

# Differences in Cardiovascular Disease Mortality Associated With Body Mass Between Black and White Persons

Jill E. Abell, PhD, MPH, Brent M. Egan, MD, Peter W. F. Wilson, MD, Stuart Lipsitz, ScD, Robert F. Woolson, PhD, and Daniel T. Lackland, DrPH

We analyzed cardiovascular disease mortality risks associated with obesity using participant-level meta-analysis of data from the Black Pooling Project for Black and White individuals. The adjusted relative risks (ARRs) were stronger among White participants than among Black participants for coronary heart disease AAR=1.21 (95% confidence interval [CI]=1.07, 1.36) versus 0.87 (95% CI=0.69, 1.09), respectively, and cardiovascular disease ARR=1.18 (95% CI=1.07, 1.29) versus 0.91 (95% CI=0.77, 1.05), respectively. The results suggest that obesity is an independent risk factor in White people, and additional study of body size and disease progression is necessary in the assessment of racial disparities. (*Am J Public Health*. 2008;98:XXX-XXX. doi:10.2105/AJPH.2006.093781)

Increased body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) has been associated with increased risks for cardiovascular disease.<sup>1-4</sup> Likewise, the racial disparities in obesity, cardiovascular disease, and stroke have left Black patients with a particularly heavy disease burden.<sup>5-7</sup> However, the disease risks attributed to obesity are inconsistent and less clear for Black individuals than for White individuals.<sup>1,3,4,8-22</sup> The association between obesity and cardiovascular disease is limited because of the relative paucity of long-term follow-up outcomes for Black men and women. We examined the association between BMI and

coronary heart disease (CHD), stroke, and cardiovascular disease mortality by reviewing data from the Black Pooling Project, which includes more than 450 000 person-years of follow-up.

## METHODS

### Data Source

The Black Pooling Project includes participant-level data on 27 691 persons (4853 Black and 22 838 White) from 4 studies: Evans County Heart Study, Charleston Heart Study, and National Health and Nutrition Examination Survey I and II (NHANES I and II). Baseline values, collected between 1960 and 1980, included height, weight, blood pressure, cholesterol, diabetes status, and smoking status.<sup>23-27</sup> Mortality follow-up ranged from 15 to 30 years and included more than

450 000 person-years (82 893 Black and 368 069 White).

### Analysis

We used 3 Cox proportional hazards regression models to calculate the relative risk of CHD, stroke, and cardiovascular disease mortality associated with obesity (BMI  $\geq 30$  kg/m<sup>2</sup>), with normal weight (BMI = 18.5–24.9 kg/m<sup>2</sup>) as the referent group. The covariates in each of these models were chosen a priori. Model 1 was adjusted for age; model 2 for age and smoking status; and model 3 for age, smoking status, hypertension, cholesterol, and diabetes. We ran these models for each race group (Black and White) and each gender in both race groups (Black and White men and women) separately in each of the 4 cohorts and then pooled

**TABLE 1—Sample Characteristics for Black and White Women and Men: Black Pooling Project**

	Black			White		
	Total	Women	Men	Total	Women	Men
Total sample, No.	4853	2843	2010	22 838	12 739	10 099
Deaths, No. (%)						
Cardiovascular disease deaths	1165 (24)	636 (22)	529 (26)	3738 (16)	1654 (13)	2084 (21)
Coronary heart disease deaths	569 (12)	297 (10)	272 (14)	2388 (10)	980 (8)	1408 (14)
Stroke deaths	302 (6)	174 (6)	128 (6)	631 (3)	343 (3)	288 (3)
Person-years	82 893	50 881	32 012	368 069	215 400	152 669
Age, y, mean (SD)	51.1 (14)	50.1 (14)	52.7 (14)	51.3 (14)	50.4 (15)	52.4 (14)
Blood pressure, mm Hg, mean (SD)						
Systolic blood pressure	148 (32)	149 (34)	147 (29)	134 (23)	133 (25)	136 (21)
Diastolic blood pressure	91 (16)	90 (16)	92 (16)	83 (12)	82 (12)	85 (12)
Cholesterol, mg/dL, mean (SD)	220 (48)	223 (49)	216 (46)	224 (48)	227 (51)	221 (45)
BMI, <sup>a</sup> %						
Underweight	4	5	4	4	4	3
Normal weight	38	31	48	47	51	42
Overweight	32	31	34	34	27	43
Obese	17	21	11	11	12	11
Morbidly obese	9	13	3	4	6	2
Diabetes, %	6	7	5	4	4	4
Smoking status, %						
Nonsmoker	54	66	36	46	59	29
Former smoker	9	6	13	21	13	31
Current smoker	37	28	51	33	28	40

<sup>a</sup>BMI = body mass index; weight in kilograms divided by height in meters squared, Underweight was defined as <18.5 kg/m<sup>2</sup>, normal weight as 18.5–24.9 kg/m<sup>2</sup>, overweight as 25–29.9 kg/m<sup>2</sup>, obese as 30–34.9 kg/m<sup>2</sup>, and morbidly obese as  $\geq 35$  kg/m<sup>2</sup>.

them according to participant-level meta-analysis to obtain an overall estimate. We tested the racial differences in the association between obesity and mortality with a z statistic—calculated as the difference in the estimated regression coefficients for obesity in Black and White individuals divided by the standard error of the difference.

**RESULTS**

Table 1 presents descriptive characteristics of participants in the Black Pooling Project.

Among White persons, obesity was independently associated with CHD, stroke, and cardiovascular disease mortality in models 1 and 2 and with CHD and cardiovascular disease mortality in model 3 (Table 2). In model 2, which controlled for age and smoking, obesity had a significantly stronger association with CHD ( $P=.002$ ), stroke ( $P=.012$ ), and cardiovascular disease ( $P<.001$ ) mortality among White individuals than among Black individuals. Similar results were obtained when the association between obesity and CHD, stroke, and cardiovascular disease mortality was calculated for each gender–race group.

Given that a previous report suggested that cardiovascular disease risk begins at a higher BMI for Black than for White individuals,<sup>21,28</sup> we also examined risk associated with morbid obesity ( $BMI \geq 35 \text{ kg/m}^2$ ). Among Black individuals, morbid obesity was not independently associated with cardiovascular disease mortality (relative risk [RR]=1.09; 95% confidence interval [CI]=0.89, 1.36), whereas among White individuals, the risk of cardiovascular disease mortality increased further (RR=1.51; 95% CI=1.29, 1.76).

**DISCUSSION**

Although significant differences in body size and cardiovascular disease mortality have been confirmed between Black and White persons, the association between obesity and mortality remains inconsistent. The Black Pooling Project enhanced the findings of previous studies that suggested that the risk of death associated with a high BMI is

**TABLE 2—Relative Risk (RRs) and 95% Confidence Intervals (CIs) of Coronary Heart Disease (CHD), Stroke, and Total Cardiovascular Disease Mortality Associated With Obesity Among Black and White Men and Women: Black Pooling Project**

	CHD, RR (95% CI)	Stroke, RR (95% CI)	Cardiovascular Disease, RR (95% CI)
<b>Total population</b>			
Model 1			
Blacks	1.12 (0.91, 1.38)	0.81 (0.61, 1.09)	0.97 (0.84, 1.12)
Whites	1.33 <sup>a</sup> (1.19, 1.48)	1.33 <sup>a</sup> (1.08, 1.65)	1.34 <sup>a</sup> (1.22, 1.46)
Model 2			
Blacks	1.01 (0.81, 1.26)	0.84 (0.63, 1.13)	1.02 (0.88, 1.20)
Whites	1.50 <sup>a</sup> (1.34, 1.69)	1.40 <sup>a</sup> (1.12, 1.73)	1.48 <sup>a</sup> (1.35, 1.62)
Model 3			
Blacks	0.87 (0.69, 1.09)	0.84 (0.61, 1.16)	0.91 (0.77, 1.05)
Whites	1.21 <sup>a</sup> (1.07, 1.36)	1.14 (0.91, 1.44)	1.18 <sup>a</sup> (1.07, 1.29)
<b>Women</b>			
Model 1			
Blacks	1.21 (0.90, 1.61)	0.98 (0.68, 1.43)	1.12 (0.93, 1.36)
Whites	1.55 <sup>a</sup> (1.32, 1.81)	1.37 <sup>a</sup> (1.04, 1.81)	1.52 <sup>a</sup> (1.34, 1.72)
Model 2			
Blacks	1.18 (0.88, 1.60)	1.08 (0.73, 1.60)	1.14 (0.94, 1.39)
Whites	1.67 <sup>a</sup> (1.42, 1.97)	1.42 <sup>a</sup> (1.07, 1.60)	1.61 <sup>a</sup> (1.42, 1.82)
Model 3			
Blacks	1.03 (0.76, 1.42)	0.96 (0.64, 1.45)	1.02 (0.83, 1.25)
Whites	1.32 <sup>a</sup> (1.12, 1.57)	1.15 (0.85, 1.54)	1.27 <sup>a</sup> (1.12, 1.45)
<b>Men</b>			
Model 1			
Blacks	0.94 (0.65, 1.34)	0.73 (0.40, 1.33)	0.96 (0.74, 1.24)
Whites	1.32 <sup>a</sup> (1.12, 1.54)	1.46 <sup>a</sup> (1.04, 2.07)	1.32 <sup>a</sup> (1.16, 1.51)
Model 2			
Blacks	0.96 (0.65, 1.40)	0.74 (0.39, 1.40)	0.99 (0.76, 1.31)
Whites	1.43 <sup>a</sup> (1.21, 1.69)	1.50 <sup>a</sup> (1.05, 2.14)	1.42 <sup>a</sup> (1.24, 1.63)
Model 3			
Blacks	0.86 (0.57, 1.28)	0.65 (0.34, 1.25)	0.88 (0.66, 1.17)
Whites	1.18 <sup>a</sup> (1.00, 1.41)	1.23 (0.85, 1.78)	1.16 <sup>a</sup> (1.01, 1.34)

Note. Model 1 was adjusted for age. Model 2 was adjusted for age and smoking status. Model 3 was adjusted for age, smoking status, cholesterol, diabetes, and hypertension. Obese was defined as having a body mass index (weight in kilograms divided by height in meters squared) as 30.0–34.9 kg/m<sup>2</sup>.  
<sup>a</sup> $P = .05$ .

stronger among White than among Black people<sup>1,12</sup> by identifying a significantly greater association between obesity and CHD, stroke, and cardiovascular disease mortality among White individuals. Among White participants, obesity was independently associated with CHD, stroke, and cardiovascular disease mortality after adjustment for age and for age and smoking, and with CHD and cardiovascular disease mortality

after adjustment for multiple comorbid risk factors. The association between obesity and stroke among White participants was attenuated in the fully adjusted model; however, the association remained significant when hypertension was removed from the model.

These results were limited by several factors, including the lack of data on body fat pattern, particularly measures of waist

circumference and abdominal visceral fat, which have been shown to be strongly associated with cardiovascular disease mortality.<sup>14,29,30</sup> This study was also limited by the use of only baseline measures for BMI and other covariates. This analysis was limited to CHD, stroke, and cardiovascular disease mortality and did not consider competing causes of mortality.

These findings confirm a stronger association between BMI and CHD, stroke, and cardiovascular disease mortality among White than among Black individuals. Nonetheless, obesity should be considered a significant risk factor for both Black and White people, and weight loss and management strategies should be used to reduce the racial disparities in cardiovascular disease. Clearly, comorbid conditions, including hypertension and diabetes, are strongly associated with obesity and have significant racial differences in severity and prevalence. Nonetheless, our results suggested that obesity does not explain the racial disparities in CHD, stroke, and cardiovascular disease. Additional longitudinal studies are needed to investigate the mechanisms of obesity and cardiovascular disease progression as well as the risks attributed to race in disease outcomes. Likewise, the results of this long-term follow-up study support the implementation of public health intervention strategies targeting all segments of the population. ■

### About the Authors

At the time of the study, Jill E. Abell, Brent M. Egan, Peter W.F. Wilson, Robert F. Woolson, and Daniel T. Lackland were with the Medical University of South Carolina, Charleston. Stuart Lipsitz was with Medical University of South Carolina, Charleston, and Harvard University, Boston, Mass.

Requests for reprints should be sent to Daniel T. Lackland, DrPH, Medical University of South Carolina, Department of Biostatistics, Bioinformatics, and Epidemiology, 135 Cannon St, Charleston, SC 29401 (e-mail: lackland@musc.edu).

This brief was accepted March 27, 2007.

### Contributors

J.E. Abell developed the data analysis plan, performed all data analysis, and drafted and reviewed the brief. B.M. Egan assisted with the interpretation of the data and writing of the brief. P.W.F. Wilson assisted with the interpretation of the data. R.F. Woolson and S. Lipsitz provided statistical expertise. D.T. Lackland assisted with study origination and interpretation of the data.

### Acknowledgments

This work was supported by a predoctoral fellowship from the American Heart Association. The Black Pooling Project was funded by the National Institutes of Health (grant 1R01HL072377).

**Note.** All analyses, interpretations, and conclusions based on data from the National Center for Health Statistics were made by the authors only.

### Human Participant Protection

This study was approved by the Medical University of South Carolina institutional review board.

### References

1. Calle EE, Thun MJ, Petrelli JM, Rodriguez C, Heath CW Jr. Body-mass index and mortality in a prospective cohort of US adults. *N Engl J Med*. 1999;341:1097–1105.
2. D'Agostino R, Grundy S, Sullivan L, Wilson P. Validation of the Framingham coronary heart disease prediction scores. *JAMA*. 2001;286:180–187.
3. Hubert HB, Feinleib M, McNamara PM, Castelli WP. Obesity as an independent risk factor for cardiovascular disease: a 26-year follow-up of participants in the Framingham Heart Study. *Circulation*. 1983;67:968–977.
4. Garrison RJ, Castelli WP. Weight and thirty-year mortality of men in the Framingham Study. *Ann Intern Med*. 1985;103(6 pt 2):1006–1009.
5. Barnett E, Casper ML, Halverson JA, et al. *Men and Heart Disease: An Atlas of Racial and Ethnic Disparities in Mortality*. Morgantown: Office for Social Environment and Health Research, West Virginia University; 2001.
6. Casper ML, Barnett E, Williams GI Jr, Halverson JA, Braham VE, Greenlund KJ. *Atlas of Stroke Mortality: Racial, Ethnic and Geographic Disparities in the United States*. Atlanta, Ga: Centers for Disease Control and Prevention; 2003.
7. Casper ML, Barnett E, Halverson JA, et al. *Women and Heart Disease: An Atlas of Racial and Ethnic Disparities in Mortality*. Morgantown: Office for Social Environment and Health Research, West Virginia University; 2000.
8. Kim KS, Owen WL, Williams D, Adams-Campbell LL. A comparison between BMI and Conicity index on predicting coronary heart disease: the Framingham Heart Study. *Ann Epidemiol*. 2000;10:424–431.
9. Stevens J, Keil J, Rust PF, Tyroler HA, Davis CE, Gazes PC. Body mass index and body girths as predictors of mortality in Black and White women. *Arch Intern Med*. 1992;152:1257–1262.
10. Kurth T, Gaziano JM, Berger K, et al. Body mass index and the risk of stroke in men. *Arch Intern Med*. 2002;162:2557–2562.
11. Harmsen P, Rosengren A, Tsiogianni A, Wilhelmson L. Risk factors for stroke in middle-aged men in Goteborg, Sweden. *Stroke*. 1990;21:223–229.
12. Stevens J, Plankey MW, Williamson DF, et al. The body mass index-mortality relationship in white and African American women. *Obes Res*. 1998;6:268–277.
13. McGee DL. Diverse population collaboration: body mass index and mortality: a meta-analysis based on person-level data from twenty-six observational studies. *Ann Epidemiol*. 2005;15:87–97.
14. Klein S, Burke LE, Bray GA, et al. Clinical implications of obesity with specific focus on cardiovascular disease: a statement for professionals from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism: endorsed by the American College of Cardiology Foundation. *Circulation*. 2004;110:2952–2967.
15. Troiano RP, Frongillo EA Jr, Sobal J, Levitsky DA. The relationship between body weight and mortality: a quantitative analysis of combined information from existing studies. *Int J Obes Relat Metab Disord*. 1996;20:63–75.
16. Manson JE, Willett WC, Stampfer MJ, et al. Body weight and mortality among women. *N Engl J Med*. 1995;333:677–685.
17. Dyer AR, Stamler J, Garside DB, Greenland P. Long-term consequences of body mass index for cardiovascular mortality: the Chicago Heart Association Detection Project in Industry study. *Ann Epidemiol*. 2004;14:101–108.
18. Rexrode KM, Hennekens CH, Willett WC, et al. A prospective study of body mass index, weight change, and risk of stroke in women. *JAMA*. 1997;277:1539–1545.
19. Durazo-arvizu R, McGee D, Li Z, Cooper R. Establishing the nadir of the body mass index-mortality relationship: a case study. *J Am Stat Assoc*. 1997;92:1, 312–319.
20. Durazo-Arvizu RA, McGee DL, Cooper RS, et al. Mortality and optimal body mass index in a sample of the US population. *Am J Epidemiol*. 1998;147:739–749.
21. Durazo-Arvizu R, Cooper RS, Luke A, Prewitt TE, Liao Y, McGee DL. Relative weight and mortality in US Blacks and Whites: findings from representative national population samples. *Ann Epidemiol*. 1997;7:383–395.
22. Sanchez AM, Reed DR, Price RA. Reduced mortality associated with body mass index (BMI) in African Americans relative to Caucasians. *Ethn Dis*. 2000;10:24–30.
23. Keil J, Sutherland S, Knapp R, Lackland D, Gazes P, Tyroler H. Mortality rates and risk factors for coronary disease in Black as compared with White men and women. *N Engl J Med*. 1993;329:73–78.
24. Cornoni JC, Waller LE, Cassel JC, Tyroler HA, Hames CG. The incidence study—study design and methods. *Arch Intern Med*. 1971;128:896–900.
25. Johnson J, Heineman E, Heiss G, Hames C, Tyroler H. Cardiovascular disease risk factors and mortality among Black and White women aged 40–64 years in Evans County, Georgia. *Am J Epidemiol*. 1986;123:209–220.
26. Keil J, Sutherland S, Hames C, et al. Coronary disease mortality and risk factors in Black and White men. *Arch Intern Med*. 1995;155:1521–1527.
27. *National Health and Nutrition Examination Survey Data*. Hyattsville, Md: National Center for Health Statistics; 2006.

28. *Clinical Guidelines on the Identification, Evaluation and Treatment of Overweight and Obesity in Adults: The Evidence Report*. Bethesda, Md: National Heart, Lung, and Blood Institute; 1998.
29. Kuk JL, Katzmarzyk PT, Nichaman MZ, Church TS, Blair SN, Ross R. Visceral fat is an independent predictor of all-cause mortality in men. *Obes Res*. 2006;14:336–341.
30. Okosun IS, Tedders SH, Choi S, Dever GE. Abdominal adiposity values associated with established body mass indexes in White, Black and Hispanic Americans: a study from the Third National Health and Nutrition Examination Survey. *Int J Obes Relat Metab Disord*. 2000;24:1279–1285.