

Socioeconomic Status, Race, and Girls' Pubertal Maturation: Results From the Project on Human Development in Chicago Neighborhoods

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The goal of this study was to determine whether aspects of pubertal maturation vary across race/ethnicity. To this end, we investigated two components of pubertal maturation (i.e., onset of menarche and perceptions of pubertal timing) in a multiethnic, multisocioeconomic sample of urban adolescent girls ($N = 866$). There were 314 African American, 404 Latina, and 148 White adolescents across low, middle, and high socioeconomic status (SES) backgrounds who completed self-report measures of these indicators of pubertal maturation. Adolescents' age at interview ranged from 8.1 to 16.44 years old ($M = 12.08$, $SD = 2.38$ years old). Primary caregivers reported information about each family's socioeconomic factors (e.g., primary caretaker's educational attainment, annual household income, and occupational prestige). At the time of the first assessment, 41% of the sample was menarcheal. The range of ages for onset of menarche was consistent across racial/ethnic groups. Results indicated that Latina girls reached menarche significantly earlier than did their White counterparts. However, after controlling for socioeconomic indicators, the significant age difference in menarcheal onset between Latina and White girls disappeared. This finding highlights the importance of including socioeconomic factors in explorations of menarcheal differences across race/ethnicity. Latinas reached menarche earlier than African Americans, and this difference across racial/ethnic groups persisted even after controlling for SES indicators. No differences were found in menarcheal age between African American and Whites. Perceptions of pubertal timing did not vary across racial/ethnic groups. Discussion focuses on issues of socioeconomic factors in studies examining pubertal maturation across racial/ethnic groups.

One of the most important developmental milestones for adolescent girls is the onset of puberty (Brooks-Gunn, 1991; Brooks-Gunn & Reiter, 1990; Caspi, Moffitt, & Silva, 1993; Graber, Brooks-Gunn, & Warren, 1995; Paikoff, Brooks-Gunn, & Warren, 1991; Stattin & Magnusson, 1990; Susman, Dorn, & Chrousos, 1991). The onset of puberty ushers in multiple changes on several levels, including the development of secondary sex characteristics, changes in body image, intensification of peer relations, and individuation from parents. The timing of girls' pubertal maturation varies widely. Previous research has shown that the timing of girls' pubertal maturation is associated with a number of important psychosocial outcomes. Girls who mature earlier than their peers are at risk for engaging in antisocial behavior (Stattin & Magnusson, 1990; Silbereisen, Petersen, Albrecht, & Kracke, 1989), experiencing higher levels of depressive symptoms (Brooks-Gunn, Graber, & Paikoff, 1994; Graber, Lewinsohn, Seeley, & Brooks-Gunn, 1997; Patton et al., 1996), using more illegal substances (D. M. Wilson et al., 1994), engaging in early sexual activity (Petersen, Graber, &

Sullivan, 1990), and performing poorly academically (Spencer, Dupree, Swanson, & Cunningham, 1998).

Given these significant implications for girls' outcomes, a good deal of research has explored the timing of girls' pubertal maturation. However, as noted by Stattin and Magnusson (1990), most studies of pubertal maturation focus on White, middle-class adolescents who are "well-adjusted ... willing and permitted to participate" (p. 26). Recently, several studies have examined pubertal maturation and timing across racial/ethnic groups. Results from these studies offer some evidence that the rate of physical and hormonal changes associated with puberty differ. Specifically, several studies have shown that the onset of puberty among African American girls is earlier than the onset among White girls (Daniels et al., 1998; Herman-Giddens et al., 1997). One explanation builds on theories of allostatic load (Schulkin, McEwen, & Gold, 1993) and the "weathering" hypothesis (Geronimus, 1996), which suggests that chronic exposure to stressors (e.g., racial discrimination, violence, substandard living conditions) are disproportionately experienced by African Americans and other minorities. These chronic stressors are hypothesized to accelerate the aging process among minorities, including contributing to early health deterioration (Geronimus, 1996) and possibly to the acceleration of pubertal maturation. In marked contrast, another explanation is offered by Tiwary (1994), who suggests that African American girls use hair products containing hormones (e.g., estrogen or placenta) that are associated with their acceleration of pubertal maturation.

Although an important line of inquiry, two key limitations exist in these previous studies of pubertal maturation across racial/ethnic groups. First, the role of socioeconomic status (SES) has not been systematically examined. Given that SES varies by race (McLoyd, 1990; W. J. Wilson, 1991), it is essential that studies comparing ethnic groups disentangle the effects of SES from those attributed to race/ethnicity. By doing so, one may discover that what appears to be racial/ethnic differences may actually reflect differences in SES present across groups. Indeed, in their examination of a large scale national study, Duncan, Brooks-Gunn, and Klebanov (1994) found a vast disparity in the income of children of African American mothers versus White mothers. This connection is further supported by information garnered from the U.S. Census Bureau, which reveals that minority families have disproportionately lower SES (indexed by educational attainment and household income) than their White counterparts.

The second limitation is that previous comparative studies examine differences between African American and White girls, but ignore pubertal development among other minority groups, such as Latina girls. Some studies do not sample Latina girls at all, whereas other studies include Latina girls,

but place them in with White or African American groups when conducting analyses (e.g., Herman-Giddens et al., 1997). Alternatively, we support the notion that the differences among people of minority status are worthy of careful examination. In light of these previous limitations, this study aims to investigate pubertal timing among African American, Latina, and White adolescent girls, accounting for the potential role of SES factors.

Pubertal Maturation: Links Across Race/Ethnicity and SES

Using the National Growth and Health Study (NGHS), Lucky, Biro, Simbartl, Morrison, and Sorg (1997) found that African American girls reached menarche an average of 6 months earlier than did their White counterparts. Although these investigators noted that the sample was "socioeconomically diverse," they failed to provide information about how variations in SES were distributed across racial/ethnic groups. Another study, based on the NGHS database, did in fact provide specific information about participants' SES. K. M. Brown et al. (1998) showed that 46.3% of the African American sample reported annual incomes at or below \$20,000, as compared to only 17.2% of the White sample. In addition, less than 24% of the African American sample reported incomes equal to or higher than \$40,000, whereas over 50% of the White sample fell into this category. Although this indicator of SES was available to the researchers, the analysis comparing pubertal maturation between African Americans and Whites did not adjust for these differences in household income. The unadjusted relationship between pubertal maturation and race/ethnicity showed that African American girls began pubertal maturation earlier than their White peers. It is unclear whether this pattern would have persisted after accounting for the effects of SES.

Similarly, in a large survey of adolescents associated with the Pediatric Research in Office Settings (PROS), Herman-Giddens et al. (1997) studied 17,077 girls, 90.4% who were White and 9.6% who were African American. The average age of menarche differed significantly between African Americans and Whites, with African American girls averaging 12.16 years old and White girls averaging 12.88 years old at menarcheal debut. However, nearly 45% of the African American sample and less than 10% of the White sample used Medicaid, suggesting disproportionately lower SES among African Americans. Because the effects of SES were not accounted for, one cannot distinguish whether different rates in maturation reflect race/ethnicity, SES, or some combination of these factors.

On another note, in the Herman-Giddens et al. (1997) study, some girls of Latina ethnicity were classified into the group of adolescents called "African

American," whereas other Latina girls were classified into the group of adolescents called "White." Although keeping the Latina girls in the study increased their sample size, and subsequently the ability to detect significant differences, this strategy undermines the interpretation of differences in pubertal maturation between racial/ethnic groups by confounding it with possible differences between Latina girls and African American and White girls. The few studies of pubertal maturation that include Latina girls as a distinct ethnicity suggest that they experience the onset of puberty even earlier than do their African American counterparts (Wasserman et al., 1990), highlighting the importance of keeping Latinas as a separate group. Despite the limitations of these earlier investigations, these studies provide a valuable stepping stone for future research to examine the unique contributions of race/ethnicity and SES to girls' pubertal maturation.

Pubertal Maturation and SES: Links With Stress

Implicit in the discussion that race/ethnicity is confounded with SES is the notion that SES may influence girls' pubertal timing. One hypothesis regarding the connection between SES and girls' timing is that those in the low-SES stratum may be exposed to more stressful conditions than those in higher-SES strata (Jargowsky & Bane, 1990; Jencks & Mayer, 1990; Kim & Smith, 1998; Silbereisen, Walper, & Albrecht, 1990). Indeed, a multitude of studies have shown that low-income families are exposed to an extraordinary number of environmental stressors, including increased negative life events (Allison et al., 1999), higher marital conflict (Kim & Smith, 1998), and limited access to adequate social and health services (W. J. Wilson, 1991, 1993). In keeping with this notion, a recent study of low-income Mexican American adolescents revealed that these youths experienced a severe level of stress which reflected the dire circumstances of resource-impoorished communities (Gillock & Reyes, 1999).

To the extent to which low-SES is an indicator of environmental stress, how might stress contribute to girls' pubertal maturation and timing? Several domains of research have provided evidence that menarcheal age is sensitive to environmental stressors (Graber, Brooks-Gunn, & Warren, 1995; Moffit, Caspi, Belsky, & Silva, 1992; Surbey, 1990; Susman, Nottelman, Dorn, Inoff-Germain, & Chrousos, 1988). Belsky and colleagues (Belsky, Steinberg, & Draper, 1991; Moffit et al., 1992) proposed a behavioral ecology model of pubertal maturation, linking childhood stressors (e.g., stressful childrearing environment) to earlier pubertal maturation. In particular, their findings suggest that exposure to chronic family stressors was associated with the early provocation of physiological changes involved in the onset of pubertal maturation. Similarly, Moffitt et al. found

support for an additive model of stress on girls' menarcheal timing. They identified that parental marital conflict and early father absence were associated with an earlier onset of menarche. Consistent with these connections, Graber et al. demonstrated that, although stressful life events were not associated with age of menarche, family conflict was linked to earlier menarcheal onset above and beyond the influence of other salient factors (e.g., weight).

On the other hand, some research has shown that environmental stress inhibits the onset of pubertal maturation. Susman et al. (1988) found that hormonal changes concomitant with pubertal onset may be affected by the heightened stress reactivity of adolescents. Specifically, their results revealed that environmental stress was implicated in the activation of the adrenal axis, which suppressed hormones involved in the onset of puberty, thus delaying pubertal maturation. Although the direction of environmental stress on pubertal timing is equivocal, it is that clear environmental stress may play an important role in the pacing of menarcheal onset.

In this study, we consider the way that different levels of SES, a proxy for environmental stress, influence racial/ethnic differences in menarcheal onset. It is important to note that using a single indicator of SES (e.g., only considering household income, cf. Daniels et al., 1998) may not provide a comprehensive portrayal of one's socioeconomic background. Rather, multiple dimensions of SES (e.g., household income, occupational prestige, and parental educational attainment) should be included to offer a more complete examination of race/ethnicity and pubertal maturation. Although there may be an overlap in SES indicators, one indicator is not interchangeable with another, and may yield different results.

Measures of Pubertal Maturation Among Girls

The first menstruation is considered by many to be the single most critical event marking puberty in girls, "signifying and symbolizing feminine identity and maturity, attributes that will constitute the core of the personality in subsequent development toward adult status" (Stattin & Magnusson, 1990, p. 45). In this study, adolescent girls provide self-reports of their age of menarcheal onset. Although there are limitations with this measure (detailed in the discussion section), the methodology of self-reported menarcheal age is consistent with recent studies of this phenomenon (Brooks-Gunn, Warren, & Hamilton, 1987; Graber et al., 1995, Graber et al., 1997). Our use of self-reported menarcheal age facilitates the comparison of findings across studies using similar methodologies. Previous work has reported good test-retest reliability with girls' self-reported menarcheal age (Bean, Leeper, Wallace, Sherman, & Jagger, 1979).

Recent work has indicated that adolescents' perception of pubertal timing (i.e., their perception that they are on time, earlier, or later maturing than their peers) may be as, or relatively more, important than actual indicators of pubertal maturation (Dubas, Graber, & Petersen, 1991; Graber et al., 1997; Petersen, Graber, & Sullivan, 1990; Silbereisen & Kracke, 1993). Graber et al. examined the consistency of self-reported pubertal timing with other markers associated with pubertal development. Perceptions of pubertal timing were associated with girls' height, weight, and body hair development. Test-retest over a 1-year period revealed that girls were in 83% agreement with their prior reports. In a study of 143 White middle- to upper middle-class girls, Petersen et al. showed that girls' perception of timing was a better predictor of their behavior than was their actual timing. Although perceived timing and actual timing (measured via menarcheal onset) are related, they are separate dimensions of adolescent girls' experience and as such, both will be examined in this study.

The purpose of this study is to determine whether pubertal maturation, measured through age of menarche and perception of pubertal timing, varies across racial/ethnic groups. To this end, we explicitly examine the effects of SES on this association among African American, Latina, and White adolescent girls from low, middle, and upper SES backgrounds.

METHOD

Sample and Procedures

Data were drawn from the first wave of the Project on Human Development in Chicago Neighborhoods (PHDCN, F. Earls, P.I.), an ongoing, multi-level, prospective, longitudinal study of children, adolescents, and adults, in their neighborhoods. The larger study includes 343 neighborhoods, termed "neighborhood clusters" (NCs). The 343 NCs contain all residents in Chicago, hence NCs are strata rather than sampling units. Census data on these neighborhoods were then used to create two stratification variables—racial/ethnic mix (seven levels) and SES (three levels).¹ A stratified

¹Chicago's 847 census tracts were combined to create the 343 NCs described here. Cluster analyses lead to the creation of internally homogenous NCs based on racial/ethnic mix, SES, housing density, and family organization. The seven racial/ethnic strata are (a) 75% or more African American, (b) 75% or more Whites, (c) 75% or more Latino, (d) 20% or more Latino and 20% or more White, (e) 20% or more Latino and 20% or more African American, (f) 20% or more African American and 20% or more White, and (g) NCs not classifiable. Although the goal of this stratification system was to obtain equal numbers of NCs from each of the 21 strata (3 × 7),

probability sample of 80 NCs representing the cross-classification of these two variables, were selected for more intensive assessments.

Participants for this study resided across these 80 neighborhoods. Individuals eligible for participation were identified based on their household composition. The longitudinal project assesses children in seven age cohorts: infants, ages 3, 6, 9, 12, 15, and 18. Of those who were eligible, 75% participated in the study (see Earls & Buka, 1997, for additional details on the design and sampling procedure of the PHDCN). For this study, participants included 866 girls (404 Latina, 314 African American, and 148 White) from the 9-, 12-, and 15-year-old cohorts. At the first assessment, these participants were between the ages of 8.1 and 16.44 years old ($M = 12.08$, $SD = 2.38$ years old). Results of one-way analysis of variance (ANOVA) showed that race/ethnicity did not vary by age of adolescent, $F(1, 865) = 0.30$, *ns*.

Adolescents and their primary caretakers were interviewed in their homes in separate face-to-face assessments. Interviews were private to ensure that each participant felt comfortable disclosing personal information. Adolescents provided information regarding menarcheal onset and their perceptions of pubertal timing. Primary caretakers were asked information regarding their race/ethnicity, educational attainment, annual household income, and information regarding their occupation.

Measures

Pubertal development: Menarcheal onset and perception of timing. Age of menarche was measured by asking girls whether or not they had begun menstruating, and if so, the month and year of the event. This date was then subtracted from their birth date to arrive at the precise age of each girls' first menarche. Those who could not recall the exact month and year of menarcheal onset indicated the age at which they began menstruating. Less than 15% of the participants chose the latter option.

Perception of pubertal timing relative to peers was measured via a five-point scale. Girls indicated whether they perceive their pubertal development to be or to have been earlier, later, or at the same time as their peers' pubertal development (1 = much earlier, 2 = somewhat earlier, 3 = same time, 4 = somewhat later, 5 = much later).

the number of NCs in each of the strata created by the cross-classification system was variable. Three of the 21 strata, in fact, were empty: No low-SES neighborhoods contained 75% or more White residents, no high-SES neighborhoods contained 75% or more Latino residents, and no high-SES neighborhoods contained the racial/ethnic mix of 20% or more Latino and 20% or more African American residents.

Indicators of SES. Three measures were used as indicators of SES: primary caretaker's level of educational attainment, family annual household income, and occupational prestige. Primary caretaker's level of educational attainment was reported in one of five categories: (a) did not go to high school, (b) completed some high school, (c) graduated high school, (d) some additional training or schooling after high school, (e) graduated college or more. Annual household income reflected income gathered from all household members who contributed to the annual household. This information was categorized on seven levels: (a) equal to or less than \$5000, (b) \$5001 to \$9,999, (c) \$10,000 to \$19,999, (d) \$20,000 to \$29,999, (e) \$30,000 to \$39,999, (f) \$40,000 to \$49,999, and (g) equal to or more than \$50,000.

Occupational prestige was based on a system developed by Nakao & Treas (1994), which used the updated 1990 Census Occupational classification system. Scores ranged between 17 and 97, with lower scores indicative of lower occupational prestige (e.g., unskilled laborer). If partnered, the higher of the occupational prestige codes between primary caretaker and his or her partner was used. Of the 883 families sampled, 118 were unpartnered and had been unemployed for more than 5 years; these families were assigned an occupational prestige score of 10, a score that is half a standard deviation away from the lowest score on the original scale. Thus, the final occupational prestige codes ranged from a minimum of 10 to a maximum of 97. A dummy variable representing whether or not the individual had an imputed occupational prestige code was entered into each analysis to identify whether the imputation itself had an unintended effect on the prediction.

Analytic plan. Given the nested structure of the data (i.e., girls are nested within neighborhood context), our first step was to determine whether menarcheal age or pubertal timing varied across neighborhood contexts. Failure to accommodate variation at the neighborhood level (i.e., intraclass correlation) could result in biased estimates of standard errors. To test for an intraclass correlation, we fit the data to a two-level hierarchical linear model (HLM), using each indicator of pubertal development in a separate baseline (i.e., no covariate) model. Results (as indicated through the final estimation of variance components) indicated that neither age of menarche nor perception of pubertal development varied significantly across neighborhood context. Because these indicators of pubertal maturation did not vary across neighborhoods, all subsequent analyses were carried out using single-level methods of analysis.

Our study is unique in several ways, including the design of a multiple cohort sampling assessment (girls in the 9-year-old, 12-year-old, and 15-year-old cohorts). Older girls, however, have more time to reach menar-

che, simply as a function of maturation, than do younger girls (Angold, Costello, & Worthman, 1998). As such, age at the time of interview was controlled in models examining menarcheal age and perception of timing.

Relatedly, at the time of the first interview, many girls had not yet reached menarche. This is the problem of right censored data. The optimal strategy to deal with censored data is survival analyses. Therefore we employ survival analysis as our analytic strategy for examining age of menarche. Survival analyses use time as a dependent variable and produce odd-ratios that indicate the probability of reaching menarche, given one's racial/ethnic group membership. The unit of analysis in survival techniques is the number of months an individual lived prior to menarche. The underlying individual data are used to estimate continuous time duration models, in which the "risk" of menarcheal onset is modeled. Those who have not yet reached menarche are treated as censored observations. In this case, the hazard function of the risk of menarcheal onset (i.e., the conditional probability of reaching menarche, having not yet reached menarche in a given time period) is a proportional hazard form. Survival analysis allows for the inclusion of all individuals in analysis, and thus affords two distinct advantages over other traditional statistical approaches (e.g., general linear model): (a) It avoids misestimation that occurs when data is right-centered (as it is in the case of menarcheal onset, where most 9-year-olds and some 12-year-olds have not yet reached menarcheal onset), and (b) it allows for the inclusion of all individuals in analysis, thus increasing the model's statistical power. We used the Weibull distribution in survival analysis.²

The first model examined the effect of race/ethnicity on pubertal development, controlling for adolescents' age at interview. The second model examined the effect of race/ethnicity on age of menarche, controlling for adolescents' age at interview, and the three indicators of SES (i.e., primary caretaker's level of educational attainment, annual household income, and occupational prestige). To meet the assumptions of this analysis, two of the SES variables (i.e., primary caretaker's level of educational attainment and annual household income) were transformed from categorical items into continuous scales by taking the midpoint of each category (e.g., the second

²Weibull distribution is the appropriate survival technique because the hazard function in this case is not constant (Affifi & Clark, 1990). The lack of constancy reflects the fact that the probability of reaching menarche is influenced by the amount of time passed. Thus, the Weibull distribution allows for the examination of the acceleration of menarcheal onset; as girls approached 12 years of age, their likelihood of reaching menarche increased dramatically (i.e., accelerated).

category of annual income was \$5,001 to \$9,999; this was transformed to the midpoint, \$7500). This transformation preserves the order of the categories and eliminates the arbitrary assignment of numbers to each dimension. As the measure of occupational prestige is in a continuous form, transformation of this variable was unnecessary.³

To examine the association between race/ethnicity and adolescents' perception of pubertal timing relative to her peers, we used Kruskal–Wallis stratum adjusted ANOVAs. The first model examined the connection between race/ethnicity and perception of pubertal timing, controlling only for adolescents' age at the interview. The second model examined this connection, controlling for adolescents' age at the interview and the three indicators of SES. To handle missing data across all measures, we used listwise deletion.

RESULTS

The results of this study are presented in three sections. First, descriptive information on adolescents' socioeconomic background (i.e., primary caregiver's level of educational attainment, annual household income, occupational prestige) is presented, along with descriptive information regarding indicators of pubertal development (i.e., menarcheal age and perception of pubertal timing). Second, the association between menarcheal age and race/ethnicity is discussed. Finally, the association between perception of pubertal timing and race/ethnicity is presented. SES indicators are considered in all analyses.

Adolescents' SES

The racial/ethnic breakdown of primary caregivers' educational attainment, annual household income, and occupational prestige are presented in Table 1.

Primary caregivers' level of educational attainment. Results of Wilcoxon Rank-Sum tests (a.k.a. Mann–Whitney *U*) showed that both African

³Tolerance statistics examining the degree of colinearity between race/ethnicity, primary caretaker's educational attainment, household income, and occupational prestige were moderately low (range = 61–80), suggesting that modeling the SES indicators simultaneously is appropriate.

TABLE 1
 Percentages, Means, Standard Deviations, and Ranges on Indicators of Socioeconomic
 Status Across Race and Ethnicity Among 9-, 12-, and 15-Year-Old Girls

<i>Race/Ethnicity</i>	<i>Primary Caregivers' Level of Educational Attainment</i>	<i>Annual Household Income</i>	<i>Occupational Prestige</i>
African American ^{a,b,c} (<i>n</i> = 314)	2.5% less than H.S.	12.7% < \$5,000	<i>M</i> = 45.34 (17.49) range = 10–97
	22.9% some H.S.	9.6% \$5–\$9,000	
	11.5% H.S. graduate	12.7% \$10–\$19,999	
	42.5% some college	20.7% \$20–\$29,999	
	10.5% college	16.9% \$30–\$39,999	
		10.2% \$40–\$49,999	
	17.2% > \$50,000	<i>M</i> = \$29,793 (20,436)	
Latina ^{a,c,d} (<i>n</i> = 404)	45.3% less than H.S.	5.0% < \$5,000	<i>M</i> = 37.88 (13.54) range = 10–97
	17.3% some H.S.	7.7% \$5–\$9,999	
	11.6% H.S. graduate	27.0% \$10–\$19,999	
	21.0% some college	24.5% \$20–\$29,999	
	4.7% college	17.1% \$30–\$39,999	
		9.7% \$40–\$49,999	
	9.2% > \$50,000	<i>M</i> = \$27,148 (16,548)	
White ^{b,c,d} (<i>n</i> = 148)	4.1% less than H.S.	4.7% < \$5,000	<i>M</i> = 53.65 (19.30) range = 10–96
	19.6% some H.S.	4.1% \$5,000–\$9,999	
	23.0% H.S. graduate	6.1% \$10–\$19,999	
	29.7% some college	12.8% \$20–\$29,999	
	23.6% college	14.2% \$30–\$39,999	
		15.5% \$40–\$49,999	
	42.6% > \$50,000	<i>M</i> = \$44,172 (20,862)	

Note. Standard deviations appear in parentheses. H.S. = high school.

^aResults of Wilcoxon-Rank Sum test showed that African Americans reported a higher level of educational attainment than did Latinas ($p < .0001$). ^bResults of Wilcoxon-Rank Sum test showed that Whites reported higher annual household salary than did African Americans ($p < .0001$). ^cResults of Wilcoxon-Rank Sum test showed that Whites had higher occupational prestige than did African Americans ($p < .0001$) and Latinas ($p < .0001$). African Americans had higher occupational prestige than did Latinas ($p < .0001$). ^dResults of Wilcoxon-Rank Sum test showed that Whites reported higher educational attainment ($p < .0001$) and higher annual household salary than did Latinas ($p < .0001$).

Americans and Whites reported a higher level of educational achievement compared to Latinas ($p < .0001$). There were no differences between the educational achievement of African American and White families ($p > .10$).

Annual household income. Results of Wilcoxon Rank-Sum tests revealed differences in annual household income across race/ethnicity, with Whites reporting higher annual household incomes compared to African Americans ($p < .0001$) and Latinas ($p < .0001$). No differences were found between annual household income across African Americans and Latinas ($p > .10$).

Occupational prestige. Wilcoxon Rank-Sum tests showed Whites were more likely to have higher occupational prestige compared to African Americans ($p < .0001$) and Latinas ($p < .0001$). African Americans were found to have higher occupational prestige than Latinas ($p < .0001$).

Adolescents' Pubertal Maturation Via Age of Menarche and Perception of Timing

Unadjusted means and standard deviations for age of menarche and information regarding girls' perception of pubertal timing relative to peers is presented in Table 2. Of the total sample, 404 girls reached menarche and indicated a specific time of first menarche. The age of first menarche ranged from 9.1 to 15.1 years old. The range of menarcheal debut was fairly consistent across racial/ethnic groups. Before adjusting for SES indicators, African American girls reached menarche an average of 1 month earlier than White girls (11.93 years [143.2 months] and 12.04 years [144.5 months], respectively) and nearly 3 months later than Latina girls (11.68 years [140.2 months]). On average, Latina girls reached menarche approximately 4 months earlier than their White counterparts.

Examining the sample by age cohort revealed expected results: 1.2% of the 9-year-old cohort had reached menarche, nearly half of the girls in the 12-year-old cohort had reached menarche (46.7%), and almost all of the girls in the 15-year-old cohort had reached menarche (97.4%). This suggests that only a few girls (the 3 girls in the 9-year-old cohort) were early maturers, whereas the majority of girls who reached menarche were not necessarily early maturers (Table 3).

Approximately half of the sample perceived themselves to be maturing at the same pace as their peers (49.5%); the remainder of the sample was

TABLE 2
Unadjusted Means and Standard Deviations of Indicators of Pubertal Development
for 9-, 12-, and 15-Year-Old African American, Latina, and White Girls

<i>Race/Ethnicity</i>	<i>Percentage and Number of Girls Who Reached Menarche</i>	<i>Age in Years and Months of First Menarche</i>	<i>Perception of Timing Relative to Peers</i>
African American (<i>n</i> = 314)	43.3%; <i>n</i> = 136	11.93 (1.1) years ^a 143.20 (13.2) months range = 9.1–15.0 years	8.1% much earlier 23.6% somewhat earlier 42.8% same 17.3% somewhat later 8.1% much later <i>M</i> = 2.94 (1.03)
Latina (<i>n</i> = 404)	41.8%; <i>n</i> = 169	11.68 (1.3) years ^{a,b} 140.20 (15.6) months range = 9.1–15.1 years	9.9% much earlier 15.9% somewhat earlier 50.4% same 20.0% somewhat later 3.8% much later <i>M</i> = 2.92 (0.95)
White (<i>n</i> = 138)	39.9%; <i>n</i> = 55	12.04 (1.3) years ^b 144.48 (15.6) months range = 9.6–15.0 years	7.7% much earlier 15.4% somewhat earlier 60.8% same 15.4% somewhat later 0.8% much later <i>M</i> = 2.86 (0.79)

Note. Standard deviations appear in parentheses.

^aResults of baseline analysis (not adjusting for differences in socioeconomic status) showed that Latinas reached menarche earlier than did African Americans. ^bResults of baseline analysis (not adjusting for differences in socioeconomic status) showed that Latinas reached menarche earlier than did Whites.

nearly evenly split between early and late maturers (27.4% and 23%, respectively). Collapsing across categories of much earlier and somewhat earlier maturers, 31.7% of African Americans perceived themselves to be earlier than their peers, 25.8% of Latinas perceived themselves to be earlier than their peers, and 23.1% of Whites perceived themselves to be earlier than their peers.

Adolescents' Menarche and Race/Ethnicity

A survival analysis employing a Weibull distribution was conducted to evaluate the difference in adolescents' menarcheal age as a function of race/ethnicity. In the first model, we examined the association between

race/ethnicity and age of menarche, without controlling for variation in SES. Results revealed that Latina girls reached menarche earlier than did their White counterparts ($p < .05$). African American girls reached menarche later than did Latina girls ($p < .05$); however, contrary to previous findings (e.g., Herman-Giddens et al., 1997), menarcheal age did not differ between African American and White girls ($p > .10$).

To determine whether the differences between racial/ethnic groups (i.e., Latina vs. White; Latina vs. African American) persisted after accounting for SES factors, the next analysis included the three SES indicators (e.g., primary caretaker's level of educational attainment, annual household income, and occupational prestige). The dummy code indicating imputation of occupational prestige (0 = not imputed, 1 = imputed) was also entered into the model to determine whether the imputation itself influenced the estimated relationship with menarcheal age.

After partialling out the variance associated with SES, the race/ethnic difference in menarcheal age between Latinas and Whites became nonsignificant. This suggests that the variance attributed to SES across race/ethnicity helped explain the differences in menarcheal onset between Latinas and Whites. Although introducing SES indicators reduced the mean difference in menarcheal age between African Americans and Latinas, menarcheal age between these racial/ethnic groups remained significant. The SES indicators did not have a direct impact on girls' menarcheal age. The dummy code for occupational prestige was also nonsignificant. This pattern of results suggests that although SES may not be directly associated with menarcheal onset, it, nonetheless, contributes to explaining the variance attributed to race/ethnicity, particularly in the case of Latinas and Whites.

Adolescents' Perceptions of Pubertal Timing and Race/Ethnicity

Results of Kruskal–Wallis stratum adjusted ANOVAs showed no differences between African American and Latina girls' perceptions of puber-

TABLE 3
Menarcheal Onset of African American, Latina, and White Girls, by Cohort

<i>Age of Cohort</i>	<i>Percentage and Number of Girls Who Reached Menarche</i>
9-year-old cohort ($n = 287$)	1.2%; $n = 3$
12-year-old cohort ($n = 319$)	46.7%; $n = 148$
15-year-old cohort ($n = 260$)	97.4%; $n = 253$

tal timing in the baseline model or after controlling for SES indicators. Similarly, there were no differences in perception of pubertal timing between Latina and White girls nor African American and White girls ($cmh = 3.73, p > .10$).

DISCUSSION

The goal of this investigation was to determine whether girls' menarcheal onset and perception of pubertal timing varied across racial/ethnic groups after accounting for the effects of SES. The SES demographics of this sample are consistent with national statistics. With the exception of educational attainment among African American families, White families reported higher SES than did Latina or African American families. African American families had higher educational attainment and occupational prestige than did Latina families, although no significant differences were found in household income between these two groups. In addition, neither menarcheal age nor perception of pubertal timing varied across neighborhoods. The issue of neighborhood mechanisms, however, remains an open question as not all participants had reached menarche at the time of assessment. As subsequent waves of data become available in our longitudinal study, we may find that neighborhood factors do exert an influence on girls' pubertal maturation.

Patterns of menarcheal onset by cohort age showed an expectable pattern: Few 9-year-olds, almost half of the 12-year-olds, and nearly all of the 15-year-olds had become menarcheal. Results of baseline comparisons between Latina and White girls revealed that Latinas reached menarche an average of 4 months earlier than Whites. After SES indicators were controlled, however, the difference in menarcheal age became nonsignificant. To the extent that SES acts as a proxy for environmental stress, these findings imply that holding constant the level of environmental stress significantly diminishes the variation in menarcheal onset between these racial/ethnic groups. Moreover, this finding suggests that SES helped explain the apparent difference in menarcheal age between Latina and Whites and is critical to account for in such investigations.

Unadjusted comparisons in menarcheal age between African American and Latina girls showed that Latina girls reached menarche approximately 3 months earlier than their African American peers. Even after holding SES constant, a significant difference in age of menarche persisted. This pattern raises the issue of going beyond SES indicators when comparing girls of minority populations, and considering other potential stressors, such as exposure to racial discrimination or level of acculturation. Further investigations of the experience of minority youth are needed.

In the baseline comparison, African Americans reached menarcheal age approximately 1 month earlier than did Whites. This difference in menarcheal age was not significant. Although a nonsignificant relationship between African Americans' and Whites' menarcheal age is in contrast with findings of some studies (Daniels et al., 1998; Herman-Giddens et al., 1997; Lucky et al., 1997), it is consistent with results that indicate that maturational timing across groups is the same (Wattigney, Srinivasan, Chen, Greenlund, & Berenson, 1999), given that nutritional health is adequate across groups (Brooks-Gunn & Reiter, 1990). Another interpretation is that the low number of menarcheal Whites in the sample may have led to insufficient power to detect significant differences with African American girls. However, it is unclear whether the observed difference in menarcheal age of 1 month would represent a meaningful difference in the lives of African American and White girls. Nonetheless, future work would benefit by the inclusion of a larger sample of adolescents, stratified to ensure adequate power to detect racial/ethnic differences.

Perception of pubertal timing showed minimal variation across racial/ethnic groups. In general, girls across the three groups reported similar perceptions of maturational timing. This pattern possibly reflects the fact that girls may be comparing themselves to their friends, who in many ways may be similar demographically (e.g., same race/ethnicity, SES, neighborhood; B. B. Brown, 1999). Thus, this measure of pubertal timing may be most relevant when comparing girls within racial/ethnic groups.

Although differences in SES across racial/ethnic groups were found, SES itself was not directly related to either girls' menarcheal onset or their self-perception of timing. This was surprising as we had expected that SES, a proxy for environmental stress, would have had a main effect on pubertal timing. This pattern, however, is in keeping with the work of Moffitt et al. (1992), who found no significant associations between indicators of SES and age of menarche in their sample of New Zealand adolescents. One interpretation of this lack of significance is that there were a limited number of Whites in the lower income range (15% of White families reported annual incomes less than \$20,000, whereas 35% of African Americans and 40% of Latinas reported annual incomes in this category). Thus, our ability to test the full range of SES across race/ethnicity may have been impeded. It is also possible that this relationship may not have been significant because SES may potentially influence pubertal timing in competing directions. For example, although it is reasonable to expect that low-SES families would be associated with earlier pubertal development due to greater exposure to adversity, higher SES may be also associated with earlier pubertal development as a function of more optimal nutrition and lower exposure to chronic infectious diseases (Rao, Joshi, & Kanade, 1998).

An alternative theory is that the greater exposure to adversity experienced by low-SES families may be associated with a delay in pubertal development (Susman et al., 1988); similarly, middle- or upper middle-class girls may (intentionally or unintentionally) delay their pubertal maturation through excessive dieting and exercise (Brooks-Gunn, Warren, & Hamilton, 1987; Hamilton, Brooks-Gunn, Warren, & Hamilton, 1988). These hypothesized connections suggest that SES may influence menarche in opposite ways, thus potentially hindering our finding a direct relationship between SES and menarcheal age. In addition, it is important to bear in mind that SES was conceptualized here as a proxy for environmental stress, and future research should include direct indicators of environmental stress (e.g., inadequate housing or health care, exposure to violence). Additional studies could also examine indicators of perceived economic strain; growing evidence suggests that strain may have greater predictive value than actual socioeconomic standing (Golding & Burnam, 1990; Pearlman, Lieberman, & Menaghan, 1981).

Several limitations of this study exist. The major limitation is that direct comparisons cannot be made between many of the studies reviewed here and our findings. This is primarily because the majority of work reviewed in this study used physical examinations of pubertal maturation. Our use of self-reported menarcheal age and perceptions of timing allow us to only approximate a comparison with findings from these other studies. Another potential limitation is that previous research has found poor reliability when retesting reports of menarcheal age (e.g., Hayward et al., 1997) as well as evidence that some girls misinterpret irregular first menses, and thus underreport their age of onset (Stattin & Magnusson, 1990). Despite the possible limitation in using girls' self-reports of menarche, several researchers have nonetheless demonstrated that adolescent girls are accurate in reporting their menarcheal age (Brooks-Gunn, Warren, Rosso, & Gargiulo, 1987; Rierdan & Koff, 1985), and have shown adequate test-retest reliability between assessments (e.g., Bean et al., 1979). Although we have no way of determining whether girls' reports of menarcheal onset are free of bias in this study, subsequent assessments of girls' menarcheal age will allow us to determine the reliability of these reports.

Another concern is that the markers of race/ethnicity were fairly broad (i.e., African American, Latina, or White). Clearly, adolescents in these groups are not homogenous. For example, not all Latinas share the same historical or current sociocultural conditions (Spencer & Dornbusch, 1990). Future efforts would greatly improve our understanding of race/ethnicity by distinguishing the cultural and social nuances within each group.

In sum, results showed that there were no differences in menarcheal age between African Americans and Whites, contrary to several recent exami-

nations. Findings also suggested that SES is important to include in examinations of menarcheal age, particularly between Latina and Whites. When comparing girls across different minority populations (e.g., between Latina and African Americans), SES factors seemed to play a minimal role, but other environmental factors (e.g., racial discrimination) might be considered in subsequent examinations. More importantly however, is the notion that although maturation rates may not differ drastically across racial/ethnic groups, one may speculate that the developmental implications of early maturation may vary dependent on one's racial/ethnic status. That is, girls in different racial/ethnic groups may have different levels of vulnerability to the effects of early pubertal timing on psychosocial outcomes (e.g., early maturing Whites may be more likely to engage in more antisocial behavior than early maturing Latinas). Thus, SES and race/ethnicity may be especially important in moderating the significance of the developmental impact of being an early or late maturer. Plans for future investigations include using a more dynamic longitudinal analysis to better understand the nature of pubertal timing within and across race/ethnicity.

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