Published in final edited form as:

J Youth Adolesc. 2011 October ; 40(10): 1315–1328. doi:10.1007/s10964-010-9609-3.

Pubertal Timing and Early Sexual Intercourse in the Offspring of Teenage Mothers

Natacha M. De Genna,

Department of Psychiatry, University of Pittsburgh School of Medicine, Program in Epidemiology, Suite 138, Webster Hall, 4415 Fifth Avenue, Pittsburgh, PA 15213, USA

Cynthia Larkby, and

Department of Psychiatry, University of Pittsburgh School of Medicine, 3811 O'Hara Street, Pittsburgh, PA 15213, USA, larkby@pitt.edu; Department of Epidemiology, Graduate School of Public Health, 3811 O'Hara Street, Pittsburgh, PA 15213, USA

Marie D. Cornelius

Department of Psychiatry, University of Pittsburgh School of Medicine, 3811 O'Hara Street, Pittsburgh, PA 15213, USA, larkby@pitt.edu; Department of Epidemiology, Graduate School of Public Health, 3811 O'Hara Street, Pittsburgh, PA 15213, USA; mdc1@pitt.edu

Abstract

Early puberty is associated with stressful family environments, early sexual intercourse, and teenage pregnancy. We examined pubertal timing and sexual debut among the 14-year-old offspring of teenage mothers. Mothers (71% Black, 29% White) were recruited as pregnant teenagers (12–18 years old). Data were collected during pregnancy and when offspring were 6, 10 and 14 years old ($n = 318$). Adolescents (50% male) compared the timing of their pubertal maturation to same-sex peers. There was a significant 3-way interaction effect of race, sex, and pubertal timing on sexual debut ($n = 305$). This effect remained significant in a model controlling for maternal age at first intercourse, substance use, exposure to trauma, authoritative parenting, and peer sexual activity ($n = 255$). Early maturation was associated with early sex in daughters, and may be one pathway for the inter-generational transfer of risk for teenage pregnancy among daughters of teenage mothers.

Keywords

Adolescence; Puberty; Pregnancy; Sexual behavior

Introduction

The United States (US) has one of the highest teenage pregnancy and birth rates in the developed world (Guttmacher Institute 2010). Longitudinal studies of the offspring of teenage mothers suggest that their offspring are at risk for many negative outcomes across the lifespan, even after controlling for the effects of lower socioeconomic status (SES) (Furstenberg et al. 1990; Hardy et al. 1997; Shaw et al. 2006). Differences in risk between the children of adult mothers and the children of teenage mothers increase during adolescence, when the offspring of teenage mothers are at greater risk of using drugs (Fergusson and Woodward 1999), running away from home (Maynard 1996), joining a gang

(Pogarsky et al. 2006), and dropping out of school (Jaffee et al. 2001). One of the differences identified in this literature is a greater risk for the adolescent offspring of teenage mothers to become parents themselves (Barber 2001; Meade et al. 2008; Pogarsky et al. 2006). Therefore, the period of adolescence may be an optimal time to investigate the family, childhood and adolescent correlates of risk for teenage pregnancy in the offspring of teenage mothers.

Pubertal timing, specifically early puberty, is associated with early sexual intercourse and teenage pregnancy (Deardorff et al. 2005; Downing and Bellis 2009; Udry 1979). Pubertal timing may help explain why some but not all offspring of teenage parents perpetuate the cycle of teenage parenthood, if some offspring reach puberty earlier than others. Hormonal changes linked to puberty encourage sensation-seeking and stimulate sexual interest (Halpern 2006; Steinberg 2005; Udry et al. 1985) and this may increase risk for early sexual debut in vulnerable youth. The prefrontal cortex develops at a much slower rate than secondary sex characteristics (Nelson et al. 2005; Spear 2000) which means that, although they appear older than their peers, early-maturing girls and boys are more likely to be influenced by their emotions and social influences, and are less likely to be able to inhibit risky behavior (Barbalat et al. 2010; Steinberg 2005). Children who reach puberty early tend to attract older and more sexually-experienced peer groups and romantic partners where sexual intercourse may be the norm (Stattin and Magnusson 1990). It is not surprising, then, that early pubertal timing has been linked to early sexual intercourse and teenage pregnancy.

Racial/ethnic differences have been reported for pubertal timing, first sexual intercourse, and teenage pregnancy in the US. Black girls may reach puberty up to a year ahead of White girls (Butts and Seifer 2010). Some authors report a significant difference between White and Black girls after adjusting for SES (Wu et al. 2002) whereas others do not (Obeidallah et al. 2000). Black youth, on average, also tend to engage in sexual intercourse earlier than White youth (Cavazos-Rehg et al. 2009; De Rosa et al. 2010; Upchurch et al. 1998). Finally, Black adolescents have higher rates of teen pregnancy than White adolescents (Hamilton et al. 2010) and are also more likely to be raised by teenage mothers. Consequently, it is important to consider racial differences in the effects of pubertal timing on risk for sexual intercourse among the offspring of teenage mothers.

The onset of puberty may signal sexual readiness to others and place girls at risk for deviant peer involvement in White but not Black girls (Cavanagh 2004). For example, Black girls reached menarche significantly earlier than White girls from the National Longitudinal Study of Adolescent Health. However, age of menarche may not be a significant predictor of sexual debut (Cavanagh 2004) or teenage pregnancy (Kahn and Anderson 1992) in Black girls. Dunbar et al. (2008) examined age at menarche and age at first sexual intercourse in 1,030 pregnant adolescent girls. In this cohort, pregnant Black and White adolescent girls reported similar age at menarche and age at first sex, although the Black girls were younger than the White girls when they first became pregnant. Early age of first sex (chronological age at coitarche) almost completely mediated the association between early menarche and early pregnancy among the White girls, but this was not the case among the Black girls. However, Black girls with more advanced pubertal development when they first had sex (older gynecological age at coitarche) were significantly more likely to become pregnant.

The majority of studies of pubertal timing, age of first sex, and teenage pregnancy focus on girls. Studies of sexual debut that have included male participants indicate that early puberty also predicts early sex in boys (Flannery et al. 1993; Michaud et al. 2006; Zabin et al. 1986). Nonetheless, the negative consequences of early pubertal timing have been demonstrated much more consistently for girls (Graber et al. 2004; Zimmer-Gembeck and Helfand 2008). Similarly, although both sons and daughters of teenage mothers have an increased risk of

becoming teenage parents themselves compared with offspring of adult parents, there may be greater risk for the daughters (Furstenberg 2007). More importantly for the current study, recent research has identified more and different pathways to teenage pregnancy for daughters of teenage mothers, including pubertal timing (Campa and Eckenrode 2006). Thus, continued research on the effect of pubertal timing on risk for early sexual debut on boys is warranted, especially in families headed by teenage mothers.

One of the pathways to teenage pregnancy in offspring of teenage mothers may be through a less optimal family environment that, according to sociobiological and life history theories, may have an impact on pubertal timing and risk for early pregnancy. A lower quality family environment may promote both early physical maturity and early sexual behavior (Belsky et al. 1991, 2010; Ellis et al. 2009). Stress and stress reactivity fostered by this environment may also contribute to poor nutrition and adiposity in children (Jackson et al. 2000; Mellin et al. 2002; Roemmich et al. 2007), which may accelerate pubertal maturation (Dunger et al. 2006; Kaplowitz et al. 2001; Lee et al. 2007). Pubertal timing also appears to be moderately heritable (Mustanski et al. 2004; Rowe 2002; van den Berg and Boomsma 2007). A genetic predisposition for early puberty may help explain early maturation, early sexual intercourse, and greater risk for teenage pregnancy in the children of teenage mothers (Moffitt et al. 1992). Another hypothesis is that adverse environments amplify the effects of early puberty on risky behavior (Ge and Natsuaki 2009; Lynne-Landsman et al. 2010). Hence, studies of the effects of pubertal timing on sexual behavior in the offspring of teenage mothers should consider both the effects of genetic predisposition for early puberty and measures of the family environment.

Not all offspring of teenage mothers perpetuate the cycle of disadvantage by becoming teenage parents themselves (Furstenberg et al. 1990) and the variability in the teenage mothers, their offspring, home environments and peer effects may contribute to the multifinality of outcomes for these adolescents. The current literature suggests that some of the effects of teenage motherhood on children are explained by socioeconomic differences (Campa and Eckenrode 2006; Haveman et al. 1995; Manlove 1997). SES has been linked to early puberty (Braithwaite et al. 2009) and early intercourse (Lammers et al. 2000). Similarly, non-optimal family environments (Ge and Natsuaki 2009; Lynne-Landsman et al. 2010), child maltreatment (Black et al. 2009), adolescent substance use (Santelli et al. 2004), and having sexually active peers (De Rosa et al. 2010) have also been associated with early puberty and early sex. Consequently, investigations of the effects of pubertal timing on early sexual intercourse should consider the effects of these other covariates, especially in the families where they might also be prevalent.

Only one other study has prospectively examined the effect of pubertal timing on sexual intercourse by age 15 in the offspring of younger mothers. Campa and Eckenrode (2006) compared the offspring of teenage mothers and older mothers from the Elmira Nurse Family Partnership Project. They report that there was no difference in perceived pubertal timing (or age at menarche in the girls) between the 2 groups of offspring. The daughters of teenage mothers were more likely to engage in early sex than the daughters of older mothers, and this effect was not mediated by pubertal timing. There were no differences in early sex between the sons of older and younger mothers, but both early puberty and early sex were associated with the sons' risk of becoming a teenage father. Campa and Eckenrode do not report any interactions between pubertal timing and gender or any racial/ethnic differences in pubertal timing or early sex, but they may not have been able to examine racial/ethnic differences because the mothers were predominantly White. More research is needed on both sons and daughters, in more diverse samples, to investigate race and sex differences and interactions among race, sex and pubertal timing on risk for early sexual intercourse in this vulnerable group.

Hypotheses

The current study examines the intersections among race, sex, and pubertal timing in the sons and daughters of teenage mothers (71% Black, 29% White). We expected that the offspring of teenage mothers who reached puberty ahead of their peers would be more likely to have had sexual intercourse by age 14 than the offspring of teenage mothers whose pubertal timing was less advanced. We predicted that the effect of early maturation on risk for early intercourse would be greater for White offspring than for Black offspring. Based on the literature examining sex differences in the effects of pubertal timing, we further predicted that the effects of pubertal timing on risk for early sex would be greater for daughters than for sons of teenage mothers. Finally, we hypothesized that the effect of pubertal maturation, race and sex on risk for early intercourse would not be attenuated by covariates associated with teenage motherhood such as SES, childhood obesity, lower quality home environment, exposure to traumatic events, substance use, and more sexually-experienced peers.

Method

Procedure

The data for this study are from the Teen Mother Study, a prospective study of teenage mothers and their children. The pregnant adolescents were recruited from the Magee-Womens Hospital prenatal clinic from 1990 to 1995. They were interviewed after a prenatal medical examination during their second trimester, and again at delivery with their newborn infants. Follow-up visits were conducted in our laboratory when the offspring were 6 (1995–2000), 10 (2000–2005), and 14 years old (2005–2010). The Institutional Review Boards of the Magee-Womens Hospital and the University of Pittsburgh approved each phase of this study. Participants were informed about confidentiality and assured that their information was protected by a Certificate of Confidentiality issued by the National Institute on Drug Abuse (NIDA).

The first contact with the teenage mothers occurred before their fifth month prenatal visit. They were interviewed about their reproductive history and substance use in a private room at the prenatal clinic. At the 6-, 10-, and 14-year follow-up visits at our offices, the mothers provided information about their demographic and psychological status and recent substance use. Children were asked about peer substance use starting at age 10. At the age 14 assessment, the children reported on their own substance use and sexual behavior. Reports on maternal substance use, growth of the offspring, 6- and 10-year outcomes have been provided in previous reports (e.g., Cornelius et al. 1995; Cornelius et al. 1999, 2002, 2007, 2010, in press). The present study focuses on pubertal timing and sexual intercourse in the 318 offspring seen at age 14.

Participants

All pregnant 12–18 year olds attending the prenatal clinic were eligible for the study. Of the 448 girls who were originally approached to participate, 3 girls refused. Of the remaining 445 pregnant teenagers, 15 moved out of the area prior to delivery, and 1 refused the delivery interview. Additional losses included six twin births, five spontaneous abortions, two still-born infants, and three live-born pre-mature infants who died. Thus, 413 live-born singletons and their teenage mothers were assessed at delivery. A total of 318 women and their offspring were assessed at the 14-year follow-up phase, 77% of the birth cohort. Twenty-three mothers refused to participate, 54 were lost to follow-up, 9 had moved out of the state, 2 children were adopted, and 7 children had died. Out of the 318 completers, data for all measures in the current study were available for 254 mother–child dyads. Missing

data were examined using Little's test (Little and Rubin 2002) and determined to be missing completely at random. Prenatal substance use and SES did not differ significantly between those mothers who completed the age 14 follow-up and those who were not assessed during this wave.

The mothers, on average, were 16.3 years old (range = 12–18) at the time of the recruitment. Most of the teenage mothers (75%) were at least 16 years old: only 25% were 12–15 years old when they entered into the study. Seventy-one percent are Black, 29% are White, and 99% of them were unmarried at delivery (Cornelius et al. 1995). At the 14-year follow-up, the average monthly family income was \$2,253 (range = \$0–\$9,990) and mean education was 12.8 years (range = 7–18). Most of the mothers (73%) had completed high school or received a General Equivalency Diploma (GED): 5% completed college. Most of the mothers (72%) were not currently married.

The offspring, on average, were 14.5 years old ($SD = 0.6$; range = 13–16) at the last wave of testing. This sample included 158 daughters and 160 sons. Most of the children (84%) lived with their biological mothers at the age 14-year follow-up; the remaining 16% of the children lived with a custodian. The current custodian was interviewed for the study, so in these cases maternal responses reflect the responses of the current maternal figure for the child. A variable indicating that the child was not in his or her biological mother's custody at the age 14 follow-up visit was not significantly associated with pubertal timing ($r = .05$) or early sexual intercourse ($r = .05$) and was dropped from further analysis.

Measures

Pubertal Timing—Adolescents were asked to compare their pubertal development to same-sex and same-age peers on a 5-point scale, a measure of perceived pubertal timing used in several other longitudinal studies (Campa and Eckenrode 2006; Carter et al. 2009; Lynne et al. 2007). The offspring were asked: “Do you think your development is any earlier or later than most other boys (girls) your age?” The possible responses were: (1) much earlier than others your age, (2) a little earlier than others your age, (3) about the same as others your age, (4) a little later than others your age, (5) much later than others your age. Half the offspring (51%) that answered this question ($n = 310$) rated themselves as “about the same as others their age,” with 22% rating themselves as “a little earlier” and 7% rating themselves as “much earlier” than others their age. Fewer adolescents rated their pubertal development as “a little later” (13%) and “much later” (5%) than their peers. From these data on pubertal timing compared to same-age and same-sex peers, an ordinal variable was created (range = 1–5: $M = 2.87$, $SD = 0.91$) and used in the current study as the measure of pubertal timing. For descriptive purposes, this ordinal measure was also trichotomized into “early” for children responding 1–2, “on time” for children who responded 3, and “late” for children responding 4–5 to the pubertal timing question. There were no significant gender differences in either measure of pubertal timing. For example, 29% of girls and 30% of boys reported that they were “a little” or “much earlier” than their same-age peers ($t = -1.37$, $p > .05$).

Sexual Intercourse—Adolescents were asked, “Have you ever had sexual intercourse?” Nearly a quarter (24%) of the offspring responded “yes” to this question, and 76% answered “no”. This dichotomous variable was the outcome measure in the current study.

Maternal Characteristics at Baseline—Mothers reported their race at the time of entry into the Teen Mother Study. The young mothers were also asked “How old were you when first had sexual intercourse?” and “How old were you when you became pregnant for the first time?” Mothers were asked to round to nearest year (i.e., 14 years old, rather than 14

and a half). The mean age of first sex for the sample of teen mothers was 14.3 years ($SD = 1.4$ years) with a range of 6–17 years old. The mean age of first pregnancy was 16 ($SD = 1.3$) with a range of 12–18 years old.

Demographic Measures—Offspring sex was recorded at delivery. The child's birth month and year was used to calculate age at the 14-year assessment. Child age was included in the multivariate analyses to control for the age range among offspring, and the effect of chronological age on risk for sexual intercourse. Maternal education and monthly family income were measured by maternal report when the children were 6 and 14 years old. On average, mothers had 12 years of education at the 6-year follow-up ($SD = 1.4$; range = 7–17 years) and 12.8 years of education at the 14-year follow-up visit ($SD = 1.5$; range = 7–18 years). Average monthly family income was \$1356 at age 6 ($SD = 1138$) and \$2253 at age 14 ($SD = 1698$). Mothers were also asked about their marital status at these time points. Only 19% of the young mothers were married 6 years post-partum, and 28% reported that they were married at the most recent follow-up.

Maternal Substance Use—Maternal substance use was ascertained at each time point by self-report (see Cornelius et al. 1995, 2002, in press). For the current study, a dichotomous variable was created for cigarette smoking (any/none), heavy smoking (defined as 10 or more cigarette packs per day/less than that amount), heavy drinking (defined as average consumption of 2 or more alcoholic drinks per day/less than that amount), and marijuana use (any/none). Other illicit drug use was rare in this sample ($n = 5$ during pregnancy, $n = 3$ at age 6, $n = 5$ at age 14). The only variable retained in multivariate analyses for this study was maternal heavy drinking at the age 6 assessments, reported by 12% of the mothers.

Childhood Obesity—The children's height and weight at age 6 was used to calculate a Body Mass Index (BMI) for Age and Sex using the Centers for Disease Control parameters. A dichotomous childhood obesity variable was then created using these scores, with children coded as obese if their BMI was at or above the 95th percentile for their age and sex (14% of the sample) and not obese if their BMI was below the 95th percentile for their age and sex. Childhood obesity was not significantly correlated with pubertal timing ($r = .03$) or sexual intercourse by age 14 ($r = -.09$). The variable did not become significant in the multivariate model, and was dropped from further analyses.

Home Environment—The Home Observation for Measurement of the Environment—Short Form (HOME-SF; Baker and Mott 1989) was used to measure the quality and quantity of support available to the adolescent for cognitive, social, and emotional development. This measure was developed for the National Longitudinal Study of Youth (NLSY) in concert with the Robert Bradley, the creator of the original HOME measure. The HOME-SF has demonstrated acceptable validity in large datasets (Center for Human Resource Research 1993; Menaghan and Parcel 1991). In this study, the HOME-SF was completed by the mother or caregiver. Items from the cognitive stimulation subscale included questions such as “About how often does your child read for enjoyment?” And “Does your family encourage your child to start and keep doing hobbies?” Items such as “About how often does your child spend time with his/her father, stepfather, or a father-figure in outdoor activities” were used to create an emotional support subscale. The cognitive stimulation and emotional support subscales were summed to create the total HOME score used in the current analyses (range = 4–18, $M = 10.8$, $SD = 2.6$).

Parenting—Authoritative parenting was assessed with the My Parents questionnaire, which has 27 items measuring 3 dimensions of parenting: parental acceptance and involvement, autonomy-granting and strictness-supervision (Steinberg et al. 1992). The

parental involvement scale ($\alpha = .72$) included 15 questions asking adolescents how strongly they agreed or disagreed with items such as “I can count on my parent(s) to help me out, if I have some kind of problem” and “My parent(s) know who my friends are.” The autonomy-granting scale ($\alpha = .82$) includes 12 items such as “my parent(s) let me make my own plans for things I want to do” and “My parent(s) tell me that their ideas are correct and that I should not question them.” The strictness-supervision scale ($\alpha = .76$) includes 9 items such as “In a typical week, what is the latest that you can stay out on week nights (Sunday-Thursday)?” and “How much do your parents REALLY know about where you go at night?”

Scores from these 3 parenting scales were summed to create composite scores. An ordinal authoritative parenting score (range = 0–3, $M = 1.4$, $SD = 0.9$) was then generated using the method described by Steinberg et al. (1992). Scores above the sample median on the involvement, autonomy, and strictness-supervision scales were coded “3” for authoritative parenting. Scores below the sample median on all 3 dimensions of parenting were assigned an authoritative parenting score of “0.” Scores above the sample median on one or two dimensions received authoritative parenting scores of “1” or “2.”

Child Trauma—Child sexual abuse was assessed by adolescent self-report using the sexual abuse scale from the Childhood Trauma Questionnaire (CTQ; Bernstein and Fink 1998). Sexual abuse was defined using a cutpoint suggested in the CTQ manual: a dichotomous variable was created to represent probable sexual abuse (CTQ sexual abuse scale > 8), reported by 14.5% of the sample. Adolescents who endorsed any sexual abuse were interviewed by a senior investigator to determine whether they were at continued risk and should be referred to the local child protective services agency. Sexual abuse was not significantly correlated with pubertal timing ($r = -.06$) or sexual intercourse by age 14 ($r = .10$), did not become significant in the multivariate model, and was subsequently dropped from analyses.

Exposure to non-sexual trauma was measured by adolescent self-report at age 14 using a modified version of the Trauma Assessment for Adults (TAA; Resnick et al. 1993, 1996). The TAA assesses current and past history of traumatic events including accidents, natural disasters, serious illnesses, unwanted sexual experiences, physical assault, witnessed violence, and murder of a close friend or family member. Adolescents who endorsed any victimization were interviewed by a senior investigator to determine whether they were at continued risk and should be referred to the local child protective services agency. For these analyses, we summed the number of endorsed life-time traumatic experiences, omitting the unwanted sexual experiences item because of overlap with the sexual abuse measure. Among the offspring who completed this measure ($n = 278$), 60% reported that they had been exposed to at least one traumatic event. Responses ranged from none to 5, with a mean score of 0.8 events ($SD = 0.9$).

Adolescent and Peer Substance Use—Substance use was measured among the adolescents who reported ever trying cigarettes, alcohol, marijuana and other substances. These dichotomous variables were used in the current analyses: ever cigarette use (28%), ever alcohol use (20%), and ever marijuana use (21%). Ever cigarette use was defined as more than just a puff, ever alcohol use was defined as more than just a sip of alcohol, and ever marijuana use was defined as ever having tried marijuana.

Peer cigarette and alcohol use was measured at age 10. The offspring were asked what proportion of their friends used each substance: none, some, most, or all. These variables were then dichotomized (0 = none, 1 = some/most/all). Thirty-six percent of the offspring reported that their peers were smoking cigarettes by age 10. A similar percentage of the

offspring (37%) reported that their peers used alcohol by age 10, but this variable was not significantly associated with pubertal timing ($r = .03$). Although peer alcohol use by age 10 was significantly correlated with early sexual intercourse ($r = .10, p < .05$), it was not significant in the regression analysis and therefore is not included in the final model.

Peer Sexual Activity—Peer sexual activity was assessed during the age 14 follow-up. The adolescents were asked how many of their peers had engaged in sex using the following forced-choice response set: none of them (51%), some of them (21%), most of them (17%), all of them (11%). The responses to this question were used to create an ordinal variable for peer sexual activity (range = 1–4, $M = 1.9$, $SD = 1.0$).

Statistical Analyses

All variables were screened for outliers, and outliers were brought to within 3 standard deviations of the mean scores. Missing data on specific variables were not imputed; thus, there were different sample sizes for different analyses, depending on which variables were entered into the model. T-tests and chi-square tests of differences were used to describe sample characteristics as a function of race and sex. Due to the sample size and the large pool of potential covariates suggested by the literature, the number of predictors included in the regression analyses was limited. Correlation analyses were conducted to examine bivariate associations among the covariates, pubertal timing, and sexual intercourse. Logistic regression analysis was used to investigate the contribution of pubertal timing and interactions between race, sex and pubertal timing to risk for sexual intercourse by age 14. This was followed by a more comprehensive regression analysis to determine whether covariates identified in the literature attenuated the associations among pubertal timing, race and sex.

Results

Differences in sample characteristics as a function of race are presented in Table 1. The Black teenage mothers became pregnant at a younger age, were less likely to be married 6 and 14 years post-partum, and reported lower family income at all time points than the White teenage mothers. The Black teenage mothers in this sample reported more years of education 6 years post-partum, but this advantage had disappeared 8 years later. Black offspring were exposed to more traumatic experiences during childhood and had lower HOME scores than the White offspring. Black offspring were nearly twice as likely to report late pubertal timing than were White offspring. However, they reported more sexual activity themselves and among their peers than did the White offspring. The White offspring of teenage mothers were more likely to have used cigarettes and alcohol by age 14.

Differences in sample characteristics as a function of sex are presented in Table 2. There was only one statistically significant difference between the male and female offspring in this sample. The sons were more likely to report having had sexual intercourse than were the daughters.

The final equation of the logistic regression model predicting sexual intercourse by the age of 14 years included pubertal timing, race, sex and interactions among these 3 variables and explained 13% of the variance ($\chi^2 = 28.59, p < .001$). As seen in Table 3, there was a significant Pubertal Timing $\times$ Race $\times$ Sex interaction effect on risk for early sexual intercourse. The interaction is depicted in Fig. 1. Half of the White girls who reported that they reached puberty earlier than their same-aged female peers had sex by age 14, compared to only 27% of early-maturing black girls and 36% of early-maturing black boys. The Black male offspring were more likely to have early sex than the other offspring, regardless of their pubertal timing (35% of early-maturers, 36% who were on-time, and 45% who

reported that they were late bloomers reported early sex). By contrast, the White male offspring were significantly less likely to have sexual intercourse than children from the other groups.

The final step of the full model with all of the covariates is presented in Table 4. This logistic regression model explained 60% of the variance in sex by age 14 in this sample of adolescent offspring of teenage mothers ($\chi^2 = 131.35, p < .001$). The three-way interaction term remained significant in this model, suggesting that the interaction effect of pubertal timing $\times$ race $\times$ sex was not attenuated by the covariates. Older child age at time of testing, peer cigarette use by age 10, exposure to trauma, ever cigarette use, ever marijuana use and greater peer sexual activity were also risk factors for early sex in this sample. Authoritative parenting was a buffer against sexual intercourse by age 14. Two maternal characteristics, earlier maternal age at first sex and maternal heavy drinking at 6 years post-partum, were associated with sex by age 14 in offspring.

Discussion

Adolescence appears to be a crucial period for the offspring of teenage mothers, when association with deviant peers may lead to health-risk behavior (e.g., smoking, marijuana use, early sexual intercourse) that can have a long-term impact on health and life outcomes. There is now a substantial body of literature associating pubertal timing with teenage pregnancy, disadvantaged environments, and risky behavior such as early sexual intercourse (e.g., Campa and Eckenrode 2006; Deardorff et al. 2005; Moffitt et al. 1992). These associations are complex, involve a myriad of environmental factors, and may differ for boys and girls (Westling et al. 2008; Udry and Billy 1987). However, few studies have examined the effect of pubertal timing on early sex in the offspring of teenage mothers. To date, none has considered maturation effects in Black and White sons as well as daughters. The current study investigates interaction effects of race, sex, and pubertal timing on early sexual intercourse in a birth cohort that provides a wealth of information about mothers and adolescent offspring from multiple time points.

Our findings support the hypothesis that adolescent offspring who reached puberty earlier than their peers would be at greater risk of early sexual intercourse, with one caveat: race and sex also matter. There was a significant three-way interaction of the effects of race and sex and pubertal timing on early sexual intercourse. As expected, the risk of early sex was inversely related to pubertal maturation in girls. However, a pure linear decrease in risk for early sex with later puberty was only seen in the Black female offspring. By contrast, later pubertal maturation did not appear to be more protective against early sex for the White daughters than being “on-time” with their peers. Additionally, a greater percentage of early-maturing White daughters had sex by age 14 than did early-maturing Black daughters, consistent with our prediction that early puberty would be a better predictor of early sex in White offspring. Although pubertal timing predicts early sex in the adolescent offspring of teenage mothers, this effect is moderated by the race and gender of the child.

One implication of these results is that early puberty may be a risk factor for teenage pregnancy in Black and White daughters of teenage mothers, despite reported racial differences in pubertal timing and age of first intercourse. Dunbar et al. (2008) reported that early sex almost entirely mediated the relationship between age at menarche and teenage pregnancy in White girls in the Colorado Adolescent Maternity Program. Campa and Eckenrode (2006) found that physical development mediated the effect of teenage fatherhood in the sons of teenage mothers (but not in the daughters) in their predominantly White sample. The daughters of teenage mothers who had sex by age 15 were significantly more likely to become teenage mothers, and this was not mediated by pubertal timing. Kahn

and Anderson (1992), in their analyses using the 1988 National Survey of Family Growth (NSFG), found that age at menarche did not predict teenage pregnancy in Black girls once early sex was added to the model. However, both age at menarche and early sex independently predicted teenage pregnancy in White girls. Moreover, they reported that the adolescent daughters of teenage mothers were more likely to become pregnant than the daughters of older mothers, even after controlling for age at menarche and age at first sex. Early puberty and early sex may have additive risk effects on the White daughters of teenage mothers, above and beyond the risk of having a teenage mother. We plan to explore these associations further when we examine data collected when the offspring are 16 years old.

Consistent with our hypothesis about gender differences, there was a stronger effect of pubertal timing on female offspring than on the male offspring. Pubertal timing appeared to have no effect whatsoever on risk for early sexual intercourse in Black sons, who were at greatest risk of sexual debut by age 14, consistent with the literature (Cavazos-Rehg et al. 2009; Furstenberg et al. 1987; Upchurch et al. 1998). White sons who reported early or late maturation were protected from early sexual intercourse compared to sons who reported being “on-time.” The rate of early sexual intercourse was very low in this subgroup of White sons (8%) and these results may be evidence of a floor effect. Nevertheless, White sons of adult mothers selected from the same hospital prenatal clinic were less likely to have had sex by this age than all of the daughters and the Black sons (De Genna et al. 2008). Early maturation may have less effect on boys’ risk for early sex because normative social pressures to have sex may be stronger for them during early adolescence (especially for Black boys) than for girls (Flannery et al. 1993; Zabin et al. 1986).

Many of the covariates entered into the final model were significant predictors of early sex, highlighting the importance of considering factors from several domains. For example, maternal age at first sex was a significant risk factor for early intercourse in offspring, consistent with the literature (Campa and Eckenrode 2006; Mott et al. 1996). This variable was included in the multivariate model as a partial control for genetic effects, although it is impossible to conclude that early sex is heritable using these data. Maternal substance use was also associated with early sexual debut in offspring, whereas authoritative parenting was protective against early sex in these families. The finding that traumatic experiences contributed to risk for sexual debut by age 14 is consistent with a recent prospective study of maltreated youth (Black et al. 2009) and with sociobiological and life history theories that emphasize the importance of the environments for early maturity and sexual behavior. This result is also compatible with the “subjective weathering” hypothesis linking childhood trauma to early puberty and early role transitions such as teenage pregnancy (Obeidallah et al. 2000). These findings suggest that studies examining the effect of pubertal timing on early sex, especially studies examining these effects in the offspring of teenage mothers, should consider risk from several domains including maternal characteristics, parenting, and exposure to trauma.

Several covariates identified as risk factors in the literature on early sexual intercourse did not reach significance in our multivariate model. Common indicators of SES such as maternal education and family income were not predictors of sex by age 14. Childhood obesity was initially included in the analyses because of its association with both stressful family environments (Mellin et al. 2002; Roemmich et al. 2007) thought to be more common in families of teenage mothers, and with early puberty (Kaplowitz et al. 2001; Lee et al. 2007). However, obesity at age 6 was not associated with perceived pubertal timing or with risk for early sexual intercourse in this sample. It is possible that childhood obesity predicts early puberty in girls only (Wang 2002). Finally, in contrast to several reports (e.g., Putnam 2003; Upchurch and Kusunoki 2004), child sexual abuse was not a predictor of early sexual intercourse in this sample.

One in four of the adolescents in this study reported sexual intercourse by age 14, a much higher number than expected based on the available data on sexual debut (Abma et al. 2004; Santelli et al. 2004). This finding is consistent with previous reports that the offspring of teenage mothers are at greater risk of engaging in early sexual intercourse (Campa and Eckenrode 2006) and may partially explain their vulnerability to teenage pregnancy. Early adolescents who have intercourse are likely to continue having sex across adolescence (Tubman et al. 1996) and engage in riskier sexual behavior, such as more having multiple sex partners and using condoms less consistently (Melchert and Burnett 1990; Smith 1997). Although the sons and daughters of teenage mothers are significantly more likely to become pregnant than their peers, the majority do not (Furstenberg 2007; Jaffee et al. 2001). Campa and Eckenrode (2006) report that daughters of unmarried teenage mothers are more likely to have early intercourse than sons of unmarried teenage mothers. It is possible that early puberty may be a turning point for some of these daughters, placing them at especially high risk of early sex. For that reason, early-maturing daughters of teenage mothers may be particularly more likely to perpetuate the cycle of teenage motherhood.

Limitations

There were several limitations to the current study. The measure of pubertal timing was based on adolescent self-report concurrent with our self-report measure of sexual intercourse. Other authors have used similar measures of perceived pubertal timing and also report more difficulties for children who feel that they have matured ahead of their peers (Campa and Eckenrode 2006; Carter et al. 2009; Lynne et al. 2007). Moreover, this measure of pubertal timing may be superior to single measures of physical events such as menarche, spermatarche, or breast development. For example, even though menarche is the most commonly used measure of puberty in studies on girls, it is a private event and only captures a single point during the years-long developmental process of puberty (Carter et al. 2009). However, due to the concurrent nature of our measures of pubertal timing and sexual debut, it is possible that girls who have had sexual intercourse may report that they have matured ahead of their peers, regardless of the timing of their physical development. Another limitation was the absence of neighborhood measures of stress and disadvantage, which may also help explain the effect of pubertal timing on risk for early intercourse in the offspring of teenage mothers (Browning et al. 2004; Obeidallah et al. 2004). Despite these limitations, the current study contributes to the literature on the effects of pubertal timing and early sexual debut in the adolescent offspring of teenage mothers.

Prevention

Based on our findings and the prevention literature, we offer several suggestions for reducing the risk of teenage motherhood across generations. There is evidence that nurse home visitation for teenage mothers may buffer daughters against early sex (Olds et al. 1998) and teenage pregnancy (Eckenrode et al. 2010). Graber et al. (2010) recommend both family-based initiatives centered on improving parent-child relationships and communication about puberty, as well as peer-focused initiatives focused on healthier peer networks. One practical implication of this study is that early physical maturation can help concerned adults identify at-risk youth, and this early identification could help target the most vulnerable populations. Programs for these children should help them remain engaged in their education and communities, focus on intentions to have sex or remain abstinent, discuss perceptions of peer norms, provide skill-based information about contraception, and limit unsupervised time alone at home (Buhi and Goodson 2007; Suellentrop 2010).

Conclusions

This is the first prospective study to examine the effects of pubertal timing on early sexual intercourse in the White and Black sons and daughters of teenage mothers. These findings

contribute to the literature on the prevalence and correlates of early sex in the offspring of teenage mothers. There was a significant interaction between pubertal timing, race and sex of the offspring. Early puberty may be a better predictor of early sex for daughters of teenage mothers than for sons, especially in White offspring. Half of the White daughters who reported that they reached puberty ahead of their female peers had sex by age 14. Early puberty and early sexual intercourse are both associated with teenage pregnancy, and may be one pathway for the inter-generational transfer of risk for teenage pregnancy among daughters of teenage mothers.

Author Biographies

Natacha M. De Genna is an Assistant Professor of Psychiatry at the University of Pittsburgh Medical School. She received her PhD in Developmental Psychology from Concordia University (Montreal, Canada). Her research interests include psychosocial correlates of health-risk behavior across the lifespan, reproductive health, and inter-generational studies.

Cynthia Larkby is an Assistant Professor of Psychiatry and Epidemiology at the University of Pittsburgh School of Medicine. She received a PhD in Epidemiology in 1998 from the University of Pittsburgh. Dr. Larkby's primary research focus is on the long-term effects of childhood adversities, such as maltreatment and traumatic events, on substance use and other psychopathology in adolescence and adulthood.

Marie D. Cornelius is an Associate Professor of Psychiatry and Epidemiology at the Graduate School of Public Health at the University of Pittsburgh School of Medicine and the Director of the Interdisciplinary Alcohol Research Training Program. She received her PhD in Epidemiology at the University of Pittsburgh. Her research interests focus on the long-term effects of gestational cigarette smoke exposure on offspring and the interplay between hereditary factors and gestational nicotine exposure with offspring nicotine dependence.

References

- Abma JC, Martinez GM, Mosher WD, Dawson BS. Teenagers in the United States: Sexual activity, contraceptive use, and childbearing, 2002. Vital and Health Statistics. 2004; 23(24):1–48.
- Baker, P.; Mott, F. National longitudinal study of youth child handbook. Center for Human Resource Research: Ohio State University; 1989.
- Barbalat G, Domenech P, Vernet M, Fournieret P. Approche neuroéconomique de la prise de risque à l'adolescence. [Risk-taking in adolescence: A neuroeconomics approach]. Encephale. 2010; 36(2): 147–154. [PubMed: 20434632]
- Barber JS. The intergenerational transmission of age at first birth among married and unmarried men and women. Social Science Research. 2001; 30(2):219–247.
- Belsky J, Steinberg L, Draper P. Childhood experience, interpersonal development, and reproductive strategy: An evolutionary theory of socialization. Child Development. 1991; 62:647–670. [PubMed: 1935336]
- Belsky J, Steinberg L, Houts RM, Halpern-Felsher BL, NICHD Early Child Care Research Network. The development of reproductive strategy in females: Early maternal harshness → earlier menarche → increased sexual risk taking. Developmental Psychology. 2010; 46(1):120–128. [PubMed: 20053011]
- Bernstein, DP.; Fink, L. Childhood Trauma Questionnaire: A retrospective self-report manual. The Psychological Corporation; San Antonio, TX: 1998.
- Black MM, Oberlander SE, Lewis T, Knight ED, Zolotor AJ, Litrownik AJ, et al. Sexual intercourse among adolescents maltreated before age 12: A prospective investigation. Pediatrics. 2009; 124(3): 941–949. [PubMed: 19706574]

- Braithwaite D, Moore DH, Lustig RH, Epel ES, Ong KK, Rehkopf DH, et al. Socioeconomic status in relation to early menarche among black and white girls. *Cancer Causes and Control*. 2009; 20(5): 713–720. [PubMed: 19107561]
- Browning CR, Leventhal T, Brooks-Gunn J. Neighborhood context and racial differences in early adolescent sexual activity. *Demography*. 2004; 41(4):697–720. [PubMed: 15622950]
- Buhi ER, Goodson P. Predictors of adolescent sexual behavior and intention: A theory-guided systematic review. *Journal of Adolescent Health*. 2007; 40(1):4–21. [PubMed: 17185201]
- Butts SF, Seifer DB. Racial and ethnic differences in reproductive potential across the life cycle. *Fertility and Sterility*. 2010; 93(3):681–690. [PubMed: 19939362]
- Campa MI, Eckenrode JJ. Pathways to intergenerational adolescent childbearing in a high-risk sample. *Journal of Marriage and the Family*. 2006; 68:558–572.
- Carter R, Jaccard J, Silverman WK, Pina AA. Pubertal timing and its link to behavioral and emotional problems among 'at-risk' African American adolescent girls. *Journal of Adolescence*. 2009; 32(3): 467–481. [PubMed: 18801563]
- Cavanagh SE. The sexual debut of girls in early adolescence: The intersection of race, pubertal timing, and friendship group characteristics. *Journal of Research on Adolescence*. 2004; 14:285–312.
- Cavazos-Rehg PA, Krauss MJ, Spitznagel EL, Schootman M, Bucholz KK, Peipert JF, et al. Age of sexual debut among US adolescents. *Contraception*. 2009; 80(2):158–162. [PubMed: 19631791]
- Center for Human Resource Research. NLSY child handbook. Center for Human Resource Research, Ohio State University; Columbus, OH: 1993. p. 85-95.
- Cornelius, MD.; Day, NL.; Richardson, G.; Taylor, P. Epidemiology of substance abuse during pregnancy. In: Ott, P.; Tarter, R.; Ammerman, R., editors. *Sourcebook on substance abuse: Etiology, epidemiology, assessment and treatment*. Allyn and Bacon; Needham Heights, MA: 1999. p. 1-13.
- Cornelius M, De Genna N, Leech S, Willford J. Effects of prenatal tobacco exposure on neurobehavioral outcomes of 10-year-old children of teenage mothers. *Neurotoxicology and Teratology*. in press.
- Cornelius MD, Goldschmidt L, Day NL, Larkby C. Alcohol, tobacco, and marijuana use among pregnant teenagers: Six-year follow-up of offspring growth effects. *Neurotoxicology and Teratology*. 2002; 24:703–710. [PubMed: 12460652]
- Cornelius MD, Goldschmidt L, De Genna NM, Day NL. Smoking during teenage pregnancies: Effects on behavioral problems in offspring. *Nicotine & Tobacco Research*. 2007; 9(7):739–750. [PubMed: 17577803]
- Cornelius MD, Goldschmidt L, De Genna NM, Richardson GA, Leech SL, Day R. Improvement in intelligence test scores from 6 to 10 years in children of teenage mothers. *Journal of Developmental and Behavioral Pediatrics*. 2010; 31(5):405–413. [PubMed: 20495472]
- Cornelius MD, Taylor P, Geva D. Prenatal tobacco and marijuana use among adolescents: Effects on offspring gestational age, growth and morphology. *Pediatrics*. 1995; 95:438–443.
- De Genna, NM.; Cornelius, MD.; Leech, SL.; Day, N. Predictors of sexual intercourse at ages 14 and 16; Paper presented as part of a symposium entitled "Longitudinal Predictors of Change in Sexual Risk across Adolescence" at the Biannual Meeting of the Society for Research on Adolescence (SRA) on March 9, 2008 in Chicago; 2008;
- De Rosa CJ, Ethier KA, Kim DH, Cumberland WG, Afifi AA, Kotlerman J, et al. Sexual Intercourse and oral sex among public middle school students: Prevalence and correlates. *Perspectives on Sex and Reproductive Health*. 2010; 42(3):197–205.
- Deardorff J, Gonzales NA, Christopher FS, Roosa MW, Millsap RE. Early puberty and adolescent pregnancy: The influence of alcohol use. *Pediatrics*. 2005; 116:1451–1456. [PubMed: 16322170]
- Downing J, Bellis MA. Early pubertal onset and its relationship with sexual risk taking, substance use and anti-social behaviour: A preliminary cross-sectional study. *BMC Public Health*. 2009; 9:446. [PubMed: 19958543]
- Dunbar J, Sheeder J, Lezotte D, Dabelea D, Stevens-Simon C. Age at menarche and first pregnancy among psychosocially at-risk adolescents. *American Journal of Public Health*. 2008; 98(10):1822–1824. [PubMed: 18703451]

- Dunger DB, Ahmed ML, Ong KK. Early and late weight gain and the timing of puberty. *Molecular and Cellular Endocrinology*. 2006; 25(254–255):140–145. [PubMed: 16824679]
- Eckenrode J, Campa M, Luckey DW, Henderson CR Jr. Cole R, Kitzman H, et al. Long-term effects of prenatal and infancy nurse home visitation on the life course of youths: 19-year follow-up of a randomized trial. *Archives of Pediatric Adolescent Medicine*. 2010; 164(1):9–15.
- Ellis BJ, Figueredo AJ, Brumbach BH, Schlomer GL. Fundamental dimensions of environmental risk: The impact of harsh versus unpredictable environments on the evolution and development of life history strategies. *Human Nature*. 2009; 20:204–268.
- Fergusson DM, Woodward LJ. Maternal age and educational and psychosocial outcomes in early adulthood. *Journal of Child Psychology and Psychiatry*. 1999; 40:479–489. [PubMed: 10190348]
- Flannery DJ, Rowe DC, Gulley BL. Impact of pubertal status, timing, and age on adolescent sexual experience and delinquency. *Journal of Adolescent Research*. 1993; 8:21–40.
- Furstenberg, FF. *Destinies of the disadvantaged. The politics of teen childbearing*. Russell Sage Foundation; New York: 2007.
- Furstenberg FF, Brooks-Gunn J, Morgan P. Adolescent mothers and their children later in life. *Family Planning Perspectives*. 1987; 19:142–151. [PubMed: 3678480]
- Furstenberg FF, Levine JA, Brooks-Gunn J. The children of teenage mothers: Patterns of early childbearing in two generations. *Family Planning Perspectives*. 1990; 22:54–61. [PubMed: 2347409]
- Ge X, Natsuaki MN. In search of explanations for early pubertal timing effects on developmental psychopathology. *Current Directions in Psychological Science*. 2009; 18(6):327–331.
- Graber JA, Nichols TR, Brooks-Gunn J. Putting pubertal timing in developmental context: Implications for prevention. *Developmental Psychobiology*. 2010; 52(3):254–262. [PubMed: 20196112]
- Graber JA, Seeley JR, Brooks-Gunn J, Lewinsohn PM. Is pubertal timing associated with psychopathology in young adulthood? *Journal of the American Academy of Child and Adolescent Psychiatry*. 2004; 43:718–726. [PubMed: 15167088]
- Guttmacher Institute. Facts on American teens' sexual and reproductive health. 2010. Retrieved January 2010. Available at: <http://www.guttmacher.org/pubs/FB-ATSRH.pdf>
- Halpern, CT. Integrating hormones and other biological factors into a developmental systems model of adolescent female sexuality. In: Diamond, LM., editor. *Rethinking positive adolescent female sexual development. New directions for child and adolescent development*. Jossey-Bass; San Francisco, CA: 2006. p. 9-22.
- Hamilton, BE.; Martin, J.; Ventura, SJ. National vital statistics reports web release. Vol. 58. National Center for Health Statistics; Hyattsville, MD: 2010. Births: Preliminary data for 2008.
- Hardy, JB.; Shapiro, S.; Astone, NM.; Miller, TL.; Brooks-Gunn, J.; Hilton, SC. *Pediatrics*. Vol. 100. 1997. Adolescent childbearing revisited: The age of inner-city mothers at delivery is a determinant of their children's self-sufficiency at age 27 to 33; p. 802-809.
- Haveman, R.; Wolfe, B.; Peterson, E. *Institute for Research on Poverty Discussion Papers*. University of Wisconsin Institute for Research on Poverty; 1995. The intergenerational effects of early childbearing; p. 1071-1095.
- Jackson TD, Grilo CM, Masheb RM. Teasing history, onset of obesity, current eating disorder psychopathology, body dissatisfaction, and psychological functioning in binge eating disorder. *Obesity Research*. 2000; 8:451–458. [PubMed: 11011912]
- Jaffee S, Caspi A, Moffitt TE, Belsky J, Silva P. Why are children born to teen mothers at risk for adverse outcomes in young adulthood? Results from a 20-year longitudinal study. *Development and Psychopathology*. 2001; 13:377–397. [PubMed: 11393652]
- Kahn JR, Anderson KE. Intergenerational patterns of teenage fertility. *Demography*. 1992; 29:39–57. [PubMed: 1547902]
- Kaplowitz PB, Slora EJ, Wasserman RC, Pedlow SE, Herman-Giddens ME. Earlier onset of puberty in girls: Relation to increased body mass index and race. *Pediatrics*. 2001; 108(2):347–353. [PubMed: 11483799]

- Lammers C, Ireland M, Resnick M, Blum R. Influences on adolescents' decision to postpone onset of sexual intercourse: a survival analysis of virginity among youths aged 13 to 18 years. *Journal of Adolescent Health*. 2000; 26(1):42–48. [PubMed: 10638717]
- Lee JM, Appugliese D, Kaciroti N, Corwyn RF, Bradley RH, Lumeng JC. Weight status in young girls and the onset of puberty. *Pediatrics*. 2007; 119(3):624–630. Available at: www.pediatrics.org/cgi/content/full/119/3/e624.
- Little, RJA.; Rubin, DB. Statistical analysis with missing data. 2nd ed.. Wiley; New York: 2002.
- Lynne SD, Graber JA, Nichols TR, Brooks-Gunn J, Botvin GJ. Links between pubertal timing, peer influences, and externalizing behaviors among urban students followed through middle school. *Journal of Adolescent Health*. 2007; 40(2):181e.7–181e.13. [PubMed: 17259062]
- Lynne-Landsman SD, Graber JA, Andrews JA. Do trajectories of household risk in childhood moderate pubertal timing effects on substance initiation in middle school? *Developmental Psychology*. 2010; 46(4):853–868. [PubMed: 20604607]
- Manlove J. Early motherhood in an intergenerational perspective: The experiences of a British cohort. *Journal of Marriage and the Family*. 1997; 59:263–279.
- Maynard, RA. Kids having kids: A Robin Hood foundation special report on the costs of adolescent childbearing. Robin Hood Foundation; New York: 1996.
- Meade CS, Kershaw TS, Ickovics JR. The intergenerational cycle of teenage motherhood: An ecological approach. *Health Psychology*. 2008; 27(4):419–429. [PubMed: 18642999]
- Melchert T, Burnett KF. Attitudes, knowledge, and sexual behavior of high-risk adolescents: Implications for counseling and sexuality education. *Journal of Counseling and Development*. 1990; 68:293–298.
- Mellin AE, Neumark-Sztainer D, Story M, Ireland M, Resnick MD. Unhealthy behaviors and psychosocial difficulties among overweight adolescents: The potential impact of familial factors. *Journal of Adolescent Health*. 2002; 31:145–153. [PubMed: 12127384]
- Menaghan EG, Parcel TL. Determining children's home environments: The impact of maternal characteristics and current occupational and family conditions. *Journal of Marriage and the Family*. 1991; 53:417–431.
- Michaud PA, Surisa JC, Deppena A. Gender-related psychological and behavioural correlates of pubertal timing in a national sample of Swiss adolescents. *Molecular and Cellular Endocrinology*. 2006; 254–255:172–178.
- Moffitt TE, Caspi A, Belsky J, Silva PA. Childhood experience and the onset of menarche: A test of a sociobiological model. *Child Development*. 1992; 63(1):47–58. [PubMed: 1551329]
- Mott FL, Fondell MM, Hu PN, Kowaleski-Jones L, Menaghan EG. The determinants of first sex by age 14 in a high-risk adolescent population. *Family Planning Perspectives*. 1996; 28(1):13–18. [PubMed: 8822410]
- Mustanski BS, Viken RJ, Kaprio J, Pulkkinen L, Rose RJ. Genetic and environmental influences on pubertal development: Longitudinal data from Finnish twins at ages 11 and 14. *Development and Psychopathology*. 2004; 40(6):1188–1198.
- Nelson EE, Leibenluft E, McClure EB, Pine DS. The social reorientations of adolescence: A neuroscience perspective on the process and its relation to psychopathology. *Psychological Medicine*. 2005; 35:1–12.
- Obeidallah D, Brennan RT, Brooks-Gunn J, Earls F. Links between pubertal timing and neighborhood contexts: Implications for girls' violent behavior. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2004; 43(12):1460–1468. [PubMed: 15564815]
- Obeidallah DA, Brennan RT, Brooks-Gunn J, Kindlon D, Earls F. Socioeconomic status, race, and girls' pubertal maturation: Results from the Project on Human Development in Chicago Neighborhoods. *Journal of Research on Adolescence*. 2000; 10(4):443–464.
- Olds D, Henderson CR Jr. Cole R, Eckenrode J, Kitzman H, Luckey D, et al. Long-term effects of nurse home visitation on children's criminal and antisocial behavior: 15-year follow-up of a randomized controlled trial. *Journal of the American Medical Association*. 1998; 280(14):1238–1244. [PubMed: 9786373]
- Pogarsky G, Thornberry TP, Lizotte AJ. Developmental outcomes for children of young mothers. *Journal of Marriage and the Family*. 2006; 68:332–344.

- Putnam FW. Ten-year research update review: Child sexual abuse. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2003; 42(3):269–278. [PubMed: 12595779]
- Resnick, HS.; Falsetti, SA.; Kilpatrick, DG.; Freedy, JR. Assessment of rape and other civilian trauma-related post-traumatic stress disorder: Emphasis on assessment of potentially traumatic events. In: Miller, TW., editor. *Stressful life events*. International Universities Press; Madison: 1996. p. 231–266.
- Resnick HS, Kilpatrick DG, Dansky BS, Saunders BE, Best CL. Prevalence of civilian trauma and post-traumatic stress disorder in a representative national sample of women. *Journal of Consulting and Clinical Psychology*. 1993; 61:984–991. [PubMed: 8113499]
- Roemmich JN, Smith JR, Epstein LH, Lambiase M. Stress reactivity and adiposity of youth. *Obesity*. 2007; 15(9):2303–2310. [PubMed: 17890499]
- Rowe DC. On genetic variation in menarche and age at first sexual intercourse—A critique of the Belsky-Draper hypothesis. *Evolution and Human Behavior*. 2002; 23(5):365–372.
- Santelli JS, Kaiser J, Hirsch L, Radosh A, Simkin L, Middlestadt S. Initiation of sexual intercourse among middle school adolescents: The influence of psychosocial factors. *Journal of Adolescent Health*. 2004; 34:200–208. [PubMed: 14967343]
- Shaw M, Lawlor DA, Najman JM. Teenage children of teenage mothers: Psychological, behavioural and health outcomes from an Australian prospective longitudinal study. *Social Science and Medicine*. 2006; 62:2526–2539. [PubMed: 16332404]
- Smith CA. Factors associated with early sexual activity among urban adolescents. *Social Work*. 1997; 42:334–346. [PubMed: 9228830]
- Spear LP. The adolescent brain and age-related behavioral manifestations. *Neuroscience and Biobehavioral Review*. 2000; 24:417–463.
- Stattin, H.; Magnusson, D. Pubertal maturation in female development. Erlbaum; Hillsdale, NJ: 1990.
- Steinberg L. Cognitive and affective development in adolescence. *Trends in Cognitive Science*. 2005; 9(2):69–74.
- Steinberg L, Lamborn SD, Dornbusch SM, Darling N. Impact of parenting practices on adolescent achievement: Authoritative parenting, school involvement, and encouragement to succeed. *Child Development*. 1992; 63:1266–1281. [PubMed: 1446552]
- Suellentrop, K. What works 2010: Curriculum-based programs that help prevent teen pregnancy. The National Campaign to Prevent Teen and Unplanned Pregnancy; Washington, DC: 2010. Available at: <http://www.thenationalcampaign.org/resources/pdf/pubs/WhatWorks.pdf>
- Tubman JG, Windle M, Windle RC. The onset and cross-temporal patterning of sexual intercourse in middle adolescence: Prospective relations with behavioral and emotional problems. *Child Development*. 1996; 67(2):327–343. [PubMed: 8625716]
- Udry JR. Age at menarche, at first intercourse, and at first pregnancy. *Journal of Biological Sciences*. 1979; 11:411–433.
- Udry JR, Billy JOG. Initiation of coitus in early adolescence. *American Sociological Review*. 1987; 52:841–855.
- Udry JR, Billy JO, Morris NM, Groff TR, Raj MH. Serum androgenic hormones motivate sexual behavior in adolescent boys. *Fertility and Sterility*. 1985; 43:90–94. [PubMed: 4038388]
- Upchurch DM, Kusunoki Y. Associations between forced sex, sexual and protective practices, and sexually transmitted diseases among a national sample of adolescent girls. *Women's Health Issues*. 2004; 14:75–84.
- Upchurch DM, Levy-Storms L, Sucoff CA, Aneshensel CS. Gender and ethnic differences in the timing of first sexual intercourse. *Family Planning Perspectives*. 1998; 30(3):121–127. [PubMed: 9635260]
- van den Berg SM, Boomsma DI. The familial clustering of age at menarche in extended twin families. *Behavioral Genetics*. 2007; 37:661–667.
- Wang Y. Is obesity associated with early sexual maturation? A comparison of the association in American boys versus girls. *Pediatrics*. 2002; 110(5):903–910. [PubMed: 12415028]
- Westling E, Andrews JA, Hampson SE, Peterson M. Pubertal timing and substance use: The effects of gender, parental monitoring and deviant peers. *Journal of Adolescent Health*. 2008; 42(6):555–563. [PubMed: 18486864]

- Wu T, Mendola P, Buck GM. Ethnic differences in the presence of secondary sex characteristics and menarche among US girls: The Third National Health and Nutrition Examination Survey, 1988–1994. *Pediatrics*. 2002; 110(4):752–757. [PubMed: 12359790]
- Zabin LS, Smith EA, Hirsch MB, Hardy JB. Ages of physical maturation and first intercourse in black teenage males and females. *Demography*. 1986; 23(4):595–605. [PubMed: 3803656]
- Zimmer-Gembeck MJ, Helfand M. Ten years of longitudinal research on U.S. adolescent sexual behavior: Developmental correlates of sexual intercourse, and the importance of age, gender and ethnic background. *Developmental Review*. 2008; 28(2):153–224.

Fig. 1. Percentage of offspring who reported sexual intercourse as a function of pubertal timing, race, and sex ($n = 105$ Black girls, $n = 112$ Black boys, $n = 48$ White girls, $n = 40$ White boys)

Table 1

Sample characteristics by maternal race

	Black (n = 226)	White (n = 92)
Teenage mothers		
Age at first sexual intercourse	M = 14.3 (1.4)	M = 14.3 (1.5)
Age at first pregnancy	M = 15.8 (1.3)	M = 16.3 (1.2)**
Married, 6 years post-partum (%)	12	37**
Married, 14 years post-partum (%)	21	44**
Education, 6 years post-partum	12.4 (1.2)	12.0 (1.8)*
Education, 14 years post-partum	M = 12.9 (1.4)	M = 12.8 (1.8)
Family income, 6 years post-partum	M = 1205 (1112)	M = 1726 (1120)**
Family income, 14 years post-partum	M = 2038 (1491)	M = 2776 (2035)**
Heavy drinker, 6 years post-partum (%)	13	10
Parenting scores, 14 years post-partum	M = 1.4 (0.9)	M = 1.4 (1.0)
Adolescent offspring		
Age	M = 14.4 (0.6)	M = 14.6 (0.6)
Male (%)	52	47
Home environment at age 6	M = 11.3 (2.9)	M = 12.9 (2.2)**
Sexual abuse (%)	15	13
Other childhood trauma	M = 0.9 (0.9)	M = 0.6 (0.7)*
Peers smoke at age 10 (%)	38	32
Cigarette use by age 14 (%)	23	39**
Alcohol use by age 14 (%)	15	33**
Marijuana use by age 14 (%)	22	19
Peer intercourse by age 14	M = 2.0 (1.1)	M = 1.6 (0.9)**
Pubertal development	M = 2.9 (0.8)	M = 2.9 (0.8)
Early (%)	31	27
On time (%)	48	62
Late (%)	21	11*

	Black (<i>n</i> = 226)	White (<i>n</i> = 92)
Ever had sexual intercourse (%)	29	16*

M = Mean (with standard deviation in parentheses)

* $p < .05$

** $p < .01$

Table 2

Sample characteristics by sex of offspring

	Girls (<i>n</i> = 158)	Boys (<i>n</i> = 160)
Teenage mothers		
Age at first sexual intercourse	<i>M</i> = 14.2 (1.4)	<i>M</i> = 14.3 (1.4)
Age at first pregnancy	<i>M</i> = 16 (1.3)	<i>M</i> = 15.9 (1.4)
Married, 6 years post-partum (%)	18	19
Married, 14 years post-partum (%)	28	27
Education, 6 years post-partum	12.2 (1.4)	12.4 (1.5)
Education, 14 years post-partum	<i>M</i> = 12.7 (1.5)	<i>M</i> = 12.9 (1.6)
Family income, 6 years post-partum	<i>M</i> = 1317 (1132)	<i>M</i> = 1393 (1146)
Family income, 14 years post-partum	<i>M</i> = 2167 (1622)	<i>M</i> = 2335 (1767)
Heavy drinker, 6 years post-partum (%)	13	11
Parenting scores, 14 years post-partum	<i>M</i> = 1.4 (1.0)	<i>M</i> = 1.3 (0.9)
Adolescent offspring		
Age	<i>M</i> = 14.5 (0.6)	<i>M</i> = 14.5 (0.6)
Race (% Black)	69	73
Home environment at age 6	<i>M</i> = 11.1 (2.5)	<i>M</i> = 10.6 (2.6)
Sexual abuse (%)	14	15
Other childhood trauma	<i>M</i> = 0.8 (0.9)	<i>M</i> = 0.8 (0.9)
Peers smoke at age 10 (%)	32	40
Cigarette use by age 14 (%)	30	25
Alcohol use by age 14 (%)	22	18
Marijuana use by age 14 (%)	20	23
Peer intercourse by age 14	<i>M</i> = 1.8 (0.9)	<i>M</i> = 2.0 (1.1)
Pubertal development	<i>M</i> = 2.8 (0.9)	<i>M</i> = 2.9 (0.9)
Early (%)	29	30
On time (%)	58	47
Late (%)	14	22
Ever had sexual intercourse (%)	20	30*

M = Mean (with standard deviation in parentheses)

10' > d'
**
50' > d'
*

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 3 Logistic regression model predicting early sexual intercourse with pubertal timing, sex, and race ($n = 305$)

Predictors	Beta	SE	Wald	Exp(B)	Confidence Intervals
Step 1					
Later pubertal timing	-0.11	0.15	0.53	0.90	0.68–1.20
Step 2					
Later pubertal timing	-0.14	0.15	0.92	0.87	0.66–1.16
Race of mother (White)	-0.73	0.33	4.90*	0.48	0.25–0.92
Sex of adolescent (male)	0.58	0.27	4.43*	1.79	1.04–3.04
Step 3					
Later pubertal timing	-0.48	0.26	3.51	0.62	0.38–1.02
Race of mother (White)	1.20	1.21	0.98	3.32	0.31–35.8
Sex of adolescent (male)	-1.36	0.89	2.32	0.26	0.05–1.48
Pubertal timing $\times$ race	-0.73	0.45	2.61	0.48	0.20–1.17
Pubertal timing $\times$ sex	0.71	0.31	5.27*	2.04	1.11–3.74
Step 4					
Later pubertal timing	-0.56	0.28	4.06*	0.57	0.33–0.99
Race of mother (White)	0.87	1.27	0.47	2.39	0.20–28.6
Sex of adolescent (male)	-1.11	0.93	1.42	0.33	0.05–2.05
Pubertal timing $\times$ race	-0.25	0.48	0.27	0.78	0.30–2.01
Pubertal timing $\times$ sex	0.77	0.33	5.42*	2.15	1.13–4.11
Pubertal timing $\times$ race $\times$ sex	-0.73	0.28	6.87**	0.48	0.28–0.83

*
 $p < .05$ **
 $p < .01$

Table 4

Final step of logistic regression model predicting early sexual intercourse with covariates ($n = 255$)

Predictors	Beta	SE	Wald	Exp(B)	Confidence intervals
Later pubertal timing	-0.70	0.43	2.71	0.50	0.21–1.14
Race of mother (White)	2.58	1.92	1.79	13.1	0.30–596
Sex of adolescent (male)	-1.10	1.40	0.61	0.34	0.02–5.18
Age of adolescent	0.81	0.38	4.43*	2.24	1.06–4.76
Family income	0.00	0.00	0.56	1.00	1.00–1.00
Maternal age at first intercourse	-0.36	0.16	5.25*	0.70	0.51–0.95
Maternal heavy drinker, 6 years post-partum	2.14	0.72	8.69**	8.46	2.05–35.0
Peer cigarette use at age 10	1.17	0.46	6.44*	3.23	1.31–8.00
Traumatic events during childhood	0.74	0.26	8.00**	2.10	1.26–3.50
Authoritative parenting	-0.52	0.25	4.31*	0.59	0.36–0.97
Adolescent used cigarettes by age 14	1.46	0.53	7.53**	4.32	1.52–12.3
Adolescent used marijuana by age 14	1.47	0.55	7.21**	4.34	1.49–12.7
Peer sexual activity	0.61	0.23	7.15**	1.83	1.20–2.85
Pubertal timing $\times$ race	-1.01	0.72	1.97	0.37	0.10–1.49
Pubertal timing $\times$ sex	0.94	0.50	3.54	2.57	0.96–6.88
Pubertal timing $\times$ race $\times$ sex	-1.11	0.48	5.38*	0.33	0.13–0.84

*
 $p < .05$

**
 $p < .01$