 0.58 (0.32–1.05) for men with the lowest WHtR (<0.45) and 2.36 (1.61–3.47) for the highest WHtR (≥0.69; versus WHtR 0.49-<0.53). Among women, the RR (95% CI) was 0.65 (0.33– 1.31) for those with the lowest WHtR (<0.42) and 2.33 (1.66–3.28) for the highest WHtR (≥0.68; versus WHtR 0.47- <0.52).

Conclusions—WHtR demonstrated statistically the best model fit and strongest associations with CVD. However, as compared to BMI, differences in cardiovascular risk assessment using other indices were small and likely not clinically consequential. Our findings emphasize that higher levels of adiposity, however measured, confer increased risk of CVD.

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DISCLOSURES: none

Keywords

obesity; cardiovascular disease; epidemiology

We face an epidemic of overweight and obesity which affects more than a billion adults worldwide.[1] While multiple health organizations recommend using body mass index (BMI) for the identification of overweight and obese individuals,[2, 3] uncertainty exists regarding the optimal approach to measure adiposity, and the utility of BMI has been questioned.[4, 5] Using BMI as the current standard measure of adiposity can result in misclassification of risk among certain populations and may not adequately describe adiposity in relation to cardiovascular risk.

Anthropometric indices of central adiposity and body composition, including the waist circumference (WC), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR), may more accurately identify groups at risk for adverse health consequences of excess weight.[2, 6–8] However, the relative utility of various anthropometric measures in assessing cardiovascular risk remains unclear.[9, 10] Furthermore, while some studies have explored the associations between anthropometric indices and cardiovascular risk beyond BMI, analytic approaches and results have been inconsistent and most studies have not directly compared multiple indices.[10]

We therefore examined the associations between various anthropometric parameters of adiposity and the risk of incident cardiovascular disease (CVD) in prospective cohorts of more than 49,000 men and women.

METHODS

Study Populations

We used data from two prospective cohorts of health professionals in the US to examine the associations between various anthropometric indices and cardiovascular risk. Baseline and follow-up information was self-reported and collected through mailed questionnaires every 6 months for the first year and annually thereafter. Details of the study methods and results have been described elsewhere.[11–15]

Physicians' Health Study (PHS)—Study subjects included participants in the PHS, a completed randomized trial of aspirin and beta carotene in the primary prevention of CVD and cancer.[11, 12] This trial included 22,071 apparently healthy male physicians, age 40–84 years in 1982, without a history of CVD or other major illnesses.

Analyses were limited to men who remained in the cohort at 9 years (n=20,889), the time at which waist and hip circumferences were requested. We excluded men who did not return the 9-year questionnaire (n=183), those missing information on waist (n=2097), hip (n=2135), or BMI (n=623), those with WC or hip circumferences <20 in. or >70 in. (n=28), and men with a history of CVD, coronary revascularization procedures, or angina prior to the 9-year questionnaire (n=1780), leaving 16,332 men for our analyses.

Women's Health Study (WHS)—Study subjects also included participants in the WHS, a completed randomized trial of aspirin and vitamin E in the primary prevention of CVD and cancer.[13–15] This trial included 39,876 female health professionals, age ≥45 years in 1993 without a history of CVD or other major illnesses.

Analyses were limited to women who remained in the cohort at 6 years (n=39,135), the only time at which waist and hip circumferences were requested. We excluded women who did not return the 6-year questionnaire (n=2070), those missing information on waist (n=3099), hip (n=3103), or BMI (n=758), those with WC <20 in. (n=4), and women with a history of CVD, coronary revascularization procedures, or angina prior to the 6-year questionnaire (n=492), leaving 32,700 women for our analyses.

Exposures

We calculated BMI from self-reported weight (kg) divided by the square of the height (m). To evaluate BMI over the range of “normal” and “overweight,” we categorized BMI as <20.0, 20.0- <22.5, 22.5- <25.0, 25.0- <27.5, 27.5- <30.0, 30.0- <35.0, ≥35.0 kg/m^2. We also assessed BMI as a continuous variable (per standard deviation unit, SD). We used baseline height and weight reported with the 9-year (PHS) or 6-year (WHS) questionnaire to calculate BMI.

Participants were asked to report circumferences using a paper tape measure supplied with the questionnaire. Instructions requested that participants (1) measure their WC at the level of the umbilicus, (2) measure their hip circumference as the largest circumference between the umbilicus and the thigh, and (3) record the measurements to the nearest quarter inch. WHR was calculated by dividing the WC by the hip circumference and WHtR by dividing the WC by the baseline height. We evaluated WC, WHR, and WHtR in seven categories defined by the percentile distributions of participants in the corresponding seven BMI categories and as a continuous variable, per SD unit. Self-reports of anthropometric measures have been validated in other health professional cohorts.[16]

Covariates

From the PHS, covariates assessed at 9 years included age (5-year categories), physical activity (rarely/never, 1–2, 3–4, 5–7 days/week), and history of cancer, diabetes, elevated cholesterol (≥240 mg/dL or history of cholesterol-lowering medication use), or hypertension (self-reported systolic blood pressure [BP] ≥140 mmHg, diastolic BP ≥90 mmHg, or antihypertensive medication use). Other covariates were obtained at the most recent prior questionnaire: smoking at 5 years (never, past, current), alcohol consumption at 7 years (rarely/never, 1–3 drinks/month, 1–6 drinks/week, ≥1 drink/day), and, from baseline, parental history of myocardial infarction before the age of 60.

From the WHS, covariates at 6 years included age (5-year categories) and history of cancer, history of diabetes, elevated cholesterol (≥240 mg/dL, cholesterol-lowering medication use, or elevated cholesterol diagnosed by a clinician), or hypertension (self-reported systolic BP ≥140 mmHg, diastolic BP ≥90 mmHg, hypertension diagnosed by a clinician, or history of antihypertensive treatment). We measured smoking (never, past, current) at baseline, updating the variable through year six. Other covariates were obtained at the most recent prior questionnaire: postmenopausal hormone use (never, past, current) at 5 years, alcohol consumption at 4 years (rare/never, 1–3 drinks/month, 1–6 drinks/week, ≥1 drink/day), and, from baseline, physical activity (≤1, 2–3, ≥4 times/week), parental history of myocardial infarction before the age of 60, highest level of education (less than a bachelor’s degree, bachelor’s degree, master’s/doctorate degree), and race (white, black, other). Dietary information was obtained at baseline from a 161-item standardized food frequency questionnaire,[17] and nutrient intake was adjusted for total energy intake using the residual method.[18] Dietary variables included cereal fiber, folate, glycemic load, *trans* fat, polyunsaturated-to-saturated fat ratio, and omega-3 fatty acids (all in quintiles).[19]

Outcome

We defined incident major CVD as first nonfatal myocardial infarction, nonfatal ischemic stroke, or fatal CVD (defined as fatal myocardial infarction, fatal ischemic stroke, sudden death, or any deaths related to ischemic heart disease; *International Classification of Diseases-Ninth Revision*, ICD-9, codes 410–414, 430–438, 798).

Confirmation of all endpoints required review of available medical records by an endpoints committee of physicians who used standardized criteria. Myocardial infarctions were confirmed by elevated plasma levels of cardiac enzymes or diagnostic electrocardiograms. Fatal myocardial infarction was confirmed based on autopsy reports, symptoms, circumstances of death, and history of coronary heart disease. Nonfatal stroke was defined as a focal neurological deficit of vascular mechanism and sudden onset that lasted more than 24 hours. Fatal stroke was documented with evidence of a cerebrovascular mechanism using all available information, including death certificates and medical records. Brain imaging and clinical information were used to distinguish between types of stroke. The interobserver agreement on the classification of major stroke subtypes was excellent in both the PHS (κ=0.81)[20] and WHS (κ=0.96).[21]

Deaths were identified through systematic searches of the National Death Index (NDI). We identified cohort members who died before March 31, 2006, and obtained their death certificates from state agencies. Trained nosologists classified causes of death according to ICD-9 codes in conjunction with the “Automated Classification of Medical Entities Decision Tables” to select the underlying cause of death. The reliability of the NDI for epidemiologic purposes among female health professionals has been previously validated (98% sensitivity, ~100% specificity).[22]

Analysis

We compared participant characteristics according to BMI categories by chi-square tests for categorical variables and analysis of variance for continuous variables. We calculated Pearson correlations (*r*) among the indices. For each index, we used Cox proportional hazards models to compute hazard ratios as the measure of the relative risks (RRs) and 95% confidence intervals (CIs) for CVD. Person-years of follow-up were calculated as the time from exposure assessment to development of the first endpoint of interest, censoring, or end of follow-up (March 31, 2006), whichever occurred first.

We considered three multivariable-adjusted models. Model 1 adjusted for potential confounders. In the PHS, these included age, physical activity, smoking, alcohol consumption, and parental history of myocardial infarction before the age of 60. In the WHS, these included age, physical activity, smoking, alcohol consumption, parental history of myocardial infarction before the age of 60, postmenopausal hormone use, race, education, and the dietary factors.

Anthropometric indices were evaluated by (1) comparing the strengths of the associations with CVD, and (2) comparing model fit as assessed by log-likelihoods. All log-likelihood comparisons involved models with constant sample sizes. For indices demonstrating the strongest associations and best model fit, we examined a second model adjusting for the confounders in Model 1 plus BMI. We compared nested models with and without BMI using the likelihood ratio test (LRT). In these models, the RRs for the indices reflect associations with CVD beyond those conveyed by BMI.

We examined a third model adjusting for the variables in Model 1 plus possible mediators of the association between adiposity and CVD (diabetes, elevated cholesterol, and hypertension). The RRs from this model reflect associations between the indices and CVD beyond those mediated through the overt development of these intermediates.

In sub-analyses, we excluded those with a history of smoking or cancer, those who developed the outcome or were censored early during follow-up (first 4 years in the PHS, 2 years in the WHS, given the shorter duration of follow-up in the WHS), and those with an absolute weight change ≥5% over the year preceding exposure assessment, to reduce bias due to potential confounding by smoking and preexisting disease.[23] In other analyses, we excluded persons with BMI ≥35.0 kg/m^2, given potential misclassification of risk at the highest BMI.

In stratified and joint models, we explored interactions between anthropometric indices and BMI, age, physical activity, or smoking status. To assess for statistically significant effect modification, we used the LRT contrasting age-adjusted models with and without interaction terms of interest.

We assessed for linear and curvilinear trends in the RR across categories of indices by including the relevant indices in models as continuous or quadratic variables, respectively, assigning median values to each category and comparing models using the LRT. Two-sided *P*-values were reported in all analyses. *P*-values <0.05 were considered statistically significant. All data analyses were performed using SAS Software Version 9.1 (SAS Institute Inc, Cary, NC).

RESULTS

Participant characteristics are shown according to baseline BMI categories in Table 1. Men with higher BMI were younger, had higher WC, WHR, and WHtR indices, and were more likely to have a history of hypertension, diabetes, and high cholesterol. They were also more likely to smoke, consumed less alcohol, and were less physically active. Leaner women were more likely to be current smokers, to use postmenopausal hormones, had lower levels of *trans*-fat and omega-3 fatty acid intake, and had higher levels of polyunsaturated-to-saturated fat, glycemic load, folic acid, and cereal fiber intake.

BMI most strongly correlated with WC (r=0.78 for men, 0.82 for women) and WHtR (r=0.80, 0.84), as well as weight (r=0.86, 0.93).

A total of 1505 cases of major CVD occurred in men after a median (SD) follow-up of 14.2 (3.4) years (606 nonfatal myocardial infarctions, 604 nonfatal ischemic strokes, and 295 fatal CVD deaths), and 414 cases (174 nonfatal myocardial infarctions, 182 nonfatal ischemic strokes, and 58 fatal CVD cases) occurred in women after 5.5 (0.9) years. For all indices, higher values were associated linearly with increasing risk of CVD, among both men and women and in both age- and multivariable-adjusted models (Table 2,Table 3). Overall, associations with CVD did not vary substantially among the indices, although associations were somewhat weaker for WHR, particularly among men (Figure 1). We also found similar measures of model fit among the various indices.

Among men, WHtR demonstrated the strongest gradient in the association with CVD, followed by WC, BMI, and WHR (Figure 1a, Table 2b). Measures of model fit were overall similar, with the best fit (lowest log-likelihood) seen using the WHtR (Table 2). Results were generally similar for women. Both WHtR and WC demonstrated the strongest gradient in the association with CVD, with weaker associations for BMI and WHR (Figure 1b, Table 3b). Measures of model fit were overall similar, with the best fit seen using the WHtR (Table 3). We found similar results examining indices as continuous variables (data not shown).

Adding BMI to models with WHtR did not significantly improve model fit (*P*=0.18 for men, 0.46 for women). Although the RRs for WHtR were attenuated after additionally adjusting for BMI, higher WHtR remained associated with increased risk of CVD (Table 2b,Table 3b). By contrast, adding WHtR to models with BMI did improve model fit and substantially attenuated the associations (Table 2a,Table 3a).

Additionally adjusting for the potential intermediates in the association between adiposity and CVD generally attenuated the RRs for the various indices, however, the overall associations remained comparable and statistically significant (Table 2e,Table 3e).

We found similar results excluding participants with BMI ≥35.0 kg/m^2 (data not shown).

Higher WHtR remained associated with increased risk of CVD after excluding persons with a history of smoking or cancer, unstable weight during the year prior to WHtR assessment, or with ≤4 (PHS) or ≤2 (WHS) years of follow-up (data not shown). By contrast, higher BMI was less strongly associated with increasing risk of CVD in this subgroup with a history of smoking or cancer or unstable weight. The RR (95% CI) was 1.43 (0.91–2.26) among obese (BMI ≥30.0 kg/m^2) men, and 1.68 (0.90–3.14) among obese women, as compared to persons with BMI <25.0 kg/m^2.

Examining the joint effects of BMI and WHtR, higher WHtR appeared strongly associated with CVD risk within BMI categories (Figures 2a, b). In analyses stratified by BMI (</≥ 25.0 kg/m^2), we did not find evidence for effect modification by BMI (LRT *P*=0.74 for men, 0.88 for women).

Higher WHtR and BMI were associated linearly with increased CVD risk among both younger and older men and women (Table 4). Although associations for both WHtR and BMI appeared stronger among younger participants, this finding was not statistically significant. Examining the joint effects of age and WHtR, those ≥60 years consistently had the highest RR of CVD, across all WHtR categories, as compared to younger persons (Figures 3a, b). We also did not find evidence for effect modification by physical activity (LRT *P*=0.25 for men, 0.51 for women) or smoking status (LRT *P*=0.99 for men, 0.96 for women).

DISCUSSION

In these prospective cohorts of men and women, we found linear associations between higher adiposity measures and risk of incident CVD. While all indices demonstrated generally similar associations with CVD and measures of model fit, the WHtR most consistently showed the strongest associations and statistically best model fit. Overall, however, we did not find substantial or likely clinically meaningful differences between BMI and WHtR. These results were similar for both men and women.

Our findings remained materially unaltered after accounting for multiple confounders and potential intermediates in the pathway between adiposity and CVD, suggesting that the increased risk conferred by higher measures of adiposity may not solely be mediated by the development of diabetes, hypertension, or high cholesterol. Associations between indices and CVD risk did not vary substantially by age, physical activity, or smoking status. Furthermore, associations between WHtR and CVD were attenuated but remained significant after adjusting for BMI, suggesting that much, but not all, of the risk conferred by a higher WHtR is reflected by BMI.

Previous studies on anthropometric indices and cardiovascular risk have shown conflicting results. Both increased WC and WHR have been associated with higher coronary risk.[7, 8, 24] Studies have been inconsistent, however, when comparing the various indices.

Although WC may be correlated more strongly with visceral fat than the WHR,[9] particularly among the elderly,[10] WC has not been a consistently stronger predictor of cardiovascular risk.[25] In a cohort of male health professionals, WHR was particularly associated with coronary risk among the elderly, whereas BMI was more strongly associated among younger individuals.[7] Conversely, in the Nurses' Health Study, both WHR and WC were associated with coronary

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risk after adjustment for BMI, with stronger associations among younger women.[8] Furthermore, while some suggest that WHR is comparably or more strongly associated with CVD, as compared to WC and BMI,[6, 26] others have shown stronger associations for WC.[27–29] WHtR has been more strongly associated with cardiovascular risk factors, such as hypertension, hyperglycemia, hypertriglyceridemia, and the metabolic syndrome, than BMI or WC in selected populations, primarily among Asian populations.[30–36]

Multiple biologic mechanisms have been implicated in mediating the adverse health effects of excess adiposity, however, the exact pathways are unknown.[10] Visceral fat may be more sensitive to lipolysis, as compared to subcutaneous fat, thereby preferentially increasing circulating free fatty acid levels.[10] Other proposed mechanisms involve secretion of adipokines, which may differ by fat storage site.[10]

Although our study has several strengths, including the prospective design, large sample size and number of outcome events, long duration of follow-up, measurement of multiple potential confounders, and confirmation of CVD events after medical record review, certain limitations should be considered. First, we used self-reported information on exposures, which may contribute to misclassification. However, validation studies of other health professional cohorts have demonstrated the reliability of self-reported information on anthropometric indices and cardiovascular risk factors.[16, 37] Moreover, due to the prospective design, we expect that such potential misclassification would likely have yielded underestimates of effect.

Second, residual confounding may have occurred with self-reported information on comorbid conditions and potential mediators. However, we analyzed multiple biologically relevant confounders, and such residual confounding would not be expected to alter substantially the observed associations. Third, our study was limited to female health professionals and mostly Caucasian male physicians in the US, which may limit the generalizability of our results to other populations. However, our study population's homogeneity in income, educational attainment, and access to medical care may reduce confounding due to socioeconomic factors.

In conclusion, we found that higher measures of both overall and central adiposity confer greater risk of subsequent CVD in both men and women, regardless of the index chosen. Current clinical guidelines using BMI to define overweight and obesity may miss identifying persons at "normal" BMI levels with increased CVD risk related to central fat distribution. However, while the WHtR and central fat distribution may particularly reflect CVD risk, we found differences between BMI and WHtR in associations with CVD and model fit to be small and likely not clinically consequential. Given its ease of measurement and current standard use in the classification of overweight and obesity, BMI may remain the most clinically practical measure of adiposity. Our findings emphasize that higher levels of adiposity, however measured, confer overall greater risk of CVD.

ABBREVIATIONS

BMI, body mass index
CI, confidence interval
CVD, cardiovascular disease
LRT, likelihood ratio test
PHS, Physicians' Health Study
SD, standard deviation
RR, relative risk
WC, waist circumference
WHR, waist-to-hip ratio
WHtR, waist-to-height ratio

WHS, Women's Health Study

Acknowledgment

We are indebted to the participants in the Physician's Health Study and the Women's Health Study for their outstanding commitment and cooperation and to the entire Physicians' Health Study and Women's Health Study staff for their expert and unfailing assistance.

FUNDING SOURCES

This work was supported by grants CA-34944, CA-40360, and CA-47988 from the National Cancer Institute, grants HL-26490, HL-34595, and HL-43851 from the National Heart, Lung, and Blood Institute, and grant 5 T32 AG000158-18 from the National Institute on Aging, Bethesda, MD.

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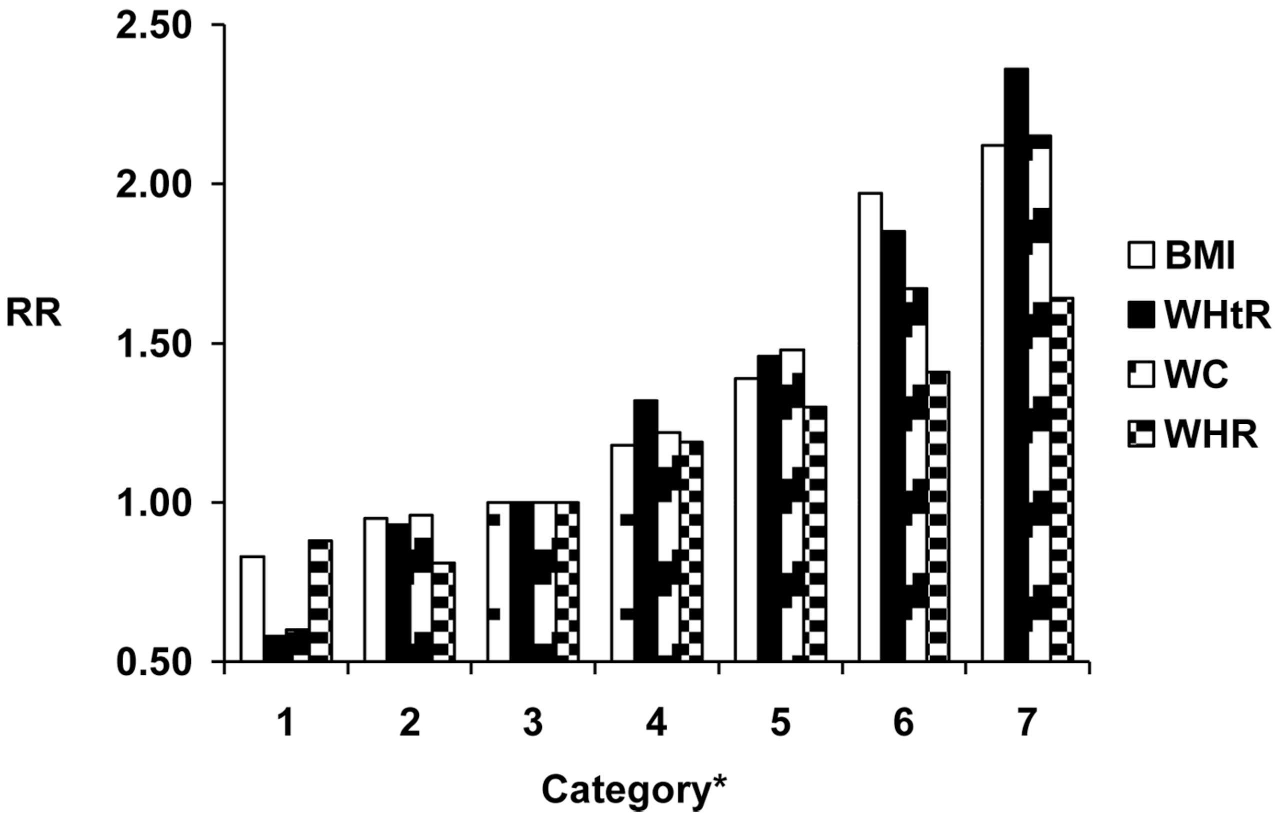

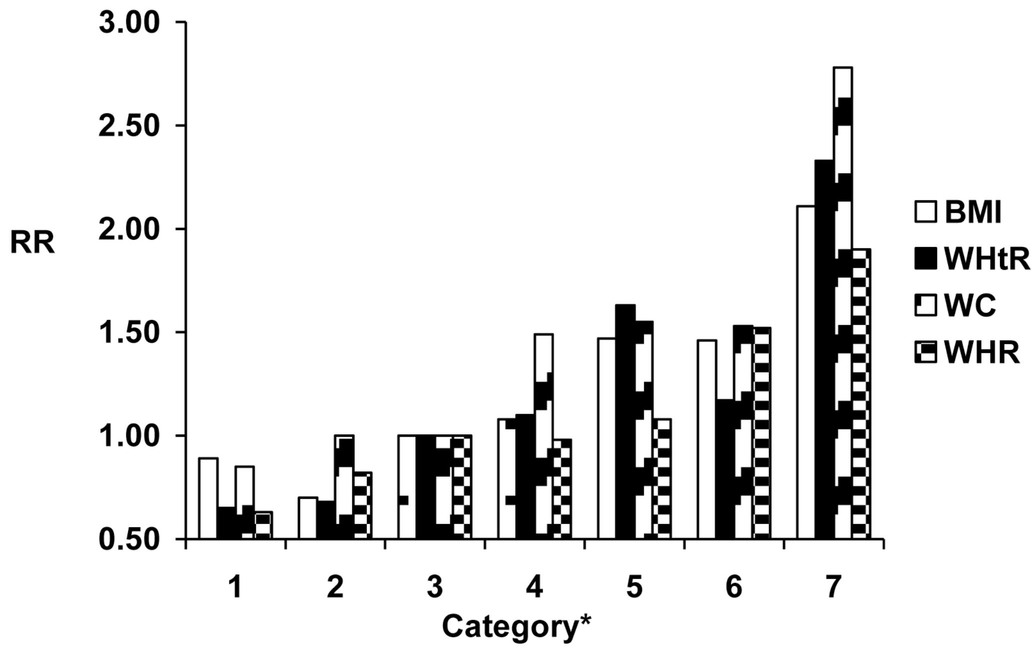

Figure 1.

Figure 1a. Relative risk (RR) of cardiovascular disease according to anthropometric indices among men Model adjusts for age, physical activity, smoking, alcohol consumption, and parental history of myocardial infarction before the age of 60.

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*BMI (body mass index) categories: <20.0, 20.0-22.4, 22.5-24.9, 25.0-27.4, 27.5-29.9, 30.0-34.9, ≥35.0 kg/m^2. WHtR (waist-to-height ratio) categories: <0.45, 0.45-<0.49, 0.49-<0.53, 0.53-<0.58, 0.58-<0.62, 0.62-<0.69, ≥0.69. WC (waist circumference) categories: 22.0-31.25, 31.5-34.25, 34.5-37.25, 37.5-40.75, 41.0-43.5, 43.75-48.0, 48.25-62.0 in. WHR (waist-to-height ratio) categories: <0.83, 0.83-<0.89, 0.89-<0.94, 0.94-<0.99, 0.99-<1.03, 1.03-<1.11, ≥1.11.

Figure 1b. Relative risk (RR) of cardiovascular disease according to anthropometric indices among women Model adjusts for age, physical activity, smoking, alcohol consumption, parental history of myocardial infarction before the age of 60 years, postmenopausal hormone use, race, education, and dietary factors.

*BMI (body mass index) categories: <20.0, 20.0-22.4, 22.5-24.9, 25.0-27.4, 27.5-29.9, 30.0-34.9, ≥35.0 kg/m^2. WHtR (waist-to-height ratio) categories: <0.42, 0.42-<0.47, 0.47-<0.52,0.52-<0.57, 0.57-<0.61, 0.61-<0.68, ≥0.68. WC (waist circumference) categories: 20.0-27.0, 27.25-30.0, 30.25-33.25, 33.5-36.5, 36.75-38.75, 39.0-43.75, 44.0-55.0 in. WHR (waist-to-height ratio) categories: <0.72, 0.72-<0.77, 0.77-<0.82, 0.82-<0.86, 0.86-<0.89, 0.89-<0.95,≥0.95.

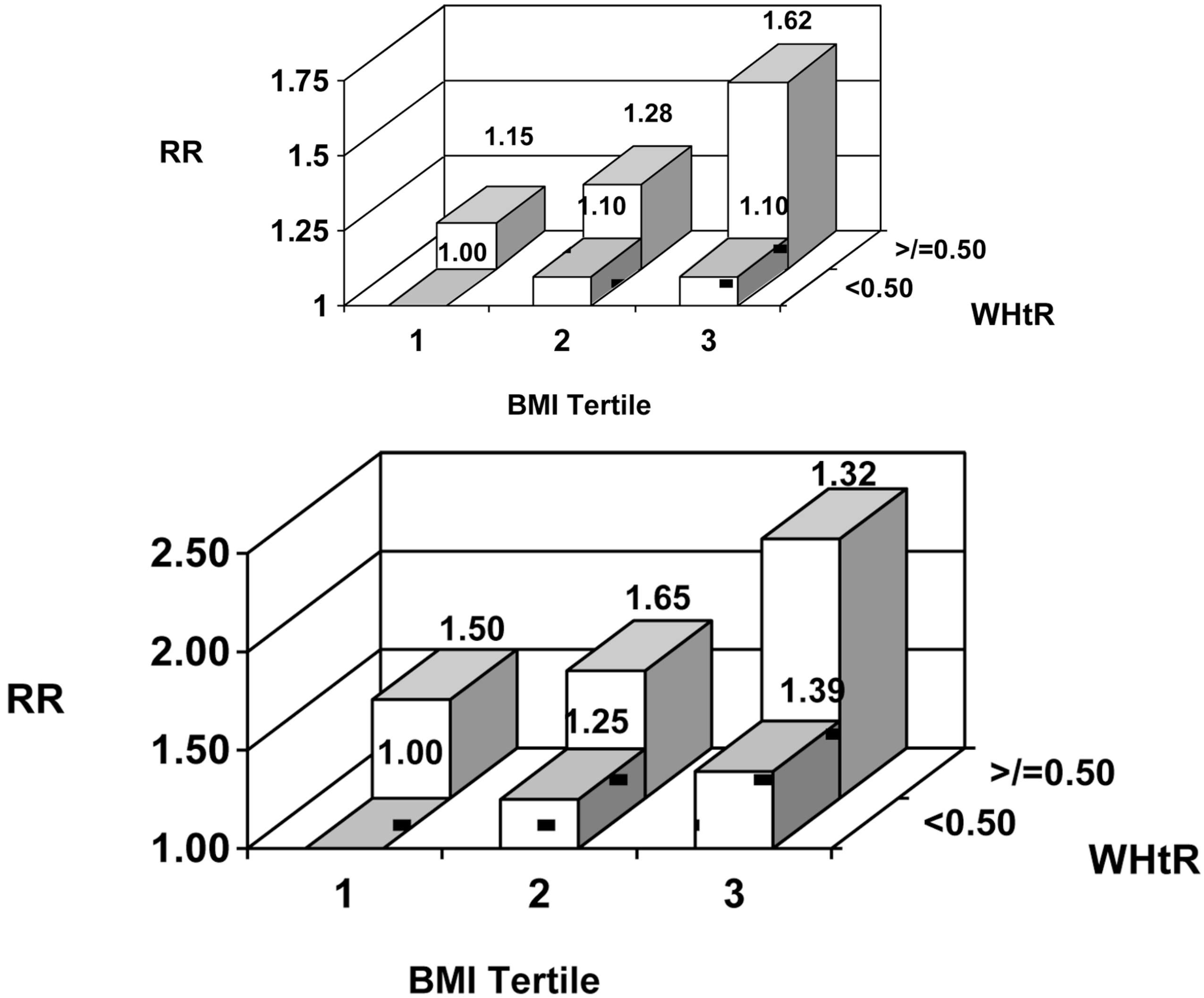

Figure 2.

Figure 2a. Relative risk (RR) of cardiovascular disease according to body mass index (BMI) and waist-to-height ratio (WHtR) among men Model adjusts for age, physical activity, smoking, alcohol consumption, and parental history of myocardial infarction before the age of 60.

Figure 2b. Relative risk (RR) of cardiovascular disease according to body mass index (BMI) and waist-to-height ratio (WHtR) among women Model adjusts for age, physical activity, smoking, alcohol consumption, parental history of myocardial infarction before the age of 60 years, postmenopausal hormone use, race, education, and dietary factors.

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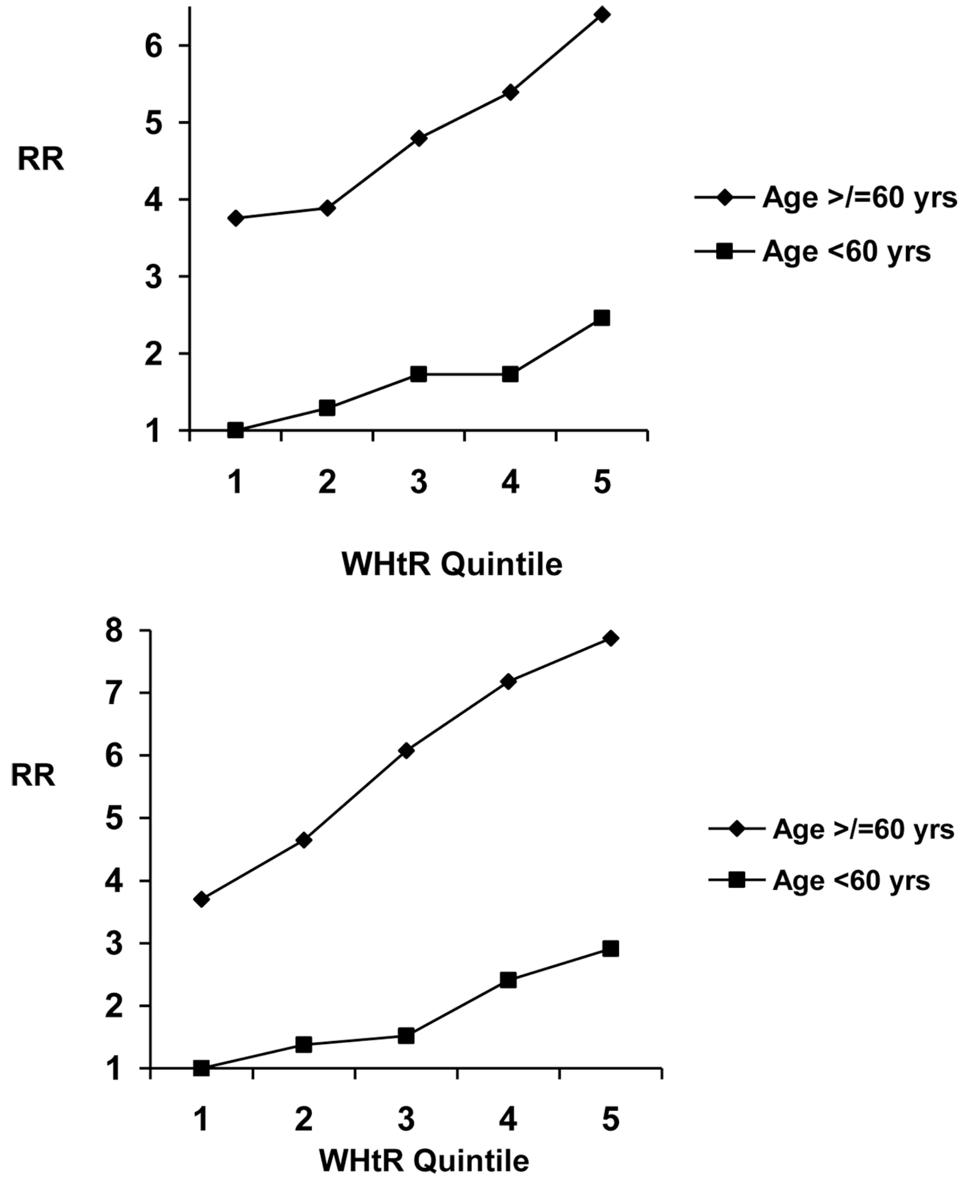

Figure 3.

Figure 3a. Relative risk (RR) of cardiovascular disease according to age and waist-to-height ratio (WHtR) among men Model adjusts for age, physical activity, smoking, alcohol consumption, and parental history of myocardial infarction before the age of 60.

Figure 3b. Relative risk (RR) of cardiovascular disease according to age and waist-to-height ratio (WHtR) among women Model adjusts for age, physical activity, smoking, alcohol consumption, parental history of myocardial infarction before the age of 60 years, postmenopausal hormone use, race, education, and dietary factors.

Table 1

Table 1(a). Characteristics of the 16,332 men in the PHS according to BMI at 9 years

	Body Mass Index (kg/m²)					*P**
	<22.5	**22.5–24.9**	**25.0–27.4**	**27.5–29.9**	**≥30.0**	
Number of men	2789	5545	4893	2006	1099	
Mean age ± SD	63.1 ± 10.0	61.7 ± 8.9	61.1 ± 8.3	60.9 ± 7.8	59.7 ± 7.5	<0.001
Mean weight, kg (lb)	67.6 (150.2)	75.4 (167.5)	82.6 (183.6)	91.5 (203.4)	103.1 (229.1)	<0.001
Mean BMI (kg/m²)	21.3	23.8	26.1	28.6	32.6	<0.001
Mean WC ± SD (in)	34.3 ± 2.3	36.4 ± 2.3	38.6 ± 2.4	41.3 ± 2.6	44.8 ± 3.7	<0.001
Mean WHR ± SD	0.92 ± 0.07	0.93 ± 0.06	0.95 ± 0.06	0.97 ± 0.06	0.98 ± 0.07	<0.001
Mean WHtR ± SD	0.49 ± 0.03	0.52 ± 0.03	0.55 ± 0.03	0.58 ± 0.04	0.64 ± 0.05	<0.001
Hypertension† (%)	29.5	33.4	39.3	46.1	57.4	<0.001
Diabetes mellitus (%)	3.3	3.3	4.1	4.2	9.6	<0.001
High cholesterol ‡ (%)	20.4	22.7	24.7	24.7	23.0	<0.001
Prior cancer (%)	5.4	5.2	4.3	4.7	3.7	0.06
Smoking status (%)						<0.001
Never	53.7	52.0	48.1	47.6	43.2	
Past	39.2	42.2	45.3	45.5	48.5	
Current	7.1	5.8	6.6	6.9	8.3	
Exercise ≥3 times/week (%)	50.5	47.4	40.5	32.4	26.3	<0.001
Alcohol intake ≥1 drink/d (%)	21.2	18.7	17.6	16.7	11.7	<0.001
Parental history of MI at <60 yrs (%)	9.1	8.7	8.7	10.4	11.2	0.02

Table 1(b). Characteristics of the 32,700 women in the WHS according to BMI at 6 years

	Body Mass Index (kg/m²)					*P**
	<22.5	**22.5–24.9**	**25.0–27.4**	**27.5–29.9**	**≥30.0**	
Number of women	6792	7421	6849	4160	7478	
Mean age ± SD	61.2 ± 7.6	60.9 ± 7.0	60.9 ± 6.9	60.7 ± 6.7	59.7 ± 6.3	<0.001
Mean weight, kg (lb)	56.1 (124.7)	63.7 (141.6)	70.4 (156.4)	77.3 (171.7)	91.8 (204.1)	<0.001

Table 1(b). Characteristics of the 32,700 women in the WHS according to BMI at 6 years

	Body Mass Index (kg/m²)					P^*
	<22.5	**22.5–24.9**	**25.0–27.4**	**27.5–29.9**	**≥30.0**	
Mean BMI (kg/m²)	20.9	23.8	26.3	28.8	34.5	<0.001
Mean WC ± SD (in)	29.7 ± 2.9	32.5 ± 3.0	35.0 ± 3.2	37.5 ± 3.3	41.9 ± 4.5	<0.001
Mean WHR ± SD	0.79 ± 0.07	0.82 ± 0.07	0.84 ± 0.07	0.86 ± 0.07	0.87 ± 0.07	<0.001
Mean WHtR ± SD	0.46 ± 0.04	0.50 ± 0.05	0.54 ± 0.05	0.58 ± 0.05	0.65 ± 0.07	<0.001
Hypertension† (%)	25.4	32.0	40.7	48.1	62.3	<0.001
Diabetes mellitus (%)	1.7	2.5	3.6	5.7	12.7	<0.001
High cholesterol ‡ (%)	27.9	32.9	35.5	39.9	39.6	<0.001
Prior cancer (%)	4.1	3.8	3.6	3.4	3.3	0.16
Postmenopausal hormone use (%)						<0.001
Never	24.6	22.8	24.7	26.4	30.8	
Past	12.9	12.6	13.6	14.1	14.4	
Current	62.5	64.6	61.6	59.5	54.7	
Smoking status (%)						<0.001
Never	52.1	51.6	51.5	51.3	52.8	
Past	36.1	39.6	39.5	40.6	40.2	
Current	11.8	8.8	9.0	8.1	6.9	
Exercise ≥4 times/week (%)	16.7	12.4	10.5	9.4	6.3	<0.001
Alcohol intake ≥1 drink/d (%)	6.8	5.7	4.7	3.9	2.4	<0.001
Dietary intake§ (%)						
Trans-fat (≥3.0 g/d)	16.3	17.0	18.9	20.0	25.0	<0.001
N-3 fatty acid (≥1.7 g/d)	18.6	19.5	19.0	21.8	20.7	<0.001
PUFA/saturated fat (≥0.7)	22.3	20.6	19.2	19.3	15.8	<0.001
Glycemic load (≥135/d)	24.8	22.2	18.5	17.6	15.2	<0.001
Folic acid (≥618μg/d)	21.8	20.7	19.6	18.1	16.7	<0.001
Cereal fiber (≥5.4 g/d)	21.3	19.8	19.7	18.9	19.3	0.01
Parental history of MI before age 60 years (%)	11.0	11.6	12.7	14.8	14.0	<0.001
Race/ethnicity (%)						<0.001
Black/African American	0.6	1.1	2.2	3.0	3.3	

Table 1(b). Characteristics of the 32,700 women in the WHS according to BMI at 6 years

	Body Mass Index (kg/m^2)					*P**
	<22.5	**22.5–24.9**	**25.0–27.4**	**27.5–29.9**	**≥30.0**	
White/Non-Hispanic	95.2	95.3	94.4	93.9	93.6	
Other/unknown	4.1	3.6	3.3	3.1	3.0	
Highest level of education (%)						<0.001
Less than bachelor's degree	51.0	52.5	56.5	57.3	61.3	
Bachelor's degree	24.0	25.1	23.8	24.2	21.7	
Master's degree or doctorate	24.9	22.4	19.7	18.4	17.0	

BMI = body mass index; WHtR = waist-to-height ratio; WC = waist circumference; WHR = waist-to-hip ratio.

* *P*-values are from Pearson chi square tests for categorical variables and analysis of variance for continuous variables.

† Hypertension defined as systolic blood pressure ≥140 mmHg, or diastolic blood pressure ≥90 mmHg, or antihypertensive medication use prior to 9 years).

‡ High cholesterol defined as level ≥240 mg/dl or lipid-lowering medication use prior to 7 years.

BMI = body mass index; WHtR = waist-to-height ratio; WC = waist circumference; WHR = waist-to-hip ratio.

* *P*-values are from Pearson chi square tests for categorical variables and analysis of variance for continuous variables.

† Hypertension defined as systolic blood pressure ≥140 mmHg, or diastolic blood pressure ≥90 mmHg, or diagnosis of hypertension by a clinician prior to 6 years.

‡ High cholesterol defined as a diagnosis of high cholesterol [≥240 mg/dl] or cholesterol-lowering medication use prior to 6 years.

§ Levels refer to highest quintile of energy-adjusted dietary intake.

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Table 2

Table 2 - Relative risks (95% confidence intervals) for cardiovascular disease according to categories of anthropometric indices among 16,332 men

(a)

	Body Mass Index (kg/m^2)						
	<20.0	**20.0–22.4**	**22.5–24.9**	**25.0–27.4**	**27.5–29.9**	**30.0–34.9**	**≥35.0**
No. of men	294	2495	5545	4893	2006	925	174
No. of cases	25	205	456	454	217	126	22
Rate (No./1000 p-y)	7.5	6.6	6.4	7.3	8.6	11.2	10.8
Age-adjusted	0.88	0.96	1.00	1.21	1.46	2.12	2.35
	(0.59–1.32)	(0.81–1.13)		(1.06–1.37)	(1.24–1.72)	(1.74–2.58)	(1.53–3.61)
−2logL=28105							
Model 1 *	0.83	0.95	1.00	1.18	1.39	1.97	2.12
	(0.55–1.24)	(0.80–1.12)		(1.04–1.35)	(1.18–1.64)	(1.61–2.41)	(1.36–3.30)
−2logL=27669							
Model 1+WHtR †	1.08	1.06	1.00	1.05	1.14	1.49	1.42
	(0.70–1.67)	(0.89–1.27)		(0.91–1.21)	(0.92–1.39)	(1.14–1.95)	(0.81–2.46)
−2logL=27648							
Model 1+WC †	0.99	1.01	1.00	1.09	1.20	1.65	1.70
	(0.65–1.53)	(0.85–1.21)		(0.95–1.26)	(0.99–1.46)	(1.27–2.15)	(0.99–2.94)
−2logL=27657							

LRT for Model 1 vs Model 1+WHtR: *P*=0.002

LRT for Model 1 vs Model 1+ WC: *P*=0.07

Table 2(b)

	Waist-to-Height Ratio						
	<0.45	**0.45-<0.49**	**0.49-<0.53**	**0.53-<0.58**	**0.58-<0.62**	**0.62-<0.69**	**≥0.69**
No. of men	288	2454	5558	4921	2034	900	177
No. of cases	11	150	412	520	251	132	29
Rate (No./1000 p-y)	2.9	4.7	5.8	8.4	10.1	12.3	14.6

Table 2(b)

	Waist-to-Height Ratio						
	<0.45	**0.45-<0.49**	**0.49-<0.53**	**0.53-<0.58**	**0.58-<0.62**	**0.62-<0.69**	**≥0.69**
Age-adjusted	0.56	0.92	1.00	1.33	1.54	1.99	2.60
	(0.31–1.03)	0.76–1.11)		(1.17–1.51)	(1.32–1.81)	(1.64–2.42)	(1.78–3.79)
−2logL=28086							
Model 1 *	0.58	0.93	1.00	1.32	1.46	1.85	2.36
	(0.32–1.05)	(0.77–1.12)		(1.16–1.50)	(1.25–1.72)	(1.51–2.26)	(1.61–3.47)
−2logL=27657							
Model 1+BMI †	0.56	0.92	1.00	1.29	1.33	1.48	1.73
	(0.30–1.04)	(0.75–1.13)		(1.11–1.49)	(1.09–1.62)	(1.13–1.94)	(1.05–2.83)
−2logL=27648							

LRT for Model 1 vs Model 1+BMI: *P*=0.18

Table 2(c)

	Waist Circumference (in)						
	22.0–31.25	**31.5–34.25**	**34.5–37.25**	**37.5–40.75**	**41.0–43.5**	**43.75–48.0**	**48.25–62.0**
No. of men	283	2475	5285	5056	2090	950	193
No. of cases	12	169	403	508	259	128	26
Rate (No./1000 p-y)	3.3	5.3	5.9	8.0	10.1	11.2	11.9
Age-adjusted	0.59	0.95	1.00	1.25	1.57	1.81	2.32
	(0.33–1.05)	(0.79–1.14)		(1.10–1.42)	(1.34–1.83)	(1.48–2.21)	(1.56–3.45)
−2logL=28104							
Model 1 *	0.60	0.96	1.00	1.22	1.48	1.67	2.15
	(0.33–1.06)	(0.80–1.15)		(1.07–1.40)	(1.27–1.74)	(1.37–2.05)	(1.44–3.21)
−2logL=27671							
Model 1+BMI †	0.61	0.97	1.00	1.16	1.28	1.24	1.38
	(0.33–1.10)	0.80–1.18)		(1.01–1.34)	(1.06–1.55)	(0.95–1.62)	(0.83–2.27)
−2logL=27657							

Table 2(c)

	Waist Circumference (in)						
	22.0–31.25	**31.5–34.25**	**34.5–37.25**	**37.5–40.75**	**41.0–43.5**	**43.75–48.0**	**48.25–62.0**
LRT for Model 1 vs Model 1+BMI: *P*=0.03							

Table 2(d)

	Waist-to-Hip Ratio						
	<0.83	**0.83-<0.89**	**0.89-<0.94**	**0.94-<0.99**	**0.99-<1.03**	**1.03-<1.11**	**≥1.11**
No. of men	269	2491	5593	4870	2010	924	175
No. of cases	16	143	443	507	251	122	23
Rate (No./1000 p-y)	4.6	4.4	6.1	8.4	10.2	11.2	10.8
Age-adjusted	0.83	0.80	1.00	1.20	1.36	1.51	1.69
	(0.50–1.36)	(0.66–0.97)		(1.06–1.36)	(1.16–1.59)	(1.23–1.84)	(1.11–2.58)
−2logL=28133							
Model 1 *	0.88	0.81	1.00	1.19	1.30	1.41	1.64
	(0.53–1.45)	(0.67–0.98)		(1.04–1.35)	(1.11–1.52)	(1.15–1.73)	(1.07–2.52)
−2logL=27694							

Table 2(e). Multivariable model adjusting for the variables in Model 1 * plus history of diabetes, hypertension, or elevated cholesterol

	Category						
BMI (kg/m^2)	**<20.0**	**20.0–22.4**	**22.5–24.9**	**25.0–27.4**	**27.5–29.9**	**30.0–34.9**	**≥35.0**
−2logL=27513	0.86	0.98	1.00	1.12	1.30	1.65	1.65
	(0.57–1.29)	(0.83–1.16)		(0.98–1.28)	(1.10–1.53)	(1.34–2.02)	(1.06–2.58)
WHtR	**<0.45**	**0.45-<0.49**	**0.49-<0.53**	**0.53-<0.58**	**0.58-<0.62**	**0.62-<0.69**	**>0.69**
−2logL=27505	0.62	0.97	1.00	1.25	1.32	1.58	1.90
	(0.34–1.12)	(0.80–1.17)		(1.10–1.43)	(1.13–1.56)	(1.29–1.93)	(1.29–2.80)
WC (in)	**22.0–31.25**	**31.5–34.25**	**34.5–37.25**	**37.5–40.75**	**41.0–43.5**	**43.75–48.0**	**48.25–62.0**
−2logL=27514	0.64	0.98	1.00	1.18	1.36	1.46	1.61
	(0.36–1.14)	(0.82–1.18)		(1.03–1.34)	(1.16–1.60)	(1.19–1.79)	(1.07–2.40)

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Table 2(e). Multivariable model adjusting for the variables in Model 1[*] plus history of diabetes, hypertension, or elevated cholesterol

	Category						
WHR	**<0.83**	**0.83-<0.89**	**0.89-<0.94**	**0.94-<0.99**	**0.99-<1.03**	**1.03-<1.11**	**>1.11**
−2logL=27525	0.88	0.85	1.00	1.13	1.20	1.26	1.60
	(0.53–1.45)	(0.70–1.02)		(0.99–1.28)	(1.03–1.41)	(1.03–1.55)	(1.04–2.46)

BMI = body mass index; WHtR = waist-to-height ratio; WC = waist circumference; WHR = waist-to-hip ratio.

[*] Model 1 adjusts for age, physical activity, smoking, alcohol consumption, and parental history of myocardial infarction before the age of 60 years.

[†] "Model 1 + WHtR," "Model 1 + WC," "Model 1 + BMI" refer to models adjusting for the variables in Model 1 plus waist-to-height ratio, waist circumference, or body mass index in 7 categories at 9 years, respectively.

Table 3 - Relative risks (95% confidence intervals) for cardiovascular disease according to categories of anthropometric indices among 32,700 women

(a)

	Body Mass Index (kg/m²)						
	<20.0	**20.0–22.4**	**22.5–24.9**	**25.0–27.4**	**27.5–29.9**	**30.0–34.9**	**≥35.0**
No. of women	1512	5280	7421	6849	4160	4938	2540
No. of cases	20	44	82	82	66	72	48
Rate (No./1000 p-y)	2.6	1.6	2.1	2.3	3.0	2.8	3.6
Age-adjusted	1.03	0.75	1.00	1.10	1.50	1.47	2.22
	(0.63–1.69)	(0.52–1.08)		(0.81–1.49)	(1.09–2.08)	(1.07–2.03)	(1.55–3.18)
−2logL=8282							
Model 1 *	0.89	0.70	1.00	1.08	1.47	1.46	2.11
	(0.54–1.46)	(0.49–1.02)		(0.80–1.47)	(1.06–2.03)	(1.06–2.01)	(1.46–3.05)
−2logL=8163							
Model 1+WHtR †	1.24	0.82	1.00	0.98	1.27	1.18	1.38
	(0.70–2.19)	(0.56–1.22)		(0.71–1.36)	(0.88–1.84)	(0.78–1.78)	(0.81–2.34)
−2logL=8144							
Model 1+WC †	1.04	0.77	1.00	1.00	1.30	1.18	1.38
	(0.59–1.82)	(0.52–1.13)		(0.73–1.38)	(0.90–1.88)	(0.79–1.77)	(0.83–2.30)
−2logL=8151							

LRT for Model 1 vs. Model 1+WHtR: *P*=0.004

LRT for Model 1 vs. Model 1+WC: *P*=0.06

Table 3(b)

	Waist-to-Height Ratio						
	<0.42	**0.42-<0.47**	**0.47-<0.52**	**0.52-<0.57**	**0.57-<0.61**	**0.61-<0.68**	**≥0.68**
No. of women	1524	5347	7305	6891	4076	5013	2544
No. of cases	9	35	78	85	75	68	64

Table 3(b)

	Waist-to-Height Ratio						
	<0.42	**0.42-<0.47**	**0.47-<0.52**	**0.52-<0.57**	**0.57-<0.61**	**0.61-<0.68**	**≥0.68**
Rate (No./1000 p-y)	1.1	1.3	2.0	2.4	3.5	2.6	4.9
Age-adjusted	0.65	0.67	1.00	1.10	1.61	1.19	2.42
	(0.33–1.30)	(0.45–1.00)		(0.81–1.49)	(1.17–1.21)	(0.86–1.65)	(1.74–3.37)
−2logL=8265							
Model 1 *	0.65	0.68	1.00	1.10	1.63	1.17	2.33
	(0.33–1.31)	(0.46–1.02)		(0.81–1.49)	(1.19–2.25)	(0.84–1.63)	(1.66–3.28)
−2logL=8150							
Model 1+BMI †	0.60	0.69	1.00	1.03	1.43	0.96	1.78
	(0.28–1.28)	(0.45–1.06)		(0.74–1.42)	(0.99–2.07)	(0.63–1.46)	(1.08–2.93)
−2logL=8144							

LRT for Model 1 vs Model 1+BMI: *P*=0.46

Table 3(c)

	Waist Circumference (in)						
	20.0–27.0	**27.25–30.0**	**30.25–33.25**	**33.5–36.5**	**36.75–38.75**	**39.0–43.75**	**44.0–55.0**
No. of women	1480	5114	7112	7158	3743	5426	2667
No. of cases	10	42	63	99	55	80	65
Rate (No./1000 p-y)	1.3	1.6	1.7	2.7	2.8	2.8	4.7
Age-adjusted	0.86	0.99	1.00	1.49	1.56	1.55	2.94
	(0.44–1.68)	(0.67–1.46)	(1.08–2.04)	(1.09–2.24)	(1.11–2.15)	(2.08–4.16)	
−2logL=8272							
Model 1 *	0.85	1.00	1.00	1.49	1.55	1.53	2.78
	(0.43–1.65)	(0.68–1.49)		(1.09–2.05)	(1.08–2.23)	(1.09–2.14)	(1.95–3.97)
−2logL=8157							
Model 1+BMI †	0.87	1.06	1.00	1.37	1.33	1.22	2.08

Table 3(c)

	Waist Circumference (in)						
	20.0–27.0	**27.25–30.0**	**30.25–33.25**	**33.5–36.5**	**36.75–38.75**	**39.0–43.75**	**44.0–55.0**
	(0.42–1.80)	(0.70–1.61)		(0.98–1.91)	(0.90–1.99)	(0.81–1.85)	(1.27–3.40)
−2logL=8151							
LRT for Model 1 vs Model 1+BMI: *P*=0.39							

Table 3(d)

	Waist-to-Hip Ratio						
	<0.72	**0.72-<0.77**	**0.77-<0.82**	**0.82-<0.86**	**0.86-<0.89**	**0.89-<0.95**	**≥0.95**
No. of women	1506	5234	7454	6846	4203	4921	2536
No. of cases	8	39	76	75	53	95	68
Rate (No./1000 p-y)	1.0	1.4	1.9	2.1	2.4	3.7	5.2
Age-adjusted	0.60	0.77	1.00	1.01	1.11	1.59	2.06
	(0.29–1.24)	(0.53–1.14)		(0.73–1.39)	(0.78–1.58)	(1.18–2.16)	(1.48–2.86)
−2logL=8277							
Model 1 *	0.64	0.82	1.00	0.98	1.08	1.52	1.90
	(0.31–1.32)	(0.56–1.21)		(0.71–1.35)	(0.76–1.53)	1.12–2.06)	(1.37–2.65)
−2logL=8165							

Table 3(e). Multivariable model adjusting for the variables in Model 1 * plus history of diabetes, hypertension, or elevated cholesterol

	Index Category, Relative Risk (95% CI)						
BMI (kg/m²)	**<20.0**	**20.0–22.4**	**22.5–24.9**	**25.0–27.4**	**27.5–29.9**	**30.0–34.9**	**≥35.0**
−2logL=8106	0.95	0.75	1.00	1.03	1.31	1.18	1.51
	(0.58–1.56)	(0.52–1.08)		(0.76–1.40)	(0.94–1.82)	(0.85–1.63)	(1.03–2.21)
WHtR	**<0.42**	**0.42-<0.47**	**0.47-<0.52**	**0.52-<0.57**	**0.57-<0.61**	**0.61-<0.68**	**≥0.68**

Table 3(e). Multivariable model adjusting for the variables in Model 1* plus history of diabetes, hypertension, or elevated cholesterol

	Index Category, Relative Risk (95% CI)						
−2logL=8095	0.70	0.72	1.00	1.01	1.43	0.95	1.66
	(0.35–1.40)	(0.48–1.08)		(0.74–1.38)	(1.03–1.97)	(0.68–1.33)	(1.17–2.37)
WC (in)	**20.0–27.0**	**27.25–30.0**	**30.25–33.25**	**33.5–36.5**	**36.75–38.75**	**39.0–43.75**	**44.0–55.0**
−2logL=8102	0.90	1.07	1.00	1.40	1.37	1.25	2.00
	(0.46–1.76)	(0.72–1.58)		(1.02–1.92)	(0.95–1.97)	(0.89–1.76)	(1.38–2.90)
WHR	**<0.72**	**0.72-<0.77**	**0.77-<0.82**	**0.82-<0.86**	**0.86-<0.89**	**0.89-<0.95**	**≥0.95**
−2logL=8104	0.71	0.88	1.00	0.93	0.96	1.28	1.51
	(0.34–1.47)	(0.60–1.30)		(0.67–1.28)	(0.67–1.37)	(0.94–1.75)	(1.08–2.12)

BMI = body mass index; WHtR = waist-to-height ratio; WC = waist circumference; WHR = waist-to-hip ratio.

* Model 1 adjusts for age, physical activity, smoking, alcohol consumption, parental history of myocardial infarction before the age of 60 years, postmenopausal hormone use, race, education, and dietary factors.

† "Model 1 + WHtR," "Model 1 + WC," "Model 1 + BMI" refer to models adjusting for the variables in Model 1 plus waist-to-height ratio, waist circumference, or body mass index in 7 categories at 6 years, respectively.

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Table 4(a) - Relative risks (and 95% confidence intervals) for cardiovascular disease according to waist-to-height ratio and age among men

	Waist-to-Height Ratio Quintiles				
	<0.50	**0.50-<0.52**	**0.52-<0.54**	**0.54-<0.58**	**≥0.58**
Age <60 years	1892	1700	1508	1444	1383
No. of cases	56	65	81	78	109
Model 1* (n=7840)	1.00	1.24 (0.86–1.77)	1.59 (1.13–2.25)	1.61 (1.14–2.29)	2.20 (1.57–3.07)
−2logL=6752					
Age ≥60 years	1390	1574	1712	1852	1877
No. of cases	141	166	223	267	319
Model 1* (n=8307)	1.00	1.00 (0.79–1.25)	1.18 (0.96–1.47)	1.33 (1.08–1.64)	1.57 (1.28–1.92)
−2logL = 19209					
	Body Mass Index Quintiles (kg/m2)				
	<22.8	**22.8-<24.3**	**24.3-<25.6**	**25.6-<27.4**	**≥27.4**
Age <60 years	1454	1534	1644	1618	1677
No. of cases	41	62	73	87	126
Model 1* (n=7840)	1.00	1.39 (0.94–2.07)	1.50 (1.02–2.21)	1.71 (1.18–2.49)	2.30 (1.61–3.29)
−2logL = 6751					
Age ≥60 years	1839	1702	1623	1674	1567
No. of cases	222	200	214	230	250
Model 1* (n=8307)	1.00	1.05 (0.87–1.28)	1.15 (0.95–1.40)	1.29 (1.07–1.56)	1.58 (1.31–1.91)
−2logL = 19213					

Table 4(b) - Relative risks (and 95% confidence intervals) for cardiovascular disease according to waist-to-height ratio and age among women

	Waist-to-Height Ratio Quintile				
	<0.47	**0.47-<0.52**	**0.52-<0.56**	**0.56-<0.62**	**≥0.62**
Age <60 years	4018	3736	3457	3327	3442
No. of cases	13	17	18	28	36
Model 1*(n=17,973)	1.00	1.25 (0.60–2.57)	1.38 (0.67–2.83)	2.06 (1.06–4.01)	2.44 (1.27–4.68)
−2logL = 2058					
Age >60 years	2466	2847	3080	3234	3093
No. of cases	31	45	63	78	85
Model 1*(n=14,709)	1.00	1.24 (0.78–1.96)	1.60 (1.03–2.46)	1.91 (1.26–2.92)	2.15 (1.41–3.28)
−2logL= 5570					
	Body Mass Index Quintiles (kg/m^2)				
	<22.5	**22.5-<24.7**	**24.7-<27.1**	**27.1-<30.7**	**≥30.7**
Age <60 years	3492	3543	3438	3562	3945
No. of cases	8	15	24	27	38
Model 1*(n=17,973)	1.00	1.77 (0.75–4.19)	2.79 (1.25–6.23)	2.93 (1.32–6.50)	3.55 (1.63–7.73)
−2logL = 2054					
Age ≥60 years	3044	2960	3137	3016	2563
No. of cases	54	51	57	73	67
Model 1*(n=14,709)	1.00	1.13 (0.77–1.66)	1.22 (0.83–1.78)	1.67 (1.16–2.40)	1.93 (1.32–2.81)
−2logL = 5572					

*Model 1 adjusts for age, physical activity, smoking, alcohol consumption, and parental history of myocardial infarction before the age of 60 years. *P*-value from LRT comparing age-adjusted models with and without interaction terms between age (</≥60 years) and WHtR (quintiles) = 0.26.

*Model 1 adjusts for age, physical activity, smoking, alcohol consumption, parental history of myocardial infarction before the age of 60 years, postmenopausal hormone use, race, education, and dietary factors. *P*-value from LRT comparing age-adjusted models with and without interaction terms between age (</≥60 years) and WHtR (quintiles) = 0.70