Body Mass Index in Young Adults: Associations with Parental Body Size and Education in the CARDIA Study

Kurt J. Greenlund, PhD, Kiang Liu, PhD, Alan R. Dyer, PhD, Catarina I. Kiefe, PhD, MD, Gregory L. Burke, MD, MS, and Carla Yunis, MD, MPH

ABSTRACT

Objectives. Associations of parental education, parental body size, and offspring's education with body mass index and 7-year change in body mass index were examined among participants in the Coronary Artery Risk Development in Young Adults (CARDIA) study.

Methods. CARDIA is a study of coronary artery disease risk factors in 5115 Black and White persons aged 18 to 30 at baseline. Analyses of covariance were carried out with body mass index and change in body mass index as the dependent variables, and with parental education, parental body size, and participant education as the major independent variables.

Results. Father's body size was positively associated with participant's baseline body mass index among Black men, White men, and White women. Mother's body size was positively associated with baseline body mass index among all race–sex groups, and with change in body mass index among White women. Father's education was inversely associated with baseline body mass index among Black men and White women, and with change among White women.

Conclusions. Parental education may influence body mass index and changes in young adulthood, especially among White women. Such associations may be both genetic and environmental and may be important for obesity prevention efforts. (*Am J Public Health.* 1996;86:480–485)

Introduction

Obesity is a severe problem in the United States, one with numerous adverse health consequences. An inverse association between socioeconomic status (SES) and adiposity has been reported for women in industrialized countries.[1–14] Reported associations of SES with obesity and overweight have been inconsistent for men.[1,3,4,9–16]

Fatness in adults may be influenced by environmental factors related to SES in childhood as well as by genetic factors.[17–24] An association of parental SES with an adult offspring's adiposity may be through childhood nutrition or the influence of SES on behaviors such as physical activity, smoking, or alcohol consumption. Similarly, parental fatness and the adult child's adiposity may be associated through genetics or, again, through parent–child associations of behaviors influencing adiposity. Thus, to understand obesity in adulthood, it is important to examine family and childhood environmental factors.

Only a few studies have examined associations of parental fatness and SES with adiposity in adult offspring.[17,18,24–29] Parental weight and body mass index have been found to be positively correlated with that of their adult children.[18,24] An inverse association of parents' SES with their adult children's adiposity has also been noted, more strongly among women than among men and more apparent in young adulthood than in earlier childhood.[25,26] However, previous studies have not examined whether associations between parental SES and adult offspring adiposity are present in different ethnic groups. Also, few previous studies have examined whether the child's own socioeconomic achievement might mediate associations of adult adiposity with parental SES, which is important for public health policy.

For the present report, analyses were conducted to assess whether parental educational attainment, parental body shape, and offspring's education were associated with body mass index and change in body mass index over 7 years among participants in the Coronary Artery Risk Development in Young Adults (CARDIA) study.

Methods

Population

CARDIA is a longitudinal study of the development of coronary artery disease risk factors in young adults. The study design and sample characteristics have been described elsewhere.[30] Briefly, 5115 adults, aged 18 to 30 years at baseline (1985–1986), were recruited from four centers (Birmingham, Ala; Chicago, Ill; Minneapolis, Minn; and Oakland, Calif). Within each center, the sample was

Kurt J. Greenlund was and Kiang Liu and Alan R. Dyer are with the Department of Preventive Medicine, Northwestern University Medical School, Chicago, Ill; Dr Greenlund is currently with the Tulane School of Public Health and Tropical Medicine, New Orleans, La. Catarina I. Kiefe is with the Division of Preventive Medicine, University of Alabama at Birmingham. Gregory L. Burke is with the Department of Public Health Sciences, Bowman Gray School of Medicine, Winston-Salem, NC. Carla Yunis is with the Division of General and Preventive Medicine, University of Minnesota, Minneapolis.

Requests for reprints should be sent to Kiang Liu, PhD, Northwestern University Medical School, Department of Preventive Medicine, 680 N Lake Shore Dr, Suite 1102, Chicago, IL 60611.

This paper was accepted August 21, 1995.

designed to include approximately equal numbers of participants by age group (18 to 24, 25 to 30), educational level (up to high school, beyond high school), ethnicity (Black, White), and sex. Participants were randomly recruited, chiefly through telephone contact (door-to-door contact in some areas of Minneapolis), from the total community or from census tract areas (except in Oakland, where participants were recruited from a health plan membership roster). Once a subgroup based on sex, race, age, and education was filled, further potential participants were ineligible. Participants were reexamined at 2 (1987–1988), 5 (1990–1991), and 7 years (1992–1993) after the baseline examination and as closely as possible to the original calendar date of examination. For the longitudinal sample used here, mean follow-up was exactly 7 years (range = 6.0 to 8.1 years).

Height and weight were measured without shoes and with light clothing. Body mass index was calculated as weight in kilograms divided by height in meters squared (kg/m^2). The difference between year 7 and baseline body mass index was used to measure change in body mass index.

Socioeconomic Indicators

Of three commonly used indices of SES (education, occupation, income), education is the most frequently used and is correlated with many health-related factors.[31,32] Father's education was obtained from participant reports of the number of years of schooling completed by the participant's father or male head of the family; mother's education was recorded similarly. Participants' education was recorded at the baseline examination (used here) and at each follow-up. For this report, parent and participant educational level was grouped as less than 12 years, 12 years (completed high school), 13 to 15 years, and 16 years and more.

In social mobility research, family SES is usually tied to the father's education (or occupation). However, a substantial number of respondents, especially among the Black participants, did not know their father's education (see results). Fewer respondents did not know the educational attainment of their mother. Further, it was not known how many individuals might have grown up in single-parent households. Thus, associations of both the father's and mother's education with the participant's body mass index and 7-year change in body mass index were analyzed.

TABLE 1—Means and Percentage Levels for Selected Descriptive Characteristics: The CARDIA Study

	Black Men	Black Women	White Men	White Women
Sample size	1157	1480	1171	1307
Baseline body mass index, kg/m^2				
Mean	24.6	25.9	24.3	23.1
SD	4.3	6.5	3.6	4.4
7-year change in body mass index, kg/m^2				
Mean	2.4	3.0	1.8	1.8
SD	2.5	3.6	2.1	3.1
No.	819	1100	1001	1055
Baseline weight, kg				
Mean	76.9	69.2	77.0	62.8
SD	15.1	18.7	12.9	12.6
Change in weight,[1] kg				
Mean	8.0	8.7	5.9	5.3
SD	8.0	9.8	6.7	8.4
No.	819	1100	1001	1055
Baseline education, y				
Mean	12.9	13.1	14.6	14.5
SD	1.9	1.8	2.5	2.3
Father's education, y				
Mean	11.6	11.6	14.3	14.2
SD	3.1	3.3	3.4	3.5
No.	842	1043	1080	1194
Mother's education, y				
Mean	12.5	12.2	13.7	13.5
SD	2.5	2.6	2.7	2.8
No.	1026	1320	1103	1260
Father's body size, %				
1–3 (thinnest)	18.8	26.2	14.1	19.7
4–6	74.0	66.1	75.8	69.7
7–9 (heaviest)	7.2	7.7	10.1	10.5
No.	1090	1391	1131	1262
Mother's body size, %				
1–3 (thinnest)	21.4	23.3	24.7	25.5
4–6	70.9	64.6	68.5	67.7
7–9 (heaviest)	7.7	12.1	6.8	6.8
No.	1139	1458	1147	1287

Sociodemographic data were reported on a male head of household for about 7% of Black participants and 4% of White participants. Sociodemographic data were reported on a female head of household for about 3% of Black participants and 1% of White participants. Data were not obtained on more than one male or female head of household, or on how long parents or heads of household lived with the children.

Parental Body Size and Other Measures

Parental fatness was based on participant reports of parental body size. Using a common body image scale depicting nine mannequin figures progressing from thin to obese,[33–36] participants were asked to record their natural mother's and father's body size during most of the participant's childhood. For these analyses, the nine categories were collapsed to three levels: 1 to 3 (thinnest), 4 to 6, and 7 to 9 (heaviest). Parental body size was recorded only for the natural parents.

Other covariates related to adiposity[1,37–41] considered here were the participant's baseline smoking status, alcohol intake, and physical activity. Current smoking status was derived from self- and interviewer-administered questions regarding whether the participant currently, formerly, or never smoked cigarettes.[42] Alcohol intake was derived from interviewer-administered questions on whether the participant drank any alcohol within the previous year. The average amount of absolute alcohol per day was recorded in milliliters.[43] Total physical activity was

TABLE 2—Participants' Adjusted[a] Mean Body Mass Indexes and Changes in Body Mass Index from Baseline to Year 7, by Father's Educational Level: The CARDIA Study

Father's Education	Black Men	Black Women	White Men	White Women
Participant's baseline body mass index, kg/m²				
No.	805	998	1047	1156
<12 y	25.6	26.8	24.6	24.6
12 y	25.0	26.5	25.0	23.4
13–15 y	26.0	26.7	24.6	23.8
16+ y	24.4	25.3	24.7	22.8
P	.03	.13	.64	.0001
df	3;793	3;986	3;1035	3;1144
Participant's 7-year change in body mass index, kg/m²				
No.	591	760	905	937
<12 y	2.61	2.97	1.86	2.40
12 y	2.42	3.17	1.78	2.63
13–15 y	2.12	2.82	1.79	2.57
16+ y	2.23	2.60	1.78	1.89
P	.54	.49	.99	.01
df	3;578	3;747	3;892	3;924

[a]Means are adjusted for father's and mother's body size and for participant's baseline age and education. Means for 7-year change in body mass index are also adjusted for baseline body mass index. Probability (*P*) is from analysis of covariance (F test).

TABLE 3—Participants' Adjusted[a] Mean Body Mass Indexes and Changes in Body Mass Index from Baseline to Year 7, by Father's Body Size: The CARDIA Study

Father's Body Size	Black Men	Black Women	White Men	White Women
Participant's baseline body mass index, kg/m²				
No.	805	998	1047	1156
1–3 (thinnest)	24.8	25.5	24.1	22.7
4–6	24.5	26.2	24.3	24.0
7–9 (heaviest)	26.5	27.3	25.8	24.2
P	.007	.08	.0001	.0002
df	2;793	2;986	2;1035	2;1144
Participant's 7-year change in body mass index, kg/m²				
No.	591	760	905	937
1–3 (thinnest)	1.83	2.76	1.60	2.60
4–6	2.33	2.81	1.75	2.35
7–9 (heaviest)	2.88	3.10	2.05	2.18
P	.06	.78	.28	.48
df	2;578	2;747	2;892	2;924

[a]Means are adjusted for father's education, mother's body size, and participant's baseline age and education. Means for 7-year change in body mass index are also adjusted for baseline body mass index. Probability (*P*) is from analysis of covariance (F test).

obtained with a physical activity history questionnaire designed for CARDIA, assessing the various types and intensity of activity done over the previous year.[44,45]

Statistical Analyses

Analyses of covariance were conducted with SAS statistical software.[46] Major independent variables were parental education, parental body size, and participant education, entered as categorical (ordinal) variables. Dependent variables were participant body mass index and change in body mass index over 7 years. All analyses were race- and sex-specific. An alpha of .05 was used to determine statistical significance in two-tailed tests.

Analyses were conducted with adjustment for participant age only, with adjustment for age and all main independent variables (parent's education, parent's body size, and participant's education), and lastly with adjustment for age, all main independent variables, and other possible confounders (smoking, alcohol consumption, and physical activity level). Models assessing the 7-year body mass index differential also included baseline body mass index as a covariate. Cross-sectional analyses were conducted on both baseline and year 7 data. Associations with mother's and father's body size were assessed both separately and jointly, as was also done for mother's and father's education.

Analyses took into account data in which parental body size was that of a natural parent, but parental education was that of a step-parent. This situation occurred for about 7% of Black participants and about 3% of White participants in cross-sectional and longitudinal (6% of Black women) analyses.

Results

Sample Characteristics

Black women had the highest baseline body mass index and the greatest 7-year change in body mass index (Table 1). The parents of Black participants had a lower mean educational level than those of White participants. A greater percentage of White participants' fathers were in the heaviest body size category compared with fathers of Black participants, while the reverse was true for Black participants' mothers compared with mothers of White participants.

Twenty-seven percent of Black men and 30% of Black women reported that they did not know their father's education, compared with 8% and 9% of White men and women, respectively. Those not knowing their father's education had a lower educational level (12.4 vs 14.1 years) and were more likely to be current smokers (43.7% vs 27.4%). There were no significant differences in baseline body mass index or weight adjusted for height between those knowing and those not knowing their father's education. A slightly greater 7-year increase in body mass index occurred among White women who did not know their father's education compared with those who did (2.6 vs 1.7 kg/m²), whereas a slightly lower 7-year weight gain was observed among Black men who did not know their father's education compared with those who did (7.0 vs 8.4 kg).

Parental Education

With adjustment for major independent variables, significant associations between father's educational level and participant's baseline body mass index were observed among Black men and White women (Table 2). Differences in participant body mass index between the lowest and highest parental education groups were 1.2 kg/m^2 among Black men and 1.8 kg/m^2 among White women. Father's education was associated with a 7-year difference in body mass index among White women only, with a difference of 0.51 kg/m^2 between the lowest and highest education groups. Associations were primarily due to those with the highest parental education having a lower body mass index or change than those in the other categories. Further adjustment for smoking, alcohol consumption, and physical activity level yielded similar results (not shown). In analyses adjusted for age only (not shown), father's education was also associated with baseline body mass index among Black women ($P = .04$).

In similar models in which father's education was replaced by mother's education (and with those participants with unknown father's education included), only the association with a 7-year change in body mass index among White women was significant ($P < .05$; not shown). Mother's education did not contribute additional explanatory value when included with father's education.

Parental Body Size

Father's body size was positively associated with body mass index among Black men, White men, and White women (Table 3). Similar though statistically nonsignificant trends were also noted among Black women. Differences in participant body mass index between the leanest and heaviest parental body size categories were 1.7 kg/m^2 for Black men, 1.8 kg/m^2 for Black women, 1.7 kg/m^2 for White men, and 1.5 kg/m^2 for White women. Trends were similar in analyses adjusted for age only and analyses adjusted for other lifestyle factors (not shown).

Mother's body size (Table 4) was positively associated with body mass index among all four race-sex groups, and with a change in body mass index among White women. Differences in participant body mass index between the leanest and heaviest maternal body size categories were 1.5 kg/m^2 for Black men, 3.7 kg/m^2 for Black women, 1.2 kg/m^2 for White men, and 2.2 kg/m^2 for White women. For the change in body mass index among White women, a difference of 1.44 kg/m^2 between the leanest and heaviest maternal body size categories was noted. When adjusted for age only, a positive association with change in body mass index among Black men and Black women ($P \leq .02$) was also observed (not shown). When adjusted for smoking, alcohol intake, and physical activity level (not

TABLE 4—Participants' Adjusted[a] Mean Body Mass Indexes and Changes in Body Mass Index from Baseline to Year 7, by Mother's Body Size: The CARDIA Study

Mother's Body Size	Black Men	Black Women	White Men	White Women
Participant's baseline body mass index, kg/m^2				
No.	805	998	1047	1156
1–3 (thinnest)	24.4	24.8	24.2	22.6
4–6	25.5	25.8	24.6	23.5
7–9 (heaviest)	25.9	28.5	25.4	24.8
P	.01	.0001	.03	.0001
df	2;793	2;986	2;1035	2;1144
Participant's 7-year change in body mass index, kg/m^2				
No.	591	760	905	937
1–3 (thinnest)	2.09	2.61	1.69	1.75
4–6	2.40	3.03	1.91	2.18
7–9 (heaviest)	2.54	3.04	1.81	3.19
P	.43	.36	.39	.004
df	2;578	2;747	2;892	2;924

[a]Means are adjusted for father's body size, father's education, and participant's baseline age and education. Means for 7-year change in body mass index are also adjusted for baseline body mass index. Probability (*P*) is from analysis of covariance (F test).

TABLE 5—Participants' Adjusted[a] Mean Body Mass Indexes and Changes in Body Mass Index from Baseline to Year 7, by Participant's Educational Level: The CARDIA Study

Participant's Education	Black Men	Black Women	White Men	White Women
Participant's baseline body mass index, kg/m^2				
No.	805	998	1047	1156
<12 y	24.9	27.0	24.9	23.7
12 y	24.9	26.2	24.6	24.2
13–15 y	25.4	26.3	24.9	23.7
16+ y	25.8	25.9	24.6	22.9
P	.26	.66	.59	.003
df	3;793	3;986	3;1035	3;1144
Participant's 7-year change in body mass index, kg/m^2				
No.	591	760	905	937
<12 y	1.91	3.00	1.93	3.22
12 y	2.40	3.10	1.75	2.27
13–15 y	2.70	3.11	1.94	2.17
16+ y	2.36	2.37	1.59	1.84
P	.16	.21	.19	.09
df	3;578	3;747	3;892	3;924

[a]Means are adjusted for father's and mother's body size, father's education, and participant's baseline age. Means for 7-year change in body mass index are also adjusted for baseline body mass index. Probability (*P*) is from analysis of covariance (F test).

shown), results were similar to those reported.

Participant Education

In an earlier CARDIA paper, participant education was noted to be inversely related to body mass index among White women, and a slight positive association was noted among Black men.[13] When adjusted for father's education and parental body size, only the association with body mass index among White women was significant (a difference of 0.8 kg/m^2 between the highest and lowest education groups), although the positive trend among Black men was still observed (Table 5).

The substitution of education at year 7 for baseline education (when most participants would have completed schooling) showed significant associations with body mass index at baseline and at year 7 among White men and women ($P \leq .01$), and with change in body mass index among White women. For these analyses, those participants with the highest education had the lowest body mass index and change in body mass index over 7 years.

Other Results

When those participants reporting education data for a step-parent were excluded from analyses, associations of parental education and parental body size with participant body mass index and change in body mass index were similar to those reported (not shown). Additionally, the association of father's body size with baseline body mass index among Black women became statistically significant ($P = .02$).

In cross-sectional analyses with body mass index at year 7 as the dependent variable (not shown), associations with parental education, parental body size, and participant education were similar to those reported here. An inverse association between father's education and year 7 body mass index among Black women ($P = .03$) was also noted after adjustment for smoking, alcohol intake, and physical activity level.

Analyses were also conducted with weight and weight change as the dependent variables, with height as a covariate in addition to those covariates already noted (not shown). Analyses yielded similar results to those reported for body mass index and change in body mass index, with similar significant and nonsignificant associations with the independent variables.

Discussion

Several previous studies have reported inverse associations between SES and obesity and weight gain, more consistently for women than for men.[1–16] Inverse associations of subjects' education with obesity have been reported among Black women.[3,6,8] A statistically nonsignificant inverse association of education with body mass index was observed among Black women in CARDIA. This discrepancy may reflect different sampling methods or adjustment for covariates. Also, education is only one indicator of SES. Years of education do not reflect the quality of education received, which will influence how well education reflects SES. Whether occupation or income as indicators of SES had an association with body mass index or change in body mass index was not examined.

Fewer studies have examined associations of parents' SES with their young adult offspring's adiposity. In CARDIA, father's education was inversely related to body mass index in White women and Black men, and with a 7-year change in body mass index among White women. These associations were independent of the participant's own education and lifestyle behaviors associated with weight (smoking, alcohol use, and physical activity). These results are in agreement with those of earlier studies reporting inverse associations between parental SES and obesity in adult offspring.[17,25–27,29]

Caution should be taken regarding associations of father's education with body mass index. A substantial number of participants did not know their father's education. When mother's education was used instead, inverse associations with body mass index were noted for White women only. However, there were no significant differences in body mass index or weight between those participants included and those excluded from analyses. Further, when the category "father's education unknown" was added to the parental education variable, results were similar to those reported (not shown).

Parental body size was positively associated with body mass index among all groups and with a 7-year change in body mass index among White women. However, it is difficult to distinguish purely genetic and environmental factors, given the indicator of parental obesity used. Adiposity has a genetic component, possibly through influencing fat cell size or number, insulin levels, or metabolic rates.[1] However, adiposity is also influenced by lifestyle factors such as diet, physical activity, smoking, and alcohol consumption. Such lifestyle components may also be conveyed from parents to children and may persist into adulthood.[47] For example, parental smoking appears to be an important factor associated with smoking in children.[48–51] Further studies should examine parent–child associations of behaviors such as diet and physical activity to assess this possible intergenerational lifestyle effect.

There may also be an interaction not examined here between genetic and socioeconomic factors regarding obesity. Garn and colleagues[14] found that obese women were more likely to "marry down" socioeconomically and to earn less income than leaner women. Obese children may face social discrimination that could influence their adult SES through the type of job or amount of education obtained or through their chances for marriage.[52] Such arguments would suggest some selection or "drift" of more obese persons toward lower social classes based on societal forces. Genetic factors related to obesity might then be of greater influence in the lower classes.

Apart from its health consequences, a sociocultural bias against obesity exists.[1,14,52,53] This bias quite likely affects women more than men and has greater consequences for women.[52] There are also cultural differences regarding views and consequences of obesity.[7,53] These considerations may help explain why, in our study, education was related to body mass index most consistently among White women, who were the leanest group overall.

The relationship of family and childhood environmental factors to adiposity in adulthood is complex and includes differences by ethnicity and sex. Public health efforts directed toward those at risk for obesity in adulthood might consider the role of families in obesity prevention. Cultural and socioeconomic differences add to the complexity of obesity prevention but should be considered in public health programs. □

Acknowledgments

This study was supported by contracts NO1-HC-48047, NO1-HC-48048, NO1-HC-48049, and NO1-HC-48050 from the National Heart, Lung, and Blood Institute, National Institutes of Health.

References

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

2. Flegal KM, Harlan WR, Landis JR. Secular trends in body mass index and skinfold thickness with socioeconomic factors in young adult women. *Am J Clin Nutr.* 1988;48:535–543.
3. Croft JB, Strogatz DS, James SA, et al. Socioeconomic and behavioral correlates of body mass index in Black adults: the Pitt County Study. *Am J Public Health.* 1992;82:821–826.
4. Keenan NL, Strogatz DS, James SA, Ammerman AS, Rice BL. Distribution and correlates of waist-to-hip ratio in Black adults: the Pitt County Study. *Am J Epidemiol.* 1992;135:678–684.
5. Rimm IJ, Rimm AA. Association between socioeconomic status and obesity in 59 556 women. *Prev Med.* 1974;3:543–572.
6. Gillum RF. Overweight and obesity in Black women: a review of published data from the National Center for Health Statistics. *J Natl Med Assoc.* 1987;79:865–871.
7. Kumanyika S. Obesity in Black women. *Epidemiol Rev.* 1987;9:31–50.
8. Kahn HS, Williamson DF, Stevens JA. Race and weight change in US women: the roles of socioeconomic and marital status. *Am J Public Health.* 1991;81:319–323.
9. Kohrs MB, Wang LL, Eklund D, Paulson B, O'Neal R. The association of obesity with socioeconomic factors in Missouri. *Am J Clin Nutr.* 1979;32:2120–2128.
10. Garn SM, Bailey SM, Cole PE, Higgins ITT. Level of education, level of income, and level of fatness in adults. *Am J Clin Nutr.* 1977;30:721–725.
11. Khoury PR, Morrison JA, Laskarzewski P, et al. Relationships of education and occupation to coronary heart disease risk factors in schoolchildren and adults: the Princeton School District Study. *Am J Epidemiol.* 1981;113:378–395.
12. Jeffery RW, Forster JL, Folsom AR, Luepker RV, Jacobs DR Jr, Blackburn H. The relationship between social status and body mass index in the Minnesota heart health program. *Int J Obes.* 1989;13:59–67.
13. Burke GL, Jacobs DR Jr, Sprafka JM, Savage PJ, Sidney S, Wagenknecht LE. Obesity and overweight in young adults: the CARDIA study. *Prev Med.* 1990;19:476–488.
14. Garn SM, Sullivan TV, Hawthorne VM. Educational level, fatness, and fatness differences between husbands and wives. *Am J Clin Nutr.* 1989;50:740–745.
15. Flegal KM, Harlan WR, Landis JR. Secular trends in body mass index and skinfold thickness with socioeconomic factors in young adult men. *Am J Clin Nutr.* 1988;48:544–551.
16. Kahn HS, Williamson DF. The contributions of income, education and changing marital status to weight change among US men. *Int J Obes.* 1990;14:1057–1068.
17. Teasdale TW, Sorensen TIA, Stunkard AJ. Genetic and early environmental components in sociodemographic influences on adult body fatness. *Br Med J.* 1990;300:1615–1618.
18. Sorensen TIA, Holst C, Stunkard AJ, Skovgaard LT. Correlations of body mass index of adult adoptees and their biological and adoptive relatives. *Int J Obes.* 1992;16:227–236.
19. Longini IM, Higgins MW, Hinton PC, Moll PP, Keller JB. Genetic and environmental sources of familial aggregation of body mass in Tecumseh, Michigan. *Hum Biol.* 1984;56:733–757.
20. Heller R, Garrison RJ, Havlik RJ, Feinleib M, Padgett S. Family resemblances in height and relative weight in the Framingham Heart Study. *Int J Obes.* 1984;8:399–405.
21. Bouchard C, Perusse L. Heredity and body fat. *Ann Rev Nutr.* 1988;8:259–277.
22. Selby JV, Newman B, Quesenberry CP Jr, et al. Genetic and behavioral influences on body fat distribution. *Int J Obes.* 1990;14:593–602.
23. Ravelli G, Stein ZA, Susser MW. Obesity in young men after famine exposure in utero and early infancy. *N Engl J Med.* 1976;295:349–353.
24. Charney E, Goodman HC, McBride M, Lyon B, Pratt R. Childhood antecedents of adult obesity. Do chubby infants become obese adults? *N Engl J Med.* 1976;295:6–9.
25. Power C, Moynihan C. Social class changes and weight-for-height between childhood and early adulthood. *Int J Obes.* 1988;12:445–453.
26. Braddon FE, Rodgers B, Wadsworth MEJ, Davies JMC. Onset of obesity in a 36 year birth cohort study. *Br Med J.* 1986;293:299–303.
27. Goldblatt PB, Moore ME, Stunkard AJ. Social factors in obesity. *JAMA.* 1965;192:1039–1042.
28. Peckham CS, Stark O, Simonite V, Wolff OH. Prevalence of obesity in British children born in 1948 and 1958. *Br Med J.* 1983;286:1237–1242.
29. Garn SM, Hopkins PJ, Ryan AS. Differential fatness gain of low-income boys and girls. *Am J Clin Nutr.* 1981;34:1465–1468.
30. Friedman GD, Cutter GR, Donahue RP, et al. CARDIA: study design, recruitment, and some characteristics of the examined subjects. *J Clin Epidemiol.* 1988;41:1105–1116.
31. Winkleby MA, Jatulis DE, Frank E, Fortmann SP. Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health.* 1992;82:816–820.
32. Kaplan GA, Kiel JE. Socioeconomic factors and cardiovascular disease: a review of the literature. *Circulation.* 1993;88:1973–1998.
33. Stunkard AJ, Sorenson R, Schlusinger F. Use of the Danish adoption register for the study of obesity and thinness. In: Kety SS, Rowland LP, Sidman RL, Matthysse SS, eds. *The Genetics of Neurological and Psychological Disorders.* New York, NY: Raven Press; 1983:115–120.
34. Fallon AE, Rozin P. Sex differences in perceptions of desirable body shape. *J Abnorm Psych.* 1985;94:102–105.
35. Rozin P, Fallon A. Body image, attitudes to weight, and misperceptions of figure preference of the opposite sex: a comparison of men and women in two generations. *J Abnorm Psych.* 1988;97:342–345.
36. Zellener DA, Marner DE, Adler RL. Effects of eating abnormalities and gender on perceptions of desirable body shape. *J Abnorm Psych.* 1989;98:93–96.
37. Gerber AM, James SA, Ammerman AS, et al. Socioeconomic status and electrolyte intake in Black adults: the Pitt County Study. *Am J Public Health.* 1991;81:1608–1612.
38. Hellerstedt WL, Jeffery RW, Murray DM. The association between alcohol intake and adiposity in the general population. *Am J Epidemiol.* 1990;132:594–611.
39. Wack JT, Rodin J. Smoking and its effects on body weight and the systems of caloric regulation. *Am J Clin Nutr.* 1982;35:366–380.
40. Hofstetter A, Schutz Y, Jécquier E, Wahren J. Increased 24-hour energy expenditure in cigarette smokers. *N Engl J Med.* 1986;314:79–82.
41. Albanes D, Jones Y, Micozzi MS, Mattson ME. Associations between smoking and body weight in the US population: analysis of NHANES II. *Am J Public Health.* 1987;77:439–444.
42. Wagenknecht LE, Burke GL, Perkins LL, Haley NJ, Friedman GD. Misclassification of smoking status in the CARDIA Study: a comparison of self-report with serum cotinine levels. *Am J Public Health.* 1992;82:33–36.
43. Dyer AR, Cutter GR, Liu K, et al. Alcohol intake and blood pressure in young adults: the CARDIA Study. *J Clin Epidemiol.* 1990;43:1–13.
44. Slattery ML, McDonald A, Bild DE, et al. Associations of body fat and its distribution with dietary intake, physical activity, alcohol, and smoking in Blacks and Whites. *Am J Clin Nutr.* 1992;55:943–949.
45. Jacobs DR Jr, Hahn L, Haskell WL, Price P, Sidney S. Validity and reliability of a short physical activity history: CARDIA and the Minnesota Heart Health Program. *J Cardiopulmonary Rehab.* 1989;9:448–459.
46. SAS Institute. *SAS/Stat User's Guide, Release 6.03 Edition.* Cary, NC: SAS Institute; 1988.
47. Lau RR, Quadrel MJ, Hartman KA. Development and change of young adults' preventive health beliefs and behavior: influence from parents and peers. *J Health Soc Behav.* 1990;31:240–259.
48. Chassin L, Presson CC, Sherman SJ, Edwards DA. Parent educational attainment and adolescent cigarette smoking. *J Subst Abuse.* 1992;4:219–234.
49. Gottlieb NH. The effects of peer and parental smoking and age on the smoking careers of college women: a sex-related phenomenon. *Soc Sci Med.* 1982;16:595–600.
50. Green G, Macintyre S, West P, Ecob R. Like parent like child? Associations between drinking and smoking behaviors of parents and their children. *Br J Addict.* 1991;86:745–758.
51. Bailey SL, Ennett ST, Ringwalt CL. Potential mediators, moderators, or independent effects in the relationship between parents' former and current cigarette use and their children's cigarette use. *Addict Behav.* 1993;18:601–621.
52. Gortmaker SL, Must A, Perrin JM, Sobal AM, Dietz WH. Social and economic consequences of overweight in adolescence and young adulthood. *N Engl J Med.* 1993;329:1008–1021.
53. Ross CE, Mirowsky J. Social epidemiology of overweight: a substantive and methodological investigation. *J Health Soc Behav.* 1983;24:288–298.