SOCIODEMOGRAPHIC FACTORS AND OBESITY IN PREADOLESCENT BLACK AND WHITE GIRLS: NHLBI'S GROWTH AND HEALTH STUDY

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The association of sociodemographic and family composition data with obesity was studied in 1213 black and 1166 white girls, ages 9 and 10, enrolled in the National Heart, Lung, and Blood Institute's Growth and Health Study. Obesity was defined as body mass index at or greater than age- and sex-specific 85th percentile as outlined in the Second National Health and Nutrition Examination Survey. The prevalence of obesity was higher for pubertal girls than for prepubertal girls and for girls with older mothers/female guardians. An odds ratio of 1.14 was observed for each 5-year increase in maternal age. Obesity was less common for girls with more siblings; the odds for obesity decreased by 14% for each additional sibling in the household. In blacks, the prevalence of obesity was not related to parental employment or to parental education. In whites, the odds of obesity were higher for girls with no employed parent/guardian in the household and for girls with parents or guardians with lower levels of educational attainment. Examining the associations between sociodemographic factors and risk of childhood obesity provides important clues for understanding racial differences in obesity, a major risk factor for coronary heart disease. (*J Natl Med Assoc.* 1997;89:594-600.)

Key words: sociodemographic factors ◆ blacks ◆ child obesity

The cardiovascular disease mortality rate for black women is over twice that for white women.[1,2] Past research has implicated obesity as one possible cause of the increased cardiovascular disease mortality rate among black women.[3] Black women are about twice as likely as white women to be obese after age 20, and this higher prevalence of obesity is maintained throughout adulthood.[4] Although the role that obesity plays in increasing cardiovascular disease risk is not fully understood, it is strongly associated with known risk factors such as blood pressure, blood lipids, and diabetes.

There appears to be no preponderant direction in the association between socioeconomic status and obesity in children.[5] However, several studies report that socioeconomic factors including parental education and income are inversely associated with child-

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Table 1. Mean (±Standard Deviation) Anthropometric Measures and Differences by Age and Race*

			Differences	
	Blacks	Whites	Unadjusted	Adjusted
9 year olds	**n=531**	**n=613**		
Height (cm)	139.3±6.9	137.0±6.0	2.3†	1.0‡
Weight (kg)	36.2±9.4	33.1±7.3	3.1†	1.4‡
Body mass index (weight/height^2)	18.5±3.8	17.5±3.1	1.0†	0.5§
% obese‖	30.3	21.2		
10 year olds	**n=668**	**n=545**		
Height (cm)	145.8±7.5	142.5±7.0	3.3†	0.5
Weight (kg)	42.4±11.8	37.7±9.5	4.7†	1.1
Body mass index (weight/height^2)‡	19.8±4.5	18.4±3.5	1.4†	0.4
% obese‖	31.6	21.1		

*Unadjusted and adjusted for maturation stage.
†$P \leq .001$.
‡$P \leq .01$.
§$P \leq .05$.
‖Obesity is defined as body mass index (weight/height^2) ≥85th percentile of the Second National Health and Nutrition Examination Survey's (NHANES II) reference population of 9- and 10-year-old girls.

hood obesity.[6-8] The mechanisms of this association are unclear. Socioeconomic factors may act to influence other risk factors for obesity including diet, physical activity levels, and psychosocial and cultural patterns. Moreover, obese adolescents have been shown to have lower socioeconomic status as adults.[9] Other demographic factors rarely have been examined in these studies of childhood obesity.

The National Heart, Lung, and Blood Institute's Growth and Health Study (NGHS) is a multicenter prospective study of black and white girls designed to elucidate risk factors associated with the development of obesity and to investigate the effects of adiposity on other cardiovascular disease risk factors such as blood pressure and blood lipid levels. The NGHS was designed to include a broad range of socioeconomic levels for both races in three geographic areas of the United States. This article uses cross-sectional baseline data from the NGHS to examine sociodemographic factors in relation to obesity in 9- and 10-year old black and white girls. Little racial difference in the prevalence of obesity was expected at ages 9 and 10; this age range predates the onset of puberty in most girls.[10]

MATERIALS AND METHODS

Participants for the NGHS were recruited by three clinical centers: the University of California at Berkeley, Berkeley, California, the University of Cincinnati/Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, and Westat Inc, Rockville, Maryland. The Maryland Medical Research Institute in Baltimore, Maryland, serves as the study coordinating center.

Berkeley recruited 887 participants from public and parochial schools in the Richmond Unified School District area. Cincinnati recruited 871 participants from public and parochial schools located in the greater Cincinnati area. Westat recruited 621 girls from Group Health Association (currently Humana Group Health Plan), a Washington, DC, area health maintenance organization.

A girl was enrolled if:

- she declared herself to be either black or white,
- she was either 9 or 10 years of age (±2 weeks),
- she lived with parents or guardians who identified themselves as being of the same race as the girl, and
- her parent/guardian provided household demographic information as well as consent for the girl's participation.

Examination of the cohort included measurements of blood pressure, maturation stage, and anthropometry. In addition, girls completed questionnaires detailing their dietary intakes and patterns, physical activity patterns, psychosocial characteristics, medical history, and beliefs and attitudes about certain aspects of health.

Table 2. Prevalence of Obesity and Odds Ratios for Household Income and Maximum Parental Education by Race*

	Total		Whites			Blacks		
	No.	% Obese	No.	% Obese	Odds Ratio	No.	% Obese	Odds Ratio
Annual Household Income								
<$20,000	717	29.6	190	33.2	2.49†	527	28.3	0.83
$20,000-$39,999	692	27.9	358	23.2	1.52‡	334	32.9	1.04
≥$40,000	815	21.6	554	16.6	R_1	261	32.2	R_1
Maximum Parental Education								
≤High school	612	30.1	234	29.1	2.21†	378	30.7	0.96
Some college	917	28.8	348	25.0	1.80†	569	31.1	0.98
≥4 years of college	826	20.5	575	15.7	R_2	251	31.5	R_2

*Tests for interactions suggested odds ratios differed between blacks and whites; thus, odds ratios reported separately for each race.
†$P<.001$.
‡$P<.05$.
R_1 Reference group is ≥$40,000.
R_2 Reference group is ≥4 years of college.

Weight was measured to the nearest 10th of a kilogram, and height was measured to the nearest millimeter. Skinfolds were measured at the triceps, suprailiac, and subscapular sites using Holtain calipers. Sexual maturation was rated on a continuum from prepubertal (stage 1) to mature (stage 4), using areolar and pubic hair stages, and menarche. Maturation staging methods have been described in detail previously.[11,12] Additional information on study methods has been reported elsewhere.[13]

Parents/guardians provided information on age, family composition, parental education, employment status during the previous 12 months, and household income. For this article, household income was divided into three categories: <$20,000, $20,000 to $39,999, and ≥$40,000. Household income levels presented here were not adjusted for cost-of-living differences among the three clinical sites. Parental educational attainment was divided into the following categories: ≤high school, some college, and ≥4 years of college. Ages of mothers or female guardians were grouped into 5-year age periods: <31, 31 to 35, 36 to 40, 41 to 45, and >45 years.

Obesity was defined as body mass index (weight in kilograms divided by height in meters squared) ≥85th percentile of the Second National Health and Nutrition Examination Survey (NHANES II) reference population of 9- and 10-year-old girls: body mass index ≥19.6 for 9-year-old girls and body mass index ≥20.9 for 10-year-old girls.[4]

Statistical Analyses

Anthropometric measures by age were compared using analysis of variance techniques to adjust the age-specific race comparisons for maturation stage. To identify independent variables related to obesity, the statistical analysis examined the following predictor variables and potential racial differences:

- household income,
- maximum parental education,
- employment status,
- number of parents/guardians in the household,
- age of mother/female guardian, and
- number of siblings.

Initially, a separate logistic regression model with obesity as the outcome variable was fitted for each of the predictor variables which included race and predictor × race interaction.[14] Next, the multivariate relationship of obesity with the above predictors and race was examined using a multiple logistic analysis with a backwards stepwise approach. Maturation stage was included in the model because it is a potential confounder, having a strong association with both race and obesity. At first, race, all of the predictors, and all of the race × predictor interaction terms were included in the model. Then, nonsignificant interactions were deleted from the model. Predictor variables found to have a significant interaction with race

Table 3. Prevalence of Obesity and Odds Ratios for Employment Status and Number of Parents/Guardians in Household by Race*

	Total		Whites			Blacks		
	No.	% Obese	No.	% Obese	Odds Ratio	No.	% Obese	Odds Ratio
Employment Status								
Neither parent/ guardian employed	296	30.4	58	43.1	3.03†	238	27.3	0.80
One or both parents/ guardians employed	2061	25.6	1100	20.0	R_1	961	32.0	R_1
No. Parents/Guardians								
1	745	32.2	219	34.3	2.36†	526	31.4	1.03
2	1612	23.4	939	18.1	R_2	673	30.8	R_2

*Tests for interactions suggested odds ratios differed between blacks and whites; thus, odds ratios are reported separately for each race.
†$P<.001$.
R_1=reference group is one or both parents/guardians employed.
R_2=reference group is two parents/guardians.

and their respective interaction terms were retained in the model and a backwards stepwise analysis was performed to see which of the remaining main effect terms could be dropped from the model. All analyses were performed using SAS statistical software.[15]

RESULTS

Of the 2379 girls enrolled in the NGHS, 1213 were black and 1166 were white; 1155 were 9 years old and 1224 were 10 years old. More black girls than white were obese at both ages (Table 1). Black girls were more mature than white girls of the same age. Significantly more black girls had begun puberty than white girls of the same age: 49.5% versus 27.5% at age 9 and 78.3% versus 44.4% at age 10. Given the racial differences in sexual maturation, anthropometric differences are presented after adjustment by maturation stage. Unadjusted data for the 9- and 10-year-old girls showed that black girls were taller and heavier, with a greater body mass index. After adjustment for maturation and age, anthropometric differences between black and white girls were reduced or eliminated (Table 1).

Significant racial differences were present in the association of obesity with household income (Table 2). The prevalence of obesity among black girls was not related to household income while the prevalence of obesity among white girls was significantly higher in the lowest income category than at higher income levels. The odds that a white girl with a household income of <$20,000 would be obese were 2.5 times higher than the odds of obesity for a white girl with a household income >$40,000.

For black girls, there was no association between obesity and the maximum educational attainment level of the parents or guardians with whom they lived (Table 2). However, the prevalence of obesity for white girls was significantly higher in the lowest education categories. The odds that a white girl with parental education no higher than high school would be obese were 2.2 times higher than the odds of obesity for a white girl whose parents had ≥4 years of college.

No parent or guardian was employed in 19.8% of black households and 5% of white households (Table 3). Obesity in black girls was not related to the employment status of parents or guardians. However, the odds of being obese were three times higher for a white girl in a home without an employed parent/guardian than for a white girl who had an employed parent/guardian.

Nearly 44% of black girls and 19% of white girls lived in homes with a single parent or guardian (Table 3). Obesity in black girls was not related to the number of parents/guardians in the home, but white girls living in single-parent/guardian homes were 2.4 times more likely to be obese than those living with two parents/guardians.

For all girls, the prevalence of obesity increased with maternal/female guardian age (Table 4). In the univariate model, the odds of being obese

Table 4. Prevalence of Obesity for Age of Mother/Female Guardian and Number of Siblings by Race

	Total		White		Black	
	No.	% Obese	No.	% Obese	No.	% Obese
Age of Mother/Female Guardian (Years)*						
<31	449	24.1	151	19.9	298	26.2
31 to 35	655	26.3	298	22.5	357	29.4
36 to 40	730	25.1	415	19.0	315	33.0
41 to 45	313	26.5	198	20.7	115	36.5
>45	167	31.7	78	26.9	89	36.0
No. Siblings†						
0	457	32.6	191	29.3	266	35.0
1	923	26.7	524	21.0	399	34.1
2	601	24.1	277	20.2	324	27.5
≥3	376	20.5	166	13.9	210	25.7

*Odds ratio=1.09; $P<.05$. Odds ratio for each 5-year increment in age of mother/maternal guardian as a predictor of obesity. Black/white differences in these odds ratios were not significant; thus, only overall odds ratios are reported.
†Odds ratio=.84; $P<.001$. Odds ratio for each additional sibling as predictor for obesity. Black/white differences in these odds ratios were not significant; thus, only overall odds ratios are reported.

increased 9% with each additional 5-year increment in maternal age.

The number of siblings in the home was inversely related to obesity in girls of both races (Table 4). Obesity was significantly more common among girls without siblings. The odds for obesity were 60% higher for girls with no siblings than for girls living with ≥3 siblings.

A multiple logistic regression model was used to ascertain the independent influence of each variable on the prevalence of girls' obesity (Table 5). In addition to maturation stage, the model incorporated six sociodemographic predictor variables: household income, maximum parental education, employment status, number of parents/guardians in household, age of mother/female guardian, and number of siblings. Mother's age, number of siblings, and maturation stage were significant for both races. Maximum parental education level and employment status were significant for white girls only. Household income and number of parents/guardians were not significant for either race.

In the multiple logistic regression model, when controlling for the effect of the other independent variables, the following associations were found: girls of both races had an odds 2.6 times higher for being obese if they were pubertal compared with prepubertal girls. For both races, the odds ratio for obesity increased by 14.4% for every 5-year increase in the maternal guardian's age and the odds of being obese decreased by 14% for each additional sibling in the household.

The following associations were found for whites only. A girl living in a household without an employed adult was 2.5 times more likely to be obese than a girl living with one or more employed parents; a white girl whose parents' maximum education level was either high school or some college was about twice as likely to be obese as a girl with a parent having ≥4 years of college education (Table 5).

DISCUSSION

The inverse association between parental socioeconomic status and child obesity has been reported since 1969 for primarily white subjects.[16-18] Numerous studies, again of primarily white subjects, have documented an inverse association between family income and adult obesity.[5] The large Midtown study showed obesity prevalence in women to be inversely correlated with socioeconomic status (measured by occupation, education, income, and rent).[19]

We found no similar association of obesity with socioeconomic status in black girls; parental education, household income, and parental employment were not related to obesity. However, mother's age, maturation stage, and number of siblings were associ-

Table 5. Multiple Logistic Regression Model on the Relationship Between Sociodemographic Factors and Obesity by Race*

Variable	Odds Ratio$_{overall}$	*P* Value	Odds Ratio$_{black}$	*P* Value	Odds Ratio$_{white}$	*P* Value
Mother's age†	1.144	<.001				
Maturation stage‡	2.609	<.001				
No. of siblings§	0.862	<.001				
Employment status‖			1.041	0.833	2.494	<.01
Maximum education¶						
High school			0.993	0.972	2.051	<.001
Some college			1.129	0.497	1.873	<.001

*Tests for interaction suggested odds ratios differed between blacks and whites for employment status (*P*=.016) and education (*P*=.030). Accordingly, odds ratios are reported separately for blacks and whites for these variables.
†Odds for 5-year increase in age of mother/maternal guardian.
‡Reference group is prepuberty.
§Odds for one-level increase in number of siblings in household.
‖Reference group is one or both parents/guardians employed.
¶Reference group is 4+ years of college.

ated with both black and white girls' obesity in our univariate testing and remained significant in the multiple logistic regression model, indicating unique association of each with obesity. It is well-established that stage of maturation is related to obesity. Other studies have confirmed the higher risk for childhood obesity associated with first-born status[20] or have shown childhood obesity to be inversely related to the number of siblings in white girls.[17,21] Ours is the first to report a similar relationship for blacks. The finding that obesity increases with increasing maternal age for both races is particularly noteworthy. We can speculate that age of mother may affect attitudes toward food, parenting styles, and other family dynamics.

We found that white girls' obesity was independently associated with parental education and employment status. Although household income level and number of parents/guardians in the household were related to white girls' obesity in univariate testing, neither was associated with obesity after controlling for the other factors in the multiple logistic regression model. In another NGHS analysis of factors using a less extensive set of socioeconomic adjustment variables, Kimm et al[22] reported parental education not to be associated with obesity in black girls after adjustment for income. Although the current analysis found education but not income significant in a multivariate model, the findings are consistent that socioeconomic status, of which education and income assess different aspects, is inversely related to obesity in white girls only.

CONCLUSION

The finding that socioeconomic factors are not associated with obesity in black girls although they are in white girls suggests that our attention should be directed to the impact of other sociocultural factors and that we should be careful not to generalize based on racially limited samples. There may be differential influences by societal pressures for thinness, by societal stigmatization of obesity, and differential eating and activity behaviors for black and white girls. Our identification of different risk factors in black and white girls encourages us to examine more closely the cultural contexts within which children live and their varied effects on health behaviors and health outcomes. The NGHS will continue this examination as its cohort approaches early adulthood.

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Literature Cited

1. *Vital Statistics of the United States, 1980, Volume II, Mortality, Part A.* Washington, DC: Government Printing Office; 1985. US Dept of Health and Human Services publication (PHS) 85-1101.

2. *Vital Statistics of the United States, 1987, Volume II, Mortality, Part A.* Washington, DC: Government Printing Office; 1989. US

Dept of Health and Human Services publication (PHS) 89-1101.

3. Johnson JL, Heinemann EF, Heiss G, Hames LG, Tyroler HA. Cardiovascular disease risk factors and mortality among black women and white women aged 40-64 in Evans County, Georgia. *Am J Epidemiol.* 1986;123:209-226.

4. Anthropometric reference data and prevalence of overweight United States, 1976-1980. *Vital Health Stat Series 11.* 1987;238:12-13.

5. Sobal J, Stunkard AJ. Socioeconomic status and obesity: a review of the literature. *Psychol Bull.* 1989;105:260-275.

6. Moore ME, Stunkard A, Skole L. Obesity, social class, and mental illness. *JAMA* 1962;181:962-966.

7. Garn SM, Clark DC. Trends in fatness and the origins of obesity. *Pediatrics.* 1976;57:443-456.

8. Khoury PR, Morrison JA, Laskarzewski P, Kelly K, Mellies MJ, King P, et al. Relationship of education and occupation to coronary heart disease risk factors in school children and adults: the Princeton School District Study. *Am J Epidemiol.* 1981;113:378-395.

9. Gortmaker SL, Must A, Perrin JM, Sobol A, Dietz WH. Social and economic consequences of overweight in adolescence and young adulthood. *N Engl J Med.* 1993;239:1008-1037.

10. Campaigne BN. Indexes of obesity and comparisons with previous national survey data in 9- and 10-year-old black and white girls: the National Heart, Lung, and Blood Institute Growth and Health Study. *J Pediatr.* 1994;124:675-680.

11. Morrison JA, Barton B, Biro FM, Sprecher DL, Falkner F, Obarzanek E. Sexual maturation and obesity in 9 and 10 year old black and white females: the NHLBI Growth & Health Study. *J Pediatr.* 1994;124:6:889-895.

12. Biro FM, Falkner F, Khoury P, Morrison JA, Lucky AW. Areolar and breast staging in adolescent girls. *Journal of Adolescent and Pediatric Gynecology.* 1992;5:271-272.

13. NHLBI Growth & Health Study Research Group. Obesity and cardiovascular disease risk factors in black and white girls: the NHLBI Growth & Health Study. *Am J Public Health.* 1992;82:1613-1620.

14. Hosner DW, Leoneshow S. *Applied Logistic Regression.* New York, NY: John Wiley and Sons Inc; 1989:82-134.

15. SAS Institute Inc. *SAS/STAT User's Guide Version.* 6th ed. Cary, NC: SAS Institute Inc; 1989.

16. Huenemann RL. Factors associated with teenage obesity. In: Wilson NL, ed. *Obesity.* Philadelphia, Pa: FA Davis Co; 1969:55-66.

17. Whitelaw GL. Association of social class and sibling number with skinfold thickness in London school boys. *Hum Biol.* 1971;43:414-442.

18. Stunkard AJ, D'Aquill E, Fox S, Filion RDL. The influence of social class on obesity and thinness in children. *JAMA.* 1972; 221:579-584.

19. Goldblatt PB, Moore ME, Stunkard AJ. Social factors in obesity. *JAMA.* 1965;192:97-102.

20. Shapiro LR. In: Lauer RM, Shekelle RB, eds. *Cultural Factors in the Development of Obesity in Childhood Prevention of Atherosclerosis and Hypertension.* New York, NY: Raven Press; 1980:213-222.

21. Rona RJ, Chinn S. National Study of Health and Growth: social and family factors and obesity in primary school children. *Ann Hum Biol.* 1982;9:131-145.

22. Kimm SYS, Obarzanek E, Barton BA, Ashton CE, Similo SL, Morrison JA, et al. Race, socioeconomic status, and obesity in 9- to 10-year-old girls and their parents: the NHLBI Growth and Health Study. *Ann Epidemiol.* 1996;6:266:275.