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Weight Status and Blood Pressure among Adolescent African American Males: The Jackson Heart KIDS Pilot Study

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Background: Obesity had not been considered a significant factor contributing to high levels of hypertension among African American males until recently. Epidemiologic research on heart disease among males has primarily focused on adults; however, the significant rise in obesity and hypertension prevalence among African American boys indicates that studies examining the relationship between excess body weight and elevated blood pressure among this high-risk population are critically needed. The purpose of our study was to examine the degree to which weight status has implications for elevated blood pressure among young African American males.

Method: The data for this cross-sectional study were drawn from adolescent males (N=105), aged 12-19 years and who participated in the Jackson Heart KIDS Pilot Study – an offspring cohort study examining cardiovascular disease risks among adolescent descendants of Jackson Heart Study participants. Blood pressure was the primary outcome of interest and weight status was a key independent variable. Other covariates were fruit and vegetable consumption, physical activity, sleep, and stress.

Results: Approximately 49% of adolescent males in the study were overweight or obese. Bivariate and multiple variable analyses suggest that obesity may be correlated with elevated diastolic blood pressure (DBP) levels among African American boys. Results from ordinary least squared regression analysis indicate that the DBP for boys carrying excess weight was 4.2 mm Hg (P<.01) higher than the corresponding DBP for their normal weight counterparts, after controlling for age, fruit and vegetable consumption, physical activity, and sleep.

Conclusions: Additional studies are needed to specify the manner through which excess weight and weight gain can accelerate the development and progression of CVD-related diseases among African American males over the life course, thereby providing evidenced-based information for tailored interventions that can reduce risks for premature morbidity, disability, and mortality among this group. *Ethn Dis*. 2015;25(3):305-312.

Key Words: Jackson Heart KIDS Pilot Study, African American Adolescent Boys, Cardiovascular Risk, Offspring Cohort Study, Population Health, Blood Pressure

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Introduction

High blood pressure is a common medical disorder that can have major implications for morbidity, disability, and mortality. This condition is particularly salient for African Americans as the prevalence of hypertension for this group is among the highest in the world.[1] While the rates of hypertension are higher among African American women than among African American men,[2] the rates of hypertension attributable to abdominal obesity is higher in African American men than African American women.[2,3] Hypertension is particularly salient for African American men as they are 1.5 times more likely to be hypertensive than White men.[1] Evidence suggests that these disparities may be persistent across the life course as studies have noted that college-age African American men are twice as likely to have hypertension than their White counterparts.[4] Research is less definitive about disparities among younger populations of males; however, recent epidemiologic evidence suggests that this line of research is critically needed.[5] High blood pressure among children and adolescents is a growing problem[6] that could have major implications for individuals, their families and communities over the life course. Early onset of hypertension can be associated with earlier initiation of burdensome chronic conditions such as coronary heart disease, heart failure, diabetes and chronic kidney disease.[7] It has been suggested that African American males

develop risk factors for hypertension and hypertension-related conditions earlier than other subpopulations,[1,8] thereby exacerbating already elevated risks for poor health outcomes.

Obesity has been identified as a major risk factor for hypertension and there has been a concomitant rise in hypertension and obesity over the past two decades.[7] Family history has been cited as an important risk factor for hypertension and obesity as both of these conditions have been linked to genetic, biochemical, behavioral, social and environmental factors shared across generations.[9,10] The multiple pathways leading to hypertension and obesity can each involve components from genetic, biological, psychological, and social environments.

The relationship between obesity and hypertension has garnered the attention of researchers as it has been suggested that the combination of obesity and hypertension can be insidious because of a heightened risk for cardiovascular sequelae.[11,12] There have been a few studies examining the relationship between obesity and blood pressure in children;[13-16] however, studies examining the relationship between excess weight and elevated blood pressure among African American boys and adolescents have been largely absent from the scientific literature. We found one study with data on obesity and its relationship with high blood pressure among African American boys and adolescents;[15] however, the data were decades old. Understanding the relationship between excess weight and elevated blood pressure among young African American males is salient given the significant increase in the proportion of this population that is overweight or obese.[17] Furthermore, this age group can provide insight into a key period in the life course that may clarify biological, behavioral, psychosocial and social processes to modify risk behaviors to impede weight gain and subsequently delay onset of disease.[18,19] Studies have shown that obesity can amplify risks for disease progression and complications; therefore, research investigating the relationship between obesity and blood pressure among groups with already elevated risks for cardiovascular disease is important.[20] The purpose of our study was to examine the degree to which weight status during adolescence can be associated with elevated blood pressure among young African American males in the Jackson Heart KIDS Pilot Study (JHS-KIDS), an observational investigation of cardiovascular disease (CVD) risks among adolescents who were children and grandchildren of participants in the Jackson Heart Study (JHS), the largest single-site cohort study of CVD among African Americans.[21,22]

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Methods

Data from this study were drawn from the JHS-KIDS Pilot Study, a prospective feasibility study of African American youth in the greater Jackson, Mississippi area to examine sensitive developmental and transition periods and their associations in the development of obesity, metabolic and CVD-related risk factors. Eligible participants for the study were adolescents aged 12-19 years and were either children or grandchildren of individuals enrolled in the Jackson Heart Study. Details about the JHS have been published elsewhere.[21,22] After receiving approval from the University of Mississippi Medical Center Institutional Review Board, the research team used multiple methods to recruit participants through contact with JHS participants (ie, informational letters, signage in the JHS exam center, and postcards distributed by JHS personnel). Interested parents or grandparents called the study phone number and answered screening questions to ensure eligibility. After confirming eligibility, a study visit was scheduled. Prior to beginning data collection, parents and adolescents were provided additional information about the pilot study and completed consent and assent forms. During a study visit, a parent or grandparent accompanying the child, regardless of their JHS partici-

pant status, and the child had their blood pressure, height, and weight and waist circumference measured. The total number of adolescents participating in the pilot study was 212 and almost half of the pilot study participants were male (*n*=105).

Participants were also asked to complete self-administered surveys during the study visit. Child participants completed a survey containing a number of measures including the Daily Hassles Adolescent Scale; nutrition, body weight and physical activity items from the Youth Risk Behavior Surveillance System; a media multi-tasking questionnaire; the Robinson Sedentary Behaviors Questionnaire; a religiosity measure; questions about cyber bullying; and the Cleveland Adolescent Sleepiness Scale. The parent/grandparent present at the study visit completed the Child Feeding Questionnaire if the child participant lived with them.

Study Variables

Outcome Variables

Blood pressure was the primary outcome variable and comprised two measurements, systolic blood pressure (SBP) and diastolic blood pressure (DBP). SBP measured the pressure in the arteries when the heart beats and DBP indicated the pressure in the arteries between heartbeats.[23] Blood pressures readings were obtained by trained staff with a random zero sphygmomanometer. The SBP and DBP variables were derived from the average of three seated measurements with a five-minute rest period in between each reading.

Independent Variables

Weight status was a two-category (normal weight and overweight/obese) variable based on body mass index (BMI) cut points specified by the Childhood Obesity Working Group of the International Obesity Taskforce.[24] Participant height and weight were used to calculate BMI and were collected using a Shorr Height Measuring Board and a Seca 770 Model scale respectively. Two measurements were taken to ensure accuracy. A crude measure of BMI was calculated using the formula, BMI=weight in kilograms / height in meters^{2}. Comparing anthropometric measures like BMI from participants would be complicated by the fact that they were still growing.[24] As a result, BMI for this study was derived using an egen function in Stata that transformed crude data to z-scores using the LMS method that allows for the development of smoothed growth using the curves and the efficient calculation of z-scores simultaneously.[24,25] Z-scores were standardized to the reference population for participants' age and sex. The population-based reference data were the 2000 Centers for Disease Control and Prevention Growth Reference in the United States.[26,27] Overweight and obese classifications were merged for two reasons. First, a two-category variable could enhance the robustness of comparative analysis of data with limited power. Secondly, the treatment protocols for overweight adolescents have been generally similar to those for obese adolescents. Normal weight for children and adolescents between 2 and 18 years of age was defined as a BMI less than the 85th percentile of CDC growth chart. Adolescents with BMIs at or above the 85th percentile were classified as overweight/obese. The two weight status categories for study participants aged 19 were normal weight (BMI <25) and overweight/obese (BMI ≥ 25).

The covariates were based on self-report during the study visit. The fruit and vegetable consumption variable was derived from four items beginning with the prompt, "During the past 7 days, how many times did you eat…?" The words "fruit," "green salad," "carrots," and "other vegetables" completed each of questionnaire items, respectively. Response categories ranged from "I did not eat […] during the past 7 days" (coded 0) to "4 or more times per day" (coded 6). The physical activity measure was derived from the response to the question, "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?" The responses ranged from "0 days" (coded 0) to "7 days" (coded 6). The sleepiness score was a composite of the responses to 16 statements from the Cleveland Adolescent Sleepiness Scale.[28] Participants were asked to respond to statements such as "I fall asleep during my morning classes" by selecting one of five possible responses ranging from "never" (coded 0) to "almost every day" (coded 4). The Daily Hassles for Adolescents index was used to measure stress. Participants responded to 18 statements (eg, "trying to get good grades") by selecting one of five possible responses ranging from "not at all a hassle" (coded 0) to "very big hassle" (coded 4). Age (in years) was also included in the analysis.

Table 1. Distribution of characteristics of African American adolescent males in the Jackson Heart Study-KIDS Pilot Study for the total sample and by weight status

Variable	Overall sample *N*=105	Normal weight[a] *n*=54	Overweight/obese[a] *n*=51	*P*
Systolic blood pressure, mean, (SD)	117 (12.9)	116 (11.0)	118 (14.6)	.32
Diastolic blood pressure, mean (SD)	65.7 (9.2)	63.4 (7.4)	68.1 (10.3)	.008
Age, mean (SD)	15.1 (2.2)	14.9 (2.3)	15.3 (2.2)	.35
Fruit and vegetable consumption, mean (SD)	6.0 (4.4)	5.7 (4.2)	6.4 (4.7)	.44
Physical activity, mean (SD)	3.9 (2.3)	4.31 (2.4)	3.4 (2.2)	.07
Sleepiness, mean (SD)	19.9 (9.4)	19.0 (9.5)	20.7 (9.4)	.36
Adolescent hassles, mean (SD)	23.4 (10.5)	22.0 (10.1)	24.9 (10.9)	.16
Overweight/obese[a], %	48.5	--	--	

a. Normal, BMI < 85th Percentile; overweight/obese, BMI ≥ 85th Percentile.

Analytic Strategy

Sample characteristics were described for the total sample and by weight status strata using means and standard deviations for continuous variables and proportions for categorical variables. T-tests and Chi-square tests were used in descriptive analyses assessing how normal weight and overweight/obese males varied across key indicators. Multivariable ordinary least squares regression models were estimated to determine the impact of weight status on blood pressure adjusting for covariates. Models were conducted for the total sample and by weight status. *P* values <.05 were considered significant. All tests were two-sided. All statistical analyses were conducted with StataSE Version 12.

Results

Female participants were excluded from this analysis, leaving 105 African American adolescent males in the analytic sample. An overall descriptive profile of the study participants is presented in Table 1. The average SBP and DBP for males in this study were 117.4 ± 12.9 mm Hg and 65.7 ± 9.2 mm Hg, respectively. The mean age for males in this study was slightly over 15 years (15.1 ± 2.2). These adolescents did not eat fruit or vegetables daily (6.0 ± 4.4); however, they did report being physically active for at least 60 minutes for nearly 4 days per week (3.9 ± 2.3) on average. The African American males in this study also had an average sleepiness score (19.9 ± 9.4) that was less than the midpoint of total score continuum. The mean score for the adolescent hassles measure (23.4 ± 10.5) was also less than midpoint of total score continuum. The results in Table 1 indicate that normal-weight males in the study were similar to their heavier counterparts on every measure except DBP. The group of study participants who were overweight or obese had a mean DBP that was significantly greater than the corresponding mean for normal-weight adolescents.

Results from overall and weight status stratified models are presented in Table 2. The findings in the pooled model indicate that excess weight among adolescents is related to higher DBP. Adolescent males in the study who were overweight or obese had DBP that were 4.22 mm Hg (*P*<.01) higher than normal weight males, on average. Age was also significant in the pooled model. The results indicated that as each participant ages by one year, their DBP increases by 1.18 mm Hg (*P*<.01) on average. The other indicators in the model were not statistically significant; however, the results indicated that the relationships between the independent variables and DBP were in the expected direction in all but one case. The negative coefficient for the sleepiness score was suggestive of an inverse relationship between sleepiness and DBP.

The weight status stratified models were not particularly robust as only age was found to be significant in the model estimated for normal weight males in the study. In a manner similar to the overall model, age had a direct relationship with the outcome variable indicating that DBP increases as normal weight African American adolescent males grow older (β=1.18, *P*<.01). The other indicators in the weight status stratified models were not statistically significant; however, the direction of the relationships appeared to vary by weight status. The signs for coefficients in the model for overweight or obese adoles-

Table 2. Relationship between high blood pressure and health behavior factors among normal weight and overweight/obese African American adolescent males in the Jackson Heart Study-KIDS Pilot Study, *N*=105

Variable	All β (SE)	Normal weight β (SE)	Overweight/obese β (SE)
Overweight/obese	4.22 (1.76)[a]	--	--
Age	1.18 (.40)[a]	1.35 (.46)[a]	.81 (.68)
Fruit and vegetable consumption	-.05 (.20)	-.01 (.23)	-.011 (.32)
Physical activity	-.4 (.39)	.57 (.43)	-.70 (.69)
Sleepiness	-.01 (.1)	.06 (.11)	-.06 (.17)
Adolescent hassles	.002 (.09)	-.03 (.10)	.03 (.15)

a. $P<.01$

cents were consistent with those in the pooled model. The signs for the fruit and vegetable consumption, sleepiness, and adolescent hassles coefficients in the normal weight model were opposite those in the pooled and overweight/obese models.

Discussion

Atherosclerotic cardiovascular disease (CVD), the leading cause of death in the United States for Black males, begins in youth and the early stages of its development are related to known risk factors including hypertension and obesity.[7] Obesity is one of the leading yet most preventable causes of CVD and hypertension, yet few studies have considered unique determinants of obesity, obesogenic behaviors or chronic diseases associated with obesity across the life course of African American males.[29] Given the rise in obesity in the US population and particularly among men of color, and the high rates of premature mortality from heart disease and related health issues among African American men, it is critical to develop a better understanding of risk and protective factors for this population at different points in the life course.[30] In addition to the poor health profile of African American males, morbidity and mortality concerns can be intensified by the financial burdens associated with treating and managing chronic disease.[19] Recent studies have shown that the annual cost for treating a kidney failure patient on hemodialysis, for example, is $82,000.[31] Projected costs of treating cardiovascular diseases are expected to exceed $800 billion by 2030.[32] The considerable social and financial implications associated with hypertension-related diseases underscore the need for scientists to give attention to high blood pressure risks earlier in the life course, particularly in such a high-risk population.

Pathologic studies indicate that the presence of multiple risk factors accelerate the development of disease[33-35] and recent increases in prevalence of high blood pressure and/or obesity among young African American males indicate that the poor health prospects for African American men could worsen. A more refined understanding of the relationship between elevated blood pressure and excess body weight among African American adolescent males is critical; however, few studies have explored the relationship between these risk factors. Knowledge about the manner in which these risk factors interact during youth to contribute to premature disease initiation and accelerated progression of disease among African American males over the life course is limited.[36] Yet, a life course approach is needed because it provides the opportunity to identify factors that are associated with weight gain and allow the opportunity to examine the impact of weight gain on blood pressure over time.[37]

Data from a small sample of males participating in a pilot study of African American adolescent males were analyzed to explore the relationship between weight status and high blood pressure. Nearly half of the males in our study were overweight or obese. The proportion of individuals in our study carrying excess weight was greater than the corresponding proportion of African American males in a recent national sample.[38] The size of our study population is too small to draw conclusions about these differences; however, it is noteworthy that individuals in this study were either sons or grandsons of JHS participants who had been enrolled in an observational study in which information about CVD risks, including obesity, had been regularly disseminated. This highlights the complexity of address-

ing CVD risks, particularly obesity, at this point in the life course, especially because the participants' parents or grandparents have been well-educated about CVD risks. Further study about the intergenerational transmission of gendered ideals and determinants of CVD risk, particularly among African American males, is warranted. The few studies that have examined these issues have found that not only do African American men influence the attitudes and behaviors of African American boys and adolescents but these youth also influence the behavior of African American men.[39-41]

The results from our study indicate that weight status can have implications for blood pressure among African American adolescent males. There were no statistically significant differences in the SBP for normal weight and overweight or obese study participants. However, overweight or obese adolescent males were found to have a DBP, on average, that was 4.22 mm Hg greater than their normal weight counterparts, after controlling for age, behavioral factors and stress. The findings for SBP and DBP were consistent with those found in a recent study using data from The Bogalusa Study.[15] Additional research along these lines are warranted because DBP has been linked to isolated systolic hypertension, a hypertensive subtype predominant in adolescent and young adult males.[42]

Age was the only other variable found to be associated with DBP among our study participants. This relationship was not particularly surprising given that blood pressure rises through childhood until reaching normal thresholds in late adolescence.[43] The lack of model robustness was not particularly surprising given the small sample size; however, the direction of the relationships in the pooled model along with the potential weight status stratified model differences warrants further study.

…overweight or obese adolescent males were found to have a DBP, on average, that was 4.22 mm Hg greater than their normal weight counterparts

Study Limitations

Our study represents an initial step toward a greater understanding of the relationship between weight status and high blood pressure among young African American males and the implications of their interaction for health outcomes over the life course. There are some limitations worth noting. The analytic models were estimated using data drawn from a small sample of African American adolescent males who reside in the South and are descendants of individuals enrolled in a longitudinal study; therefore, the results are not generalizable to African American adolescent males or adolescent males in other geographic regions of the US or from other racial/ethnic groups. The models in this study were estimated using cross-sectional data, which does not allow for the specification of temporal events or determination of causal inferences. The small sample size limits the number of independent variables included in regression analysis, thereby limiting the number of factors considered. The usual limitations associated with self-report data, recall bias and social desirability, also apply to this study.[44]

Conclusion

This study provides a glimpse into the complex relationship between weight status and high blood pressure status among young African American males. Additional studies are needed to examine the degree to which social, psychological, and behavioral factors impact the association of weight status with high blood pressure. Research is also needed to specify the manner through which excess weight and weight gain can accelerate the development and progression of CVD-related diseases among African American males over the life course, thereby laying the foundation for tailored interventions that can reduce risks for premature morbidity, disability, and mortality among this group.

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Dr. Bruce earned a masters degree from Winston Salem State University and is a professor of Criminal Justice and Sociology at Jackson State University.

Dr. Thorpe earned a baccalaureate degree from Florida A&M University and is an alumnus of the NIA Summer Institute (currently the NIA Butler-Williams Scholars Program), the Summer Research Program at the Michigan Center for Urban African American Aging Research (MCUAAAR; P30-AG15281) and is a past recipient of Health Disparities Loan Repayment Program (L60 MD001407).

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Acquisition of data: Bruce, Beech
Data analysis and interpretation: Thorpe, Bruce
Manuscript draft: Bruce, Beech, Thorpe, Griffith
Statistical expertise: Thorpe, Bruce
Acquisition of funding: Bruce, Beech
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