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Original article

Socioeconomic status and age at menarche: an examination of multiple indicators in an ethnically diverse cohort

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ABSTRACT

Purpose: Ethnic disparities exist in US girls' ages at menarche. Overweight and low socioeconomic status (SES) may contribute to these disparities but past research has been equivocal. We sought to determine which SES indicators were associated uniquely with menarche, for which ethnic groups, and whether associations operated through overweight.
Methods: Using National Longitudinal Study of Youth data, we examined associations between SES indicators and age at menarche. Participants were 4851 girls and their mothers. We used survival analyses to examine whether SES, at various time points, was associated with menarche, whether body mass index mediated associations, and whether race/ethnicity modified associations.
Results: Black and Hispanic girls experienced menarche earlier than whites. After adjusting for SES, there was a 50% reduction in the effect estimate for "being Hispanic" and 40% reduction for "being black" versus "being white" on menarche. SES indicators were associated uniquely with earlier menarche, including mother's unmarried status and lower family income. Associations varied by race/ethnicity. Body mass index did not mediate associations.
Conclusions: Racial differences in menarche may in large part be due to SES differences. Future experimental or quasiexperimental studies should examine whether intervening on SES factors could have benefits for delaying menarche among blacks and Hispanics.

Introduction

Marked racial/ethnic differences exist in age at menarche in the United States, with black and Hispanic girls experiencing menarche significantly earlier than non-Hispanic whites and Asians [1–3]. Understanding these disparities is critical because early menarche has been linked to poor health outcomes across the life course, including behavioral problems in adolescence and reproductive cancers in adulthood [4,5]. Numerous studies since the 1970s have shown that body weight is highly correlated with menarcheal timing, with heavier girls experiencing menarche at younger ages [6–10]. Research to date suggests that ethnic differences in menarcheal timing appear largely due to differences in overweight across racial/ethnic groups [7]. However, upstream factors that influence prepubertal weight gain, such as socioeconomic status (SES), are understudied and may play a prominent role in explaining why girls from certain ethnic groups are heavier and start menstruating earlier.

Menarche is biologically linked to adequate nutrition and body fat increases, which hormonally signal that a developing girl's body is ready to prepare for reproduction [11,12]. As the prevalence of obesity has increased in the United States, girls' age at pubertal onset has simultaneously declined [6,13–15]. Girls growing up in low SES environments are at particularly high risk for both obesity and early menarche. Low-income families have less access to healthful foods and fewer opportunities for safe physical activity [16–19]. This may partially explain the racial disparities in menarcheal timing observed in the United States, given that black and Hispanic youth are more likely to grow up in lower income communities and, on average, tend to be more overweight compared with their non-Hispanic white counterparts [19].

Past research examining associations between SES on menarche has yielded inconsistent results. Some studies have shown that lower SES is associated with earlier menarche [20], whereas others have shown no association [21] or mixed results depending on the SES indicator examined [7,22]. One reason for equivocal findings may be that a variety of SES indicators are used across studies (e.g., family income, single parenthood, parental education, parental occupation, income-to-needs ratio, and poverty), yet are referred to, collectively, as SES. Studies have found that certain SES indicators, such as single

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parent status and household income, were associated with earlier menarche, whereas other indicators were not [22–24]. SES has also been assessed with combinations of indicators. For instance, using longitudinal data from the Collaborative Perinatal Project ($n = 262$), James-Todd et al [20] created an SES index (comprised income, education, and occupation) and found that a 20-unit decrease in this index at the age of 7 years was associated with a 4-month decrease in age at menarche later in life; however, specific indicators were not examined to assess unique SES effects. Few studies have included multiple indicators concurrently to tease apart unique effects, and of those that have, there appear to be differential associations depending on the indicators used. Moreover, some evidence suggests that the timing of when SES indicators are measured (e.g., at birth vs. later in childhood) may influence findings [20]. No known studies have examined whether SES of the previous generation (grandparents' SES) in addition to parents' generation influences a girls' menarcheal timing.

Another explanation for equivocal results across studies examining SES and menarche is that race/ethnicity may modify these associations. In other words, certain SES indicators may influence menarche differentially depending on ethnicity. In a 2012 study, using data from National Longitudinal Study of Youth, Regan et al [25] found that age of menarche declined with increases in exposure to poverty during early childhood for whites, but there was no effect for African Americans. Another longitudinal study using National Growth and Health Study data also revealed racial differences in the association between family income and menarche. Black girls from high income brackets experienced menarche early, whereas the reverse was true for whites [23]. In contrast, a study using National Health and Nutrition Examination Survey data found no associations between SES indicators and age at menarche when race was included as a covariate; however, effect modification by race was not tested [21]. Studies that control for race may show no significant association, or an attenuated association, between SES and menarche, whereas within-ethnic group studies or stratified analyses may yield associations that vary by race.

Finally, a significant gap in the literature is that there has been a dearth of research examining whether (body mass index) BMI operates as a mediator between SES and menarche. This is an important area for investigation given that girls' body weight may present one of the few modifiable targets for intervention to delay puberty. One recent longitudinal study showed that, for African American girls, the availability of more neighborhood recreational facilities delayed girls' breast development; however, this association was not mediated by girls' BMI [26]. Given the paucity of studies that have concurrently examined BMI when studying the effects of SES on menarche, it is unclear whether BMI might operate as a mediator of these effects.

The present study addresses these gaps. We aimed to (1) assess the unique effects of multiple SES indicators on age at menarche longitudinally, using two prepubertal time points and two generations of SES data; (2) examine whether prepubertal BMI mediated associations between SES indicators and age at menarche; and (3) test whether associations varied by race/ethnicity. Based on the literature, we hypothesized that certain SES factors, particularly family income and father absence, would be more highly correlated with menarcheal timing compared with others. Both father absence and low-income family have the potential to disrupt the home environment significantly and lead to poor nutrition and overweight. Single parent and low-income households often have fewer resources available to control the food environment and to promote opportunities for recreation. We anticipated that by examining these and other SES factors together, we could tease apart their potential unique effects and also determine whether they were differentially related to menarche across ethnic groups.

To examine these hypotheses, we used data from a large nationally representative study to examine the relative influence of various SES indicators assessed at birth and at age the age of 7 years on age at menarche. The multigenerational nature of these data allowed us to examine parental/family SES during daughters' childhood and grandparents' SES. This is a marked strength of the present study given the scarcity of research examining potential intergenerational effects of SES on menarche.

Method

Participants

We used data from the National Longitudinal Survey of Youth 1979 (NLSY79), an ongoing examination of 12,686 men and women born between 1957 and 1964 [27]. Participants in this cohort were interviewed annually between 1979 and 1994, and biennially thereafter. The children of these adults entered the study in 1986 and ranged from 9 to 16 years old at that time. These children were surveyed biennially from 1986 to present as part of the NLSY Children and Young Adult survey. Participants in the original cohort were sampled using a complex multistage sampling approach. Households in the United States were randomly sampled and screened for eligible participants; blacks, Hispanics, economically disadvantaged non-Hispanic nonblack youth, and individuals serving in the military were oversampled [27]. Our analyses focused on mothers in the original NLSY79 cohort and their daughters. This included 4851 daughters (aged 916 years), assessed from 1986 to 2010, and their mothers ($n = 3216$) who participated in the original NLSY79. Mothers reported retrospectively on their parents (girls' grandparents) to obtain data about the previous generation. Data were completely de-identified and were not subject to human subjects review.

Measures

Age at menarche

Daughter's age at first menstrual period (in years) was assessed using mother's report for girls aged younger than 14 years. When the child was 14 years old or older, we used child report. These data were collected at each survey wave (on a biennial basis) since the girls entered the study in 1986. Less than 2 years of recall were required because of the study design of biennial surveys. Retrospective report of age at menarche is reliable, particularly when length of the recall is short [28,29].

Nontime-varying independent variables

Nontime-varying independent variables included covariates: year of daughter's birth, family size at daughter's birth, mother's age at menarche in years, and daughter's race/ethnicity, and SES indicators: grandfather's and grandmother's highest level of education and maternal prenatal health care. Daughter's prepubertal BMI was converted to age (in months) and sex-specific percentiles based on the Centers for Disease Control definitions. BMI percentile at ages 8 to 9 years was included to test for mediational effects of body weight. However, to minimize missing data, values for BMI were based on surveys completed within 1 year, (before or after) the child was 8 to 9 years old. This age range (7–10 years) was specifically chosen because it generally follows SES assessment at the age of 7 years (to establish temporal precedence in mediational models) and because it typically precedes menarche for most girls in the United States.

Time-varying independent variables

Time-varying independent variables included SES indicators: family income, family wealth, household size, mother's education,