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BODY MASS AND CARDIOVASCULAR REACTIVITY TO RACISM IN AFRICAN AMERICAN COLLEGE STUDENTS

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Objective: The purpose of the present study was to examine the effects of body mass on cardiovascular reactivity to racism in African American college students.

Design and Methods: Cardiac output, stroke volume, heart rate and blood pressure were measured as participants viewed a racially noxious scene on videotape. Body mass was measured using body mass index calculated using height and weight. We hypothesized that obese individuals would have greater cardiovascular reactivity to the scene than overweight individuals or individuals with normal weight. We also hypothesized that obese women would have the greatest cardiovascular reactivity to the scenes compared to overweight and normal weight women, and obese, overweight, and normal weight men. Lastly, we hypothesized that women would have greater cardiovascular reactivity than their male counterparts.

Results: Multivariate analysis of variance revealed that obese participants had significantly greater stroke volume and cardiac output than participants of normal weight, indicating that obese participants were less emotionally aroused by the stressor. There was also a significant interaction between sex and body mass for heart rate reactivity between the stressor and recovery periods. Obese women had the largest drop in heart rate, while obese men had the smallest drop from the stressor period to the recovery period.

Conclusions: The findings revealed that obese participants were less aroused by the stressors and recovered from them more quickly than overweight participants and participants of normal weight. The frequent experiences of weight prejudices by the obese group may have desensitized them to other prejudices such as the racial intolerance shown in the stressor. (*Ethn Dis*. 2009;19:2–6)

Key Words: Body Mass, Cardiovascular Reactivity, Racially Noxious Stressor

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INTRODUCTION

In 2005 and 2006, 33% of adult men and 35% of adult women in the United States were obese. While obesity rates did not significantly differ among African American men and White men, African American women had the greatest prevalence of obesity (51%) of any ethnic group in the country.[1,2] In addition to their obesity rates, African American women also are at a risk of experiencing psychological stress.[3] Stress has been associated with body weight, and those who experience high levels of stress are most likely to be overweight or obese.[4–6]

Cardiovascular hyperactivity to stress has been associated with increased cholesterol levels,[7] increased body mass, and high levels of central adiposity.[7,8] Participants with high levels of central adiposity who were subjected to stress had higher heart rates and systolic and diastolic blood pressures in response to the stress.[9] Similar findings were reported among adolescent participants, in whom greater levels of waist circumference were associated with higher blood pressure reactivity.[10] While psychological stressors in general can contribute to the metabolic syndrome, racial stressors cause increases in cardiovascular and metabolic responses as well.[11–16] In one study, while BMI and weight were not significantly related to internalized racism, a form of intra-group racism, waist circumference was positively correlated with internalized racism in girls.[15] In addition, girls with high levels of internalized racism had a higher risk of insulin resistance than did their male counterparts. Whereas few studies have examined the relationship between body mass and attitudes toward racism, no studies to date have examined the effects of body mass on cardiovascular reactivity to a racially noxious stressor.

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Obesity as a Risk Factor of Cardiovascular Disease

Obesity is a major risk factor for cardiovascular diseases such as heart disease, hypertension and stroke. One primary reason for these associations is the metabolic syndrome, a cluster of cardiovascular risk factors associated with insulin resistance.[17–19] Insulin, a hormone produced by the pancreas, keeps glucose levels controlled by assisting the cells with the conversion of blood glucose to energy. For many overweight and obese people however, the body no longer recognizes insulin and becomes insulin resistant. Insulin resistance results when the muscle, fat, and liver cells cannot use insulin efficiently. The excess insulin and blood glucose that is not converted into energy lead to cardiovascular diseases.[17–21]

Racial stressors have been shown to elicit cardiovascular hyperactivity in African Americans, and examining mediators such as body mass will improve our understanding of the underlying mechanisms of this relationship. To this end, we examined the ability of body mass to mediate cardiovascular reactivity to racism in African American men and women. Cardiovascular indices were measured as the participants viewed a racially noxious scene and a neutral scene on videotape. We proposed the following hypotheses: 1) obese individuals have more cardiovascular reactivity to racism than do people who are not obese; 2) obese women have the most cardiovascular reactivity; and 3) women in general have more cardiovascular reactivity than do men.

Table 1. Means and standard deviations for cardiovascular indices and body mass index*

	Females (*n* = 33)	Males (*n* = 15)	All Participants (*N* = 48)
Heart rate (bpm)	74.6 (9.5)†	68.2 (11.2)	73.0 (10.1)
Stroke volume (mL)	73.47 (11.95)	87.75 (12.73)	79.9 (14.89)
Cardiac output (L/mm)	5.73 (.86)	6.02 (.73)	5.93 (.91)
Systolic blood pressure (mm Hg)	116.4 (13.47)	118.3 (7.44)	116.9 (12.12)
Diastolic blood pressure (mm Hg)	63.7 (8.00)	57.4 (6.68)	63.2 (8.69)
Body mass index (kg/m^2)	26.23 (5.09)	27.9 (5.37)	26.75 (5.19)

*Collapsed across periods and scenes.
†Standard deviations in parentheses.

METHODS

Forty-eight African American college students (15 men and 33 women) aged 18–25 years (average of 19 years) participated in this study. All participants were screened for cardiovascular disorders and prescription medications that could interfere with the functioning of the cardiovascular system. Students who were under the age of 18 or those who had cardiovascular disorders and were taking prescribed medications were not allowed to participate in the study. The participants were recruited from a university in the Southeast. All participants volunteered to be in the study and were treated in accordance with the American Psychological Association ethical guidelines. The university's institutional review board approved the study protocol.

A Pulsewave CR 2000 cardiovascular profiling instrument (Hypertension Diagnostics, Inc, Eagan, Minnesota) was used to noninvasively assess body mass index (BMI) and cardiovascular responses (heart rate, cardiac output, stroke volume, systolic and diastolic blood pressure). A videotaped scene depicting racism and a neutral scene were used in this study. The racially noxious scene showed people telling the story of the beating of Emmett Louis Till and showed pictures of him before the beating. Emmett Till, a 14 year-old African American boy, was brutally beaten and killed by White men in Money, Mississippi in 1955 for saying 'bye baby' to a White woman. The murder of Emmett Till propelled the Civil Rights Movement. The neutral scene showed children playing on a city street. Cardiovascular reactivity was measured as the participants viewed the two videotape scenes. The scenes were counterbalanced so that each scene was seen first and second an equal number of times. Samples were taken before each scene (pre-stressor period), during the scenes (stressor period), and while the participant recovered from the scenes (recovery period). Each period lasted two minutes, and measurements were taken 20 seconds into the period. BMI was classified into three categories based on the guidelines of the Department of Health and Human Services:[22] normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), and obese (BMI $\geq$30 kg/m^2).

A multivariate analysis of variance was used to examine the effects of body mass (obese, overweight, normal) and sex (men, women) on each cardiovascular index. Reactivity to the stressor was also obtained by determining the difference between the pre-stressor and the stressor periods. Reactivity during recovery was obtained by determining the difference between the stressor and the recovery periods. A second multivariate analysis of variance was used to examine the effects of body mass and sex on each cardiovascular index between the pre-stressor and stressor periods and between the stressor and recovery periods.

RESULTS

BMI and Cardiovascular Reactivity to the Scenes

See Table 1 for overall means collapsed across periods and scenes. Our first hypothesis suggested that obese individuals would have greater cardiovascular reactivity to the scenes, particularly the racially noxious scene, than overweight individuals or individuals with normal weight. While there were no significant differences in stroke volume and cardiac output for BMI across the scenes, there were significant differences in these indices within the scenes. For example, within the racially noxious scene, we observed a significant effect for BMI on stroke volume during the stressor period [$F(2,36)=3.88$, $P<.05$] and cardiac output during the stressor period [$F(2,36)=6.34$, $P<.01$] collapsed across sexes. A Tukey post hoc test revealed that obese and overweight participants had greater stroke volume and cardiac output as they viewed the scenes than did participants of a normal weight.

Table 2. Stroke volume and cardiac output means for levels of BMI* during the prestressor (baseline) and stressor periods†

	Racially Noxious Scene		Neutral Scene	
	Pre-stressor	Stressor Period	Pre-stressor	Stressor Period
Stroke Volume (mL)				
Normal	71.86 (10.97)‡	72.8 (10.89)	71.93 (12.23)	74.6 (9.91)
Overweight	85.6 (11.6)	85.5 (14.2)	83.6 (14.2)	80.9 (16.3)
Obese	86.1 (17.2)	85.0 (18.3)	86.1 (17.2)	89.1 (13.4)
Cardiac Output (L/mm)				
Normal	5.6 (.68)	5.4 (.50)	6.15 (.90)	5.50 (.60)
Overweight	5.9 (.86)	6.0 (.98)	6.15 (.90)	6.11 (.91)
Obese	6.5 (.54)	6.4 (.58)	6.4 (.63)	6.55 (.57)

*normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), and obese (BMI ≥30 kg/m^2).
†Collapsed across sexes
‡Standard deviations are in parentheses

Table 3. Mean differences in heart rate and for BMI* and sex during the neutral scene

	Stressor-Recovery Period	
	Male (*n* =15)	Female (*n* =33)
Heart Rate (bpm)		
Normal	7.00 (11.53)*	−1.00† (6.72)
Overweight	.33 (2.08)	4.29 (7.54)
Obese	−1.00 (6.86)	25.83 (20.76)

*Standard deviations are in parentheses.
†Negative values indicate that the heart rate values were less in the stressor period than the recovery period

For the neutral scene, there was a significant main effect for BMI [Wilkes Lambda (12)=.506, $P<.05$], which indicated a robust effect size. BMI had a significant effect on cardiac output during the stressor period [$F(2,36)=5.32$, $P<.01$] (collapsed across sexes). Tukey post hoc test revealed that obese participants and overweight participants had significantly greater cardiac output than did participants of normal weight, which indicates that obese and overweight participants were less emotionally aroused by the stressor. The stroke volume and cardiac output means are in Table 2. BMI did not have a significant effect on heart rate and blood pressure reactivity.

BMI, Sex and Cardiovascular Reactivity to the Scenes

The second hypothesis stated that obese women would have the greatest cardiovascular reactivity to the scenes. To test this hypothesis, a multivariate analysis of variance was used to examine the effects of body weight (obese, overweight, normal) and sex (men, women) on each cardiovascular index between the pre-stressor and stressor periods and between the stressor and recovery periods. Contrary to the hypothesis, we observed a significant interaction between sex and BMI for heart rate [$F(2,29)=5.99$, $P<.01$] reactivity between the stressor and recovery periods. Specifically, obese women had the largest drop in heart rate, while obese men had the smallest drop from the stressor period to the recovery period. There were no significant main or interaction effects for systolic blood pressure between the stressor and recovery periods. We also observed a significant interaction between sex and BMI for systolic blood pressure [$F(2,33)=3.83$, $P<.05$] between the pre-stressor and stressor periods of the neutral scene. There were no significant main or interaction effects in heart rate between the prestressor and stressor periods. See mean differences in heart rate for BMI and sex in Table 3 and mean differences in systolic blood pressure for BMI and sex in Table 4. The findings revealed that women who were overweight showed the largest decrease in blood pressure, while men who were overweight show the largest increase in blood pressure. These findings revealed that overweight and obese women recovered from the racial stressor more quickly than overweight and obese men.

Table 4. Mean differences in systolic blood pressure for BMI and sex in the neutral scene

	Pre-stressor – Stressor Period	
	Male	Female
Systolic blood pressure (mm Hg)		
Normal	1.5 (2.52)*	.53 (4.77)
Overweight	−33.25† (56.54)	3.27 (5.93)
Obese	−11.58 (33.73)	−3.33 (12.01)

*Standard deviations are in parentheses
†Negative values indicate that the systolic blood pressure values were less in the pre-stressor period than the stressor period

Sex and Cardiovascular Reactivity to the Scenes

Our third hypothesis stated that women participants would have greater cardiovascular reactivity to the scenes than their male counterparts. For the racist stress condition, we found a main effect for sex [Wilkes Lambda (6)=.654, $P<.05$]. The significant univariate effects for sex showed that women participants had higher diastolic blood pressures [$F(1,35)=4.54$, $P<.05$]

In response to the scenes, obese participants had greater stroke volume and cardiac output than did participants of normal weight.

and faster heart rates during the stressor period [$F(1,35)=12.29$, $P<.01$] than did men. This finding also held true for stroke volume [$F(1,35)=4.67$, $P<05$], which indicated that men were less stressed by the racially noxious scene than women.

For the neutral condition, there was a significant main effect for sex [Wilkes Lambda (6)=.411, $P<.01$]. Sex had a significant effect on diastolic blood pressure, heart rate, and stroke volume during the stressor period of this condition. Specifically, women had higher diastolic blood pressures [$F(1,36)=9.18$, $P<.01$] and faster heart rates [$F(1,36)=10.81$, $P<.01$] than men. In the same vein, men had significantly greater stroke volume [$F(1,36)=8.84$, $P<.05$] during the neutral scene, which shows that the men were less stressed by the scene than were the women.

DISCUSSION

In response to the scenes, obese participants had greater stroke volume and cardiac output than did participants of normal weight. Unexpectedly, obese participants appeared less stressed by the scenes than were participants of normal weight. The high levels of cardiac output and stroke volume responses to the racially noxious scene by obese participants indicate that their body responded effectively to the stressor as opposed to participants of normal weight. This finding may be attributed to the racially noxious stressor. Since obese and overweight individuals tend to experience weight prejudices more often that their normal-weight counterparts,[23] they may be desensitized to other forms of prejudices such as the racial intolerance shown in the scene.

The second major finding showed that women had higher diastolic blood pressures, faster heart rates, and less stroke volume in response to the scenes compared with men. Increases in reactivity in women may have occurred because women are more likely to empathize with people who are victimized by racial discrimination. Along these lines, a study that examined the ability of sex to mediate the effects of corporal punishment on empathy found that women reported feeling significantly more empathy than men.[24] When BMI was included in the equation, sex differences in cardiovascular reactivity were reversed.

The last major finding revealed an interaction between sex and BMI for heart rate reactivity between the stressor and recovery periods of the racially noxious scene. This finding revealed that obese women recovered from the racially noxious stressor more quickly than did obese men. There was also an interaction between sex and BMI for systolic blood pressure between the pre-stressor and stressor periods of the neutral scene. This finding revealed that women who were overweight had a decrease in blood pressure from the pre-stressor to stressor periods, while men who were overweight showed an increase in blood pressure between these periods. These results are consistent with earlier findings that showed that obese women appeared to be less stressed and recovered more quickly from the stressor than did women of normal weight and obese, overweight, and normal-weight men. Since obese women encounter weight discrimination and prejudices more than any other group,[23] they may habituate to other types of discrimination more readily.

Limitations of the Study

A limitation of the study was that insulin resistance and central adiposity were not measured. Since insulin resistance and central adiposity are risk factors for cardiovascular disease,[25] they may also affect the way the cardiac and vascular systems react to racism. Future studies should examine the effects of these two conditions on cardiovascular reactivity to racism.

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AUTHOR CONTRIBUTIONS

Design concept of study: Clark
Acquisition of data: Clark
Data analysis and interpretation: Clark, Hill
Manuscript draft: Clark, Hill
Statistical expertise: Hill
Supervision: Clark