Maturational Timing and Overweight Prevalence in US Adolescent Girls

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A B S T R A C T

Objectives. This study examined the relation of age at menarche to overweight in US adolescent girls.

Methods. Effects of age at menarche and race/ethnicity on overweight were estimated via logistic regression, after adjustment for sociodemographic characteristics, in a sample of 6507 Hispanic, Black, White, and Asian American girls who participated in wave 2 of the National Longitudinal Study of Adolescent Health.

Results. Overweight prevalence rates were significantly higher in early maturing adolescents of all racial/ethnic groups but highest (57.5%) among early maturing Black girls. Early maturation nearly doubled the odds of being overweight (body mass index at or above the 85th percentile).

Conclusions. Greater public health attention should be focused on the high prevalence of overweight, particularly among minority female adolescents. (*Am J Public Health.* 2001;91:642–644)

Recent surveys show an alarming trend of increased prevalence rates of overweight in US adolescents, particularly among minorities. In the 1960s, 12.1% of Black females were overweight; by the mid-1990s, the percentage had increased to 30.7%.[1] Data from the Third National Health and Nutrition Examination Survey (NHANES III) for 1988 through 1991 showed that 23.4% of Mexican American female adolescents aged 12 to 17 years were overweight.[1] NHANES III provides inadequate information about other Hispanic groups and Asian Americans.

Early sexual maturation is one factor consistently related to increased body weight in adolescents and young adults. Several large retrospective studies have shown that among female young adults, those who experienced menarche before 12 years of age are heavier and fatter than late-maturing girls.[2,3] Size differences attributed to early menarche have been shown to persist into later adulthood and to be accentuated with age. Longitudinal studies conducted in the United States[4] and the Netherlands[5,6] show a strong relation of early maturation to increased body mass index (BMI) and body fat. The causal direction of this association remains controversial.[7–9]

The National Growth and Health Study[9] and a study of more than 17 000 girls attending private US pediatric clinics[10] provide strong evidence of earlier maturation among Black girls. The data from the National Growth and Health Study show that this pattern of early maturation fully accounts for Black–White BMI differences among girls aged 10 years. Comparable studies have not been conducted with other minority groups.

We used data from the National Longitudinal Study of Adolescent Health ("Add Health") to assess the relation of age at menarche to subsequent overweight among girls in 4 different racial/ethnic groups (non-Hispanic Blacks, non-Hispanic Whites, Hispanics, and Asians). Add Health data were well suited for this analysis because they are derived from a large, nationally representative sample supplemented with special minority samples. Use of sample weights allowed generalization to the population of adolescent girls attending US middle and high schools, providing a public health perspective on the magnitude of the problem of overweight in female adolescents.

Methods

Add Health selected a nationally representative school-based sample of young people augmented with special samples of Cuban, Puerto Rican, and Chinese youths and Blacks with a college-educated parent. From the primary sampling frame of all high schools in the United States, a stratified sample of 80 high schools and 52 feeder middle schools was selected proportional to enrollment. Among the more than 90 000 young people who completed an in-school questionnaire, a sample was drawn to complete a more intensive in-home survey of adolescents and parents. Survey procedures were approved by the Institutional Review Board of the School of Public Health, University of North Carolina at Chapel Hill.

Wave 1 of the in-home survey (1994–1995) included 20 745 young people. Wave 2 (1996) included 14 738 of the wave 1 participants who had not yet graduated from high school. We used wave 2 data because height and weight were measured by Add Health interviewers in wave 2, whereas this information was obtained by self-report only in wave 1.

The analysis sample of 6507 girls excluded those with a major physical disability, those younger than 13 years or older than 19 years, those who were pregnant, those who were Native American (because of the small sample size), and those with missing information on height, weight, maturation status, or race/ethnicity. Also excluded were those for whom a sample weight could not be determined. The sample was 54.8% non-Hispanic White, 21.1% non-Hispanic Black, 17.0% Hispanic (51% Mexican, 16% Cuban, 17% Puerto Rican), and 7.1% Asian (42% Filipino, 26% Chinese). No statistically significant bias related to missing data was detected in weighted analyses using the Heckman method.[11]

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TABLE 1—Percentages of Early, Average, and Late Maturing Participants and Overweight (Body Mass Index ≥85th Percentile) Prevalence, by Race/Ethnicity: National Longitudinal Study of Adolescent Health, 1996

Racial/Ethnic Group	Early Maturing		Average Maturing		Late Maturing		% ≥85th Percentile
	%	% Overweight	%	% Overweight	%	% Overweight	
White	7.8	36.4	77.0	22.4	15.2	12.1	22.3
Black	12.3	57.5	72.0	36.4	15.6	37.5	39.2
Hispanic	13.6	41.9	73.9	28.5	12.5	28.2	30.3
Asian	5.2	21.4	67.9	13.7	26.9	6.3	12.1
Total	9.1	41.5	75.4	25.0	15.4	18.7	25.5

Note. Percentages are weighted to be nationally representative. Categories based on age at menarche were as follows: early, ≤11 years; average, 11–13 years; and late, ≥14 years.

Overweight was defined as a BMI at the 85th percentile or above according to the age- and sex-specific percentiles of NHANES I.[12,13] No skinfold measurements were available. Although there are limitations to its interpretation, BMI is widely recommended as the best and most practical indicator of fatness among adolescents.[14,15]

However, BMI may not have the same relationship with body fatness in all racial/ethnic groups,[16] and maturation-related misclassification may result in overestimations of overweight prevalence rates among early maturing adolescents and underestimations among later maturing adolescents.[17,18] Significant BMI–height correlations among younger adolescents led us to include height in all multivariate models. *Parental obesity* was measured only by the mother's report that she or the youth's biological father was obese.

Race/ethnicity was coded from adolescents' answers to the following questions: What is your race? Which one category best describes your racial background? Are you of Hispanic or Latino origin? Parents were asked their race and country of birth. We categorized youths as Hispanic, non-Hispanic White, non-Hispanic Black, or Asian American. For simplicity, we refer to these groups as Hispanic, White, Black, and Asian. Youths were also asked whether they were born in the United States.

Girls reported their *menarcheal status* and *age at menarche* in whole years. Reliability of self-reported age at menarche is well established.[19–23] Girls were categorized as maturing early, average, or late on the basis of their age at menarche (younger than 11 years, 11–13 years, 14 years or older).[2,3] Premenarcheal girls (n=212) were classified as late maturing if their current age was 14 years or greater (n=162) or if they were aged 13 years but rated themselves as less mature than their peers (n=48). Premenarcheal girls aged 13 years who self-rated as more mature than their peers were classified as average in terms of their maturation (n=2).

In regard to *socioeconomic status* (SES), income and education were reported by parents or, if missing, by the adolescent. Income was divided into quintiles, and mother's education was categorized as less than high school, high school, some college, college, or professional degree. Urban, rural, or suburban residence was ascertained from data provided by school administrators.

We used Stata (version 6) survey procedures[24] that accounted for poststratification sample weights to allow generalization of the results to the population of adolescents attending schools in the United States and to adjust standard errors for cluster sampling. We used logistic regression to identify significant correlates of maturational timing and to estimate the strength of the relation of overweight to maturation status (early and late vs average maturation), controlling for age, height, race/ethnicity, whether the adolescent was born in the United States, family income, mother's education, residence (urban, rural, suburban), and parental obesity.

Results

Significantly higher proportions of Black and Hispanic girls experienced menarche before 11 years of age (Table 1). A significantly higher proportion of Asian girls reached menarche at 14 years of age or later. After maternal education, family income, age, and residence were controlled for, Black girls were 1.55 (95% confidence interval [CI]=1.15, 2.05) times more likely than Whites to mature early, and Hispanics were 1.76 (95% CI=1.18, 2.62) times more likely than Whites to mature early. Asians were 1.65 (95% CI=1.04, 2.62) times more likely to mature late. After age was controlled for, results showed that early maturing girls were shorter (by 1.6 cm) and heavier (by 3.8 kg) than those who matured later.

In all racial/ethnic groups, overweight prevalence rates were significantly higher in early maturing girls and significantly lower in later maturing girls (Table 1). Within each maturation group, the prevalence of overweight was highest among Blacks, followed by Hispanics, Whites, and Asians. An alarming 57.5% of early maturing Black girls exceeded the 85th NHANES I BMI percentile, and 32.5% exceeded the 95th percentile.

Overall, early maturing girls were nearly twice as likely as average maturing girls to be overweight (Table 2). The relation of maturation to overweight was not modified by maternal education or family income; crude and SES-adjusted estimates of the relation of mat-

TABLE 2—Relation of Early Maturation to Overweight (Body Mass Index ≥85th Percentile): Add Health Study, 1996

Racial/Ethnic Group	Odds Ratio	95% Confidence Interval
White	1.91	1.36, 2.69
Black	2.57	1.52, 4.32
Hispanic	1.93	1.06, 3.49
Asian	1.79	0.35, 9.01
Total	1.98	1.52, 2.57

Note. Values are estimates from logistic regression models controlling for family income, maternal education, residence (urban/rural/suburban), parental obesity, adolescent age and height, and whether the adolescent was born in the United States. Results are weighted to be nationally representative. Standard error terms are adjusted for complex survey design effects.

uration to overweight were similar. In models stratified by race/ethnicity, the odds ratios associated with early maturation were highest among Black girls, with those maturing early being 2.57 times more likely than average maturing White girls to be overweight.

Discussion

The present data document the high prevalence of overweight and the strong relationship of early maturation to overweight among US adolescent girls. While this relationship has been documented in other studies, our study of Add Health participants is noteworthy because of its sampling design and inclusion of large groups of minorities not well represented in other national surveys. The sample weights allowed for generalization to the national population of girls attending middle and high schools in the United States. More than 2.2 million young women in this population can be considered at risk of overweight. The trend of earlier maturation among Black girls, coupled with their high prevalence of overweight and the rapidly increasing rates of type 2 diabetes among adolescents,[25] underscores the need for obesity prevention efforts targeted toward this group. □

Contributors

The authors shared equally in the conceptualization of the study and the data analysis. Both authors contributed to the interpretation of the data and to multiple revisions of the manuscript.

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