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Peer and Individual Risk Factors in Adolescence Explaining the Relationship between Girls' Pubertal Timing and Teenage Childbearing

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Abstract

Girls with early pubertal timing are at elevated risk for teenage childbearing; however, the modifiable mechanisms driving this relationship are not well understood. The objective of the current study was to determine whether substance use, perceived peer substance use, and older first sexual partners mediate the relationships among girls' pubertal timing, sexual debut, and teenage childbearing. Data are from Waves 1 – 15 of the female cohort of the National Longitudinal Surveys of Youth 1997 (NLSY97), a nationwide, ongoing cohort study of U.S. men and women born between 1980 and 1984. The analytic sample (N=2,066) was 12-14 years old in 1997 and ethnically diverse (51% white, 27% black, 22% Latina). Using structural equation modeling, we found substance use in early adolescence and perceived peer substance use each partially mediated the relationships among girls' pubertal timing, sexual debut, and teenage childbearing. Our findings suggest early substance use behavior as one modifiable mechanism to be targeted by interventions aimed at preventing teenage childbearing among early developing girls.

Keywords

pubertal timing; female adolescents; teen pregnancy; teen childbearing; substance use

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Introduction

Teenage childbearing is associated with deleterious outcomes across the life span for both mother and child. In addition to increased risk for adverse birth outcomes (Chen et al., 2007), teen mothers (Patel & Sen, 2012) and their children (Jaffee, Caspi, Moffitt, Belsky, & Silva, 2001) are at elevated risk for physical, emotional, and social adversity throughout their lives. Despite declines in teenage childbearing in recent decades (The Office of Adolescent Health, 2015), the U.S. still has one of the highest teen birth rates in the developed world (United Nations Statistics Division, 2014), demonstrating a critical need to better understand the mechanisms by which this disparity occurs and the necessary areas for intervention among adolescents.

A number of socio-ecological factors in childhood and adolescence are associated with girls' increased risk for teenage pregnancy and childbearing. Some of the most salient socio-ecological predictors of teenage pregnancy and childbearing in the U.S. include minority race or ethnicity (Meade, Kershaw, & Ickovics, 2008) and childhood family characteristics such as lower maternal education, being born to a teen mother, and father absence from the household (Driscoll & Abma, 2015). It is not assumed that these socio-ecological factors are directly causal of teenage childbearing, but rather that they are easily measured characteristics commonly associated with environmental conditions that may place girls at increased risk for teenage pregnancy and childbearing such as low levels of parental monitoring, lower economic and educational prospects, and family, peer, and community norms accepting of early childbearing (Meade et al., 2008). It is important that research examining the precursors of teenage childbearing take into account these socio-ecological factors.

One notable population at risk for teenage pregnancy and childbearing consists of girls who experience pubertal development earlier than their same-age peers (Deardorff, Gonzales, Christopher, Roosa, & Millsap, 2005). Two primary psychosocial mechanisms have been hypothesized to explain why early pubertal timing may place girls at elevated risk for earlier sexual debut and teenage childbearing, the developmental readiness and maturational deviance hypotheses. Per the developmental readiness hypothesis (Mendle, Turkheimer, & Emery, 2007), because early developing girls physically appear older than same-age peers, they may be accepted into older, more deviant peer groups. Consequently, they are more likely to be exposed to and initiate risk behaviors such as substance use (Negri & Trickett, 2012) and risky sexual behavior (Savolainen et al., 2015) at earlier ages than their same-age peers. Although these girls may be as physically developed as girls 1-4 years their seniors, their cognitive and emotional developmental levels are more similar to their same-age peers. Hence, they may not have developed the decision-making capabilities necessary to successfully navigate the social situations they experience within older, more deviant peer groups. Relatedly, according to the maturational deviance hypothesis, off-timed pubertal development is posited to create additional stress due to the experience of physical maturational deviance from one's peers (Brooks-Gunn, Petersen, & Eichorn, 1985). Consequently, early developing girls' heightened risk for behaviors leading to teenage childbearing (such as early substance use and risky sexual behavior) may reflect maladaptive strategies for coping with additional stress they experience due to maturational deviance.

The developmental readiness and maturational deviance hypotheses are not mutually exclusive mechanisms and both have been shown to explain the link between early pubertal development and risk behavior in adolescence. There is a dearth of research elucidating the modifiable mechanisms by which girls' early pubertal timing leads to teenage childbearing, but both the developmental readiness and maturational deviance hypotheses point to the need to explore the role of substance use and peer influence.

Early developers are more likely to engage in substance use throughout adolescence compared with their peers (Cance, Ennett, Morgan-Lopez, Foshee, & Talley, 2013). In turn, substance use in adolescence is associated with risky sexual behaviors and teen pregnancy (Salas-Wright, Vaughn, Ugalde, & Todic, 2015). The relationship between substance use and riskier sexual behaviors in adolescence is often attributed to the direct influence of alcohol and illicit drugs on impairing sexual decision-making (Townshend, Kambouropoulos, Griffin, Hunt, & Milani, 2014). However, tobacco, alcohol, and illicit drug use in adolescence are each associated with earlier sexual debut (Kirby, 2002). This suggests that substance use in adolescence could also be a proxy for "risk-prone" adolescents who tend to engage in multiple types of risk behaviors across adolescence (Crockett, Raffaelli, & Shen, 2006). While research examining the relationship between girls' pubertal timing and teenage pregnancy and childbearing to date has not directly assessed the influence of older and more deviant peers, recent studies that have assessed the influence of peers on early developing girls' risk behaviors in adolescence have produced mixed findings. Some find older and more deviant peers draw early developing girls into risk behaviors in that exposure to these peers leads to earlier sexual debut (Savolainen et al., 2015) and increased use of alcohol and marijuana (Negriff & Trickett, 2012). Others find no mediating peer effects (Negriff, Susman, & Trickett, 2011) or mediating effects only among subsamples of girls (Negriff, Brensilver, & Trickett, 2015). However, perception of peer deviance (e.g., substance use) is associated with a greater likelihood of personal deviance (Deutsch, Chernyavskiy, Steinley, & Slutske, 2015). It is, therefore, difficult to disentangle the influence of peers on early developing girls' risk behaviors in adolescence that may lead to teenage pregnancy and childbearing. Presently, pubertal timing is not a modifiable target for teenage childbearing prevention programs, but it is possible to target both substance use and peer influence and thus there is a need to explore the potential role of these factors.

A seminal retrospective study conducted by Deardorff and colleagues (2005) examined the associations between age at menarche, sexual debut, alcohol initiation, and first pregnancy within a sample of ethnically diverse women from Arizona. Earlier age at initiation of alcohol use and earlier sexual debut together explained the relationship between early pubertal development and age at first pregnancy. This study marked an essential first step in identifying potential points of intervention to reduce early developing girls' risk for teen pregnancy. However, the study was retrospective in design, thereby limiting the researchers' ability to control for confounding socio-ecological factors in childhood other than race and ethnicity. They were also unable to assess the impact of older and more deviant peers in adolescence who are assumed to influence early developing girls' substance using behaviors and initiation of sex per the developmental readiness hypothesis. Further, this study assessed women's age at first pregnancy as the outcome of interest rather than age at first childbirth. Approximately 40% of teen pregnancies in the U.S. do not result in a live birth (Kost &

Henshaw, 2014) and the social and health trajectories of girls who become pregnant in adolescence but do not become mothers differ from those who become adolescent mothers (Patel & Sen, 2012). Thus, there is a need to extend the work of Deardorff and her colleagues.

The Current Study

The aim of the current study is to inform the understanding of the modifiable mechanisms of the association between girls' pubertal timing and teenage childbearing and the salient areas for intervention to reduce early developing girls' risk for teenage childbearing. To the authors' knowledge, this is the first study to assess the influence of individual and peer risk factors in adolescence on the relationship between girls' pubertal timing and teenage childbearing. The current study advances knowledge regarding girls' pubertal timing and teen childbearing by drawing from an ethnically diverse, nationwide sample of U.S. adolescents from a prospective, longitudinal study design. Further, we explore both individual and peer mediators of the relationship between girls' pubertal timing, age at sexual debut, and teenage childbearing while controlling for potentially confounding socio-ecological factors (see Figure 1).

Drawing from the developmental readiness hypothesis, the maturational deviance hypothesis, and the posited influence of substance use in early adolescence on sexual risk behaviors, we predicted that early substance use, perceptions of peers' substance use, and having an older first sexual partner would each partially mediate the relationship between girls' pubertal timing and their age at sexual debut. We further hypothesized that girls' age at sexual debut would mediate the relationship between girls' risk factors in adolescence and teenage childbearing.

Methods

Participants

Data are from female participants in the National Longitudinal Surveys of Youth 1997 (NLSY97), a nationwide, ongoing cohort study of U.S. men and women born between 1980 and 1984 (U.S. Bureau of Labor Statistics, 2014). At Wave 1 (1997), participants were between the ages of 12 and 18. Participants turned 20 years of age between 2000 and 2005 and continue to be interviewed annually. The final analytic sample for the current study included 2,066 participants of the original female cohort (N=4,385). Only participants ages 12-14 at Wave 1 were included in analyses as they provided data regarding their own and their peers' substance using behaviors in early adolescence—prior to reporting on sexual behaviors and partners, which begins in the NLSY97 when participants reach age 15 (see Figure 1). Similarly, participants reporting their age at first sex to be prior to Wave 1 or prior to menarche were excluded from analyses. Childhood sexual abuse may prompt early pubertal development among girls (Zabin, Emerson, & Rowland, 2005) and can lead to psychopathology in adolescence, including substance abuse (Kilpatrick et al., 2000). Thus, the temporality of the relationship between sexual debut, early pubertal timing, and early adolescent substance use could not be determined for participants reporting an age of sexual debut prior to menarche or Wave 1 (n=143). In order to maintain the hypothesized

temporality, these girls were not included in the present study. Further, those missing information on the key predictor of interest (menarche, $n=10$) and outcome of interest (teenage childbearing, $n=91$) were excluded from analyses. Those excluded were older at Wave 1, more likely to have mothers who attended college, more likely to have experienced father absence in youth, reported more peer and personal substance use at Wave 1, were younger at sexual debut, and were more likely to experience early menarche and teen childbearing. They did not differ by other background characteristics (race/ethnicity, maternal high school graduation, and maternal age at first birth). Due to the analytic methods employed and because the analytic sample consisted of a sub-sample of the original female cohort, we did not use NLSY sampling weights per the NLSY97 sample weighting recommendations (U.S. Bureau of Labor Statistics, 2014). The present study was deemed not to be human subjects research by the Institutional Review Board of the sponsoring university.

Measures

Pubertal timing—Participants were asked the month and year they had reached menarche beginning at Wave 1. Participants that did not know their month or year of menarche reported age at menarche. Participants that had not reached menarche by Wave 1 were asked their status of menarche (yes/no) and month/year or age at menarche in subsequent waves until menarche was reported. Early menarche was treated as a dichotomous variable based on prior research with the NLSY (Walker, 2001) and the distribution in ages at menarche among our sample ($M=12.38$, $SD=1.30$): early menarche (<1 standard deviation below the mean, <11.08 years; 14.0%) versus non-early menarche (11.08 years and older).

Teenage childbearing—Participants' month and year of birth was subtracted from the month and year of the birth of their first child to calculate participants' age at first birth. Age at first birth was dichotomized for analyses into having had a birth before age 20 (15.4%) versus having their first birth at age 20 or later. As previous research identifying teen mothers to be at increased risk for adversity has defined teenage childbearing in several ways, we conducted sensitivity analyses with teenage childbearing defined as have a first birth at less than 17 years of age, less than 18 years of age, and less than 19 years of age. Results for all sensitivity analysis models were similar to those for teenage childbearing defined as having a first birth before age 20.

Age at first sex—Participants began reporting age at first sex at age 15 (Waves 2 and beyond), which was treated as a continuous variable in analyses ($M=16.25$, $SD=1.80$).

Substance use at ages 12-14—At Wave 1, participants answered yes (1) or no (0) to three items concerning their lifetime use of cigarettes (“Have you ever smoked a cigarette?”), alcohol (“Have you ever had a drink of an alcoholic beverage? By a drink we mean a can or bottle of beer, a glass of wine, a mixed drink, or a shot of liquor. Do not include childhood sips that you might have had from an older person's drink.”), and marijuana (“Have you ever used marijuana, for example: grass or pot, in your lifetime?”) (Moore, McGroder, Hair, & Gunnoe, 1999). The NLSY97 Substance Use Index is a sum of

the positive responses ($M=0.62$, $SD=0.93$) and was treated as a continuous variable in analyses.

Perceived peer substance use at ages 12-14—At Wave 1, participants reported the percentage of their same grade peers that smoke cigarettes, get drunk at least once a month, and have ever used marijuana, inhalants, or other drugs. Answer choices were: 1=almost none, 2=about 25%, 3=about half (50%), 4=about 75%, and 5=almost all (more than 90%). Responses to these three items were used to create a continuous latent variable.

Older first sexual partner—When participants reported age at first sex, they also reported the age of their first sexual partner. After removing extreme outliers (more than 3 standard deviations above or below the mean age difference), we computed the age difference between the participant and her first sexual partner ($M=1.73$, $SD=2.03$). We then dichotomized the variable so girls with first sexual partners with an age difference over 1 standard deviation above the mean age difference (3.76 years) were considered to have “older” first sexual partners (15.2%). In research exploring the role of the age difference of romantic partners in adolescence, age difference is sometimes considered as a continuous (Volpe, Hardie, Cerulli, Sommers, & Morrison-Beedy, 2013) and sometimes as categorical—often with two years in age difference signaling an “older” partner (Halpern, Kaestle, & Hallfors, 2006). As such, we conducted sensitivity analyses with the age difference treated continuously and with 2 years difference signaling an older partner. Neither variation significantly altered results.

Covariates—Background factors available in the dataset that have demonstrated to be associated with both girls' pubertal timing and their risk for teenage childbearing were chosen as covariates for multivariate models: race/ethnicity, mother's highest level of education, whether the participant's mother had her first birth before age 20, and father absence during youth (prior to or at Wave 1). Participant age at Wave 1 was also included as a covariate due the strong association between older age and increased risk for lifetime substance use in adolescence.

Statistical analysis

Structural equation modeling was conducted using MPlus Version 7.31 (Muthen & Muthen, 2012) to assess the hypothesized pathways between early menarche and teenage childbearing. The Weighted Least Squares with Means and Variance Adjusted (WLSMV) estimator was used as it has been shown to be a robust estimator appropriate for models including binary dependent variables (Muthen & Muthen, 2012). Unstandardized coefficients (b) and standard errors (SE) are reported throughout. Using the WLSMV estimator, the unstandardized coefficients are modeled as probit regression coefficients. A positive coefficient indicates that an increase in the predictor is associated with an increase in the predicted probability of the outcome. A negative coefficient indicates that an increase in the predictor is associated with a decrease in the predicted probability of the outcome.

Per our hypotheses, we modeled a direct path between age at first sex and teenage childbearing, while the direct path between early menarche and teenage childbearing was

fixed to zero per our prediction that early menarche would lead to teenage childbearing through one's own and peers' substance use, having an older first sex partner, and age at sexual debut. We tested a total of nine mediation pathways. Participants' substance use at ages 12-14, perceived peer substance use at ages 12-14, and having an older first sex partner were included in the model as mediators of the relationship between early menarche and age at first sex (mediation pathways 1-3). Age at sexual debut was considered in the model as a mediator of the relationships between participants' substance use at ages 12-14, perceived peer substance use at ages 12-14, having an older first sex partner and teenage childbearing (mediation pathways 4-6).

Finally, we tested the compound mediation pathways connecting early menarche to teenage childbearing (e.g., the relationship between early menarche and teenage childbearing through participants' substance use at ages 12-14 and age at sexual debut; mediation pathways 7-9). Participants' substance use, perceived peer substance use, and having an older first sex partner were all correlated. All pathways controlled for all covariates (see Figure 1). The significance of the hypothesized mediational pathways were computed using RMediation, a web-based R package which produces confidence intervals for indirect parameter coefficients and is robust with continuous, categorical, and dichotomous variables (Tofighi & MacKinnon, 2011).

Results

Descriptive statistics

Girls with early menarche were, on average, 1.11 years younger at sexual debut and 6 months younger at their first birth than girls with on-time or later age at menarche (see Table 1). As expected, early menarche was also associated with greater substance use and perceived peer substance use at ages 12-14. Non-Hispanic black and Hispanic girls were more likely to experience early menarche compared with non-Hispanic white girls. Neither participants' mothers' age at first birth nor the age difference of their first sexual partners were associated with early age at menarche.

Over 15% of participants had their first birth before age 20. Non-Hispanic black and Hispanic girls, girls whose mothers attained more education, whose mothers were teen mothers themselves, and girls who experienced father absence during youth were all more likely to give birth before age 20. Girls who gave birth before age 20 were 1.5 years younger at sexual debut, more often had an older partner at sexual debut, and had greater substance use and perceived peer substance use at ages 12-14.

Mediation Model

The model explained 42% of the variance in teenage childbearing (see Figure 2). Scholars recommend assessing a combination of model fit indices to determine model fit (Hu & Bentler, 1999). A Root Mean Square Error of Approximation (RMSEA) value of less than .06, Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) values of greater than .95, and a Weighted Root Mean Square Residual (WRMR) value of less than .90 all suggest good model fit. (Schreiber, Nora, Stage, Barlow, & King, 2006). Per these standard cutoff

criteria, our mediation model fit the data well (RMSEA=.034, 95% CI=.027, .042; CFI=.997; TLI=.987; WRMR=.515). At the 95% confidence level, five of the nine hypothesized mediation pathways were statistically significant, and one was marginally significant. Unstandardized coefficients for direct effects are presented in Figure 2, for indirect effects in Table 2, and each are described below.

Age at first sex—Early pubertal timing was not significantly directly associated with age at first sex ($b=-.10$, $SE=.06$) in the mediation model. Older age at sexual debut was directly associated with a lower probability of teenage childbearing ($b=-.33$, $SE=.04$, $p<.005$).

Substance use in early adolescence—Early menarche was positively associated with substance use in early adolescence ($b=.09$, $SE=.03$, $p<.005$), which, in turn, was associated with a lower age at first sex ($b=-.48$, $SE=.05$, $p<.005$). Participants' substance use in early adolescence significantly mediated the relationship between early menarche and age at first sex ($b=-.04$, 95% CI=-.07,-.01). Also, age at first sex significantly mediated the relationship between substance use in early adolescence and teenage childbearing ($b=.16$, 95% CI=.12,.21). Accordingly, substance use in early adolescence and age at first sex together significantly mediated the relationship between early menarche and teenage childbearing ($b=.014$, 95% CI=.003,.024). Thus, early developing girls were more likely to report engaging in substance use in early adolescence, which was associated with a younger age at sexual debut and thus led to a higher probability of teenage childbearing.

Perceived peer substance use—Early menarche was positively associated with perceived peer substance use ($b=.11$, $SE=.04$, $p<.005$), which, in turn, was associated with a lower age at first sex ($b=-.14$, $SE=.06$, $p<.05$). Participant substance use and perceived peer substance use in early adolescence were positively correlated ($b=.31$, $SE=.03$, $p<.005$). Perceived peer substance use in early adolescence significantly mediated the relationship between early menarche and age at first sex ($b=-.016$, 95% CI=-.034,-.002) and age at first sex significantly mediated the relationship between perceived peer substance use in early adolescence and teenage childbearing ($b=.05$, 95% CI=.01,.09). However, perceived peer substance use in early adolescence and age at first sex together were marginally significant in mediating the relationship between early menarche and teenage childbearing ($b=.005$, 95% CI=.000,.011). Hence, early developing girls were more likely to perceive their peers were engaging in substance use, which was associated with a younger age at sexual debut and thus led to a higher probability of teenage childbearing, although this mediating relationship was marginally significant.

Older first sexual partner—Having an older first sexual partner was positively associated with teenage childbearing ($b=.18$, $SE=.07$, $p<.05$). However, it was not correlated with participant nor perceived substance use in early adolescence (each $b=.05$, $SE=.04$), nor was it associated with early menarche ($b=-0.002$, $SE=.063$) or age at sexual debut ($b=.02$, $SE=.06$). Consequently, having an older partner at sexual debut did not significantly mediate the relationships among girls' pubertal timing, sexual debut, and teenage childbearing (see Table 2).

Discussion

The aim of the current study was to inform the understanding of the modifiable mechanisms of the relationship between girls' pubertal timing and teenage childbearing and the salient areas for intervention to reduce early developing girls' risk for teenage childbearing. Our study drew from an ethnically diverse, nationwide sample of U.S. adolescents from a prospective, longitudinal study design to test whether early substance use, perceived peer substance use, or having an older first sexual partner mediate the relationship among girls' early pubertal timing, sexual debut, and teenage childbearing. As such, we add to previous literature in this field in important ways. Specifically, we extended our outcome of interest beyond adolescent risk behaviors and teen pregnancy to teenage childbearing, which is associated with elevated risk for physical, emotional, and social adversity across the life span for women and their children. Further, we considered salient, potentially confounding background characteristics in our multivariate models so as not to overestimate the influence of pubertal timing and substance use in adolescence on sexual risk behaviors and risk for teenage childbearing. Finally, in addition to considering individual risk factors in adolescence, we also considered the influence of peer deviance and older peers on the relationship between girls' pubertal timing and teenage childbearing, thus providing a more nuanced test of the developmental readiness hypothesis that informs much of the research in this field.

Age at menarche was associated with age at first childbirth, such that early developing girls in this study had a younger age of first childbirth. This finding extends previous research (Deardorff et al., 2005) that found early pubertal timing was linked to teenage pregnancy. While, on average, early developing girls were only 6 months younger at their first birth than their on-time and later developing peers (20.8 years of age vs. 21.4 years of age), the odds of being a teenage mother was 1.38 times greater for early developing girls. Furthermore, this age difference comes at a critical time in a woman's life course where a difference of six months could influence the attainment of postsecondary education. Thus, future research should explore whether teenage childbearing mediates the relationship between early pubertal development and educational attainment.

Girls with early menarche were more likely to report substance use at ages 12-14 and lower ages at sexual debut. And, as predicted, the relationship between early menarche and age at first sex was explained by substance use and perceived peer substance use in early adolescence. In other words, girls with early pubertal timing that were not using substances in early adolescence and perceived that their peers were not using substances were not at elevated risk for earlier sexual debut. Also, as predicted, girls who had sex at earlier ages were at higher risk for teenage childbearing. These findings provide support for both the developmental readiness hypothesis, which posits that early developing girls are exposed to and engage in more risk behaviors due to the disparity between their physical, cognitive, and emotional development, as well as the maturational deviance hypothesis, which proposes that the additional stress experienced by early developing girls due to their physical maturational deviance from their same-age peers leads to maladaptive coping behaviors in the form of substance use or sexual risk-taking. Our finding that substance use in early adolescence partially explains the relationship among early menarche, early sexual debut,

and teenage childbearing adds to previous findings of early initiation of alcohol use explaining the relationship among early menarche, age at sexual debut, and adolescent pregnancy among Arizona women (Deardorff et al., 2005). This is also consistent with the body of literature demonstrating early initiation of and more intense substance use predicting earlier sexual debut among girls (Cavazos-Rehg et al., 2011; Kirby, 2002) and supports the theory that multiple domains of risk behaviors, such as substance use and sexual risk, tend to cluster within individuals (Crockett, Raffaelli, & Shen, 2006). Thus, this result provides additional evidence of the importance of early developing girls' own substance use behaviors in early adolescence as a potential intervention target in preventing sexual risk behaviors in adolescence and teenage motherhood.

With regards to the role of peer deviance, which to date remains unclear in the literature (Negri et al., 2015; Savolainen et al., 2015), we did find evidence of a marginally significant indirect pathway between early menarche, perceived peer substance use in early adolescence, age at sexual debut, and teenage childbearing. Our results suggest that perceptions of peers' substance use may partially explain the relationship between early menarche and teenage childbearing above and beyond that of girls' personal substance use. However, the mediating influence of perceived peer substance use was only marginally significant in comparison to the influence of girls' own substance use. This may have been due, in part, to the measurement of perceived peer substance use. Participants were asked the substance using behaviors of other students in their grade, not explicitly their "friends." Thus, the associations among peer substance use and variables of interest in the present study may have been strengthened had participants reported the substance using behaviors of their friends or if participants' friends had reported their own substance using behaviors (Henry, Kobus, & Schoeny, 2011).

Contrary to the study hypothesis, having an older partner at sexual debut was not associated with early pubertal timing nor age at first sex, although it was associated with a greater likelihood of teenage childbearing, as expected. This is contrary to previous research that has found early developing girls to be more likely to have older romantic partners than their on-time and later developing peers (Halpern, Kaestle, & Hallfors, 2006), and adolescent girls with older boyfriends to be more likely to have sexual relationships (Kaestle, Morisky, & Wiley, 2002). It is possible that the measurement of early pubertal timing could have impacted the results; research linking early development with older romantic partners assessed *perceived* pubertal timing. The perception of maturity may be more closely linked to the characteristics of girls' romantic partners than more objective measures of maturity, such as age at menarche. This points to a need to replicate this research with multiple measures of pubertal timing to better understand the relationships between pubertal timing and older sexual partners.

Hence, in considering the influence of peers on the relationship between pubertal timing and teenage childbearing, our findings were mixed. If perceived peer substance use at ages 12-14 is an appropriate proxy for peer substance use, this finding provides support for the developmental readiness hypothesis in that early developing girls' acceptance by and association with substance using peers in early adolescence exposes them to earlier and riskier sexual behaviors than their on-time and later developing peers which in turn puts

them at increased risk for teenage childbearing. However, having an older first sexual partner was not associated with a younger age at sexual debut, which refutes the hypothesis. This discrepancy in findings provides further evidence for the need for more nuanced and better measured examination of the influence of peers on early developing girls' risks for adverse outcomes in adolescence and beyond.

The major strengths of the current study are its large, nationwide sample of ethnically diverse participants; its prospective, longitudinal design; and that it tightly controlled for background characteristics influential of both pubertal timing and adolescent risk behaviors. As we did not use NLSY97 sample weights in analyses, the sample is not generalizable to all females in the United States, but rather the 2,066 individuals of the female cohort included in analyses. Our study was limited by the measurement of pubertal timing. Age at menarche is only one of many indicators of girls' pubertal timing and occurs late in the pubertal development process (Dorn & Biro, 2011). Nonetheless, it is generally considered an acceptable approximation of pubertal timing (Brooks-Gunn, Warren, Rosso, & Gargiulo, 1987). Still, other indicators of pubertal timing (e.g., breast development, perceived pubertal timing, hormone levels) were not present in the current dataset and may have helped to provide a more nuanced exploration of which aspects of girls' early pubertal development put them most at risk for teenage childbearing. In addition, the girls excluded from the analytic sample differed by several study characteristics. Substance use differences at Wave 1 were primarily due to the older age of the respondents at Wave 1 that were excluded. Other differences were largely driven by the 143 girls excluded due to reporting sexual debut prior to menarche or Wave 1. Because the resulting analytic sample was overall a lower risk sample, it is likely that the results represent a conservative estimate of the relationships between early pubertal timing and teenage childbearing.

The current study findings and limitations suggest important directions for future research. Given that the subsample of girls excluded from the study due to sexual debut prior to menarche or Wave 1 differed significantly from the final analytic sample, future longitudinal surveys examining the role of pubertal timing on subsequent risk behavior in adolescence should begin assessing pubertal development in childhood, prior to pubertal onset. The current study was unable to assess the role of childhood sexual abuse, which has been linked with early pubertal debut and adolescent substance use, as well as teenage pregnancy. Future research should examine whether childhood sexual abuse is an explanatory variable for the mechanisms found in this study, or if the relationships between pubertal timing, peer and individual substance use, sexual debut, and teenage childbearing remain after controlling for childhood sexual trauma. Relatedly, we did not assess alternative models (e.g., whether having an older sex partner leads to increased substance use) due to the timing of when substance use and perceived peer substance use were assessed in the NLSY97; substance use and perceived peer substance use were only assessed at Wave 1 whereas information about sexual behavior was not assessed until participants reached age 15. Future studies should simultaneously and continuously assess substance use, peer influences, and sexual risk behaviors across adolescence to explore alternative models and examine the interplay of these risk behaviors over time in how they may mediate the relationship between pubertal timing and risk for teenage childbearing. The current study could also be extended by measuring multiple aspects of girls' pubertal timing, beyond age at menarche, to determine

which are most influential in predicting sexual health behaviors and outcomes. As previously mentioned, the assessment of peer substance use was based on participant report and, as such, future replication studies should compare the relative influence of perceived peer substance use and peer-reported substance use. Finally, future research should examine potential psychological correlates of the behaviors observed in this study. Understanding the role of sensation seeking, psychological distress, body satisfaction, and self-esteem would help practitioners and researchers better understand the modifiable psychological constructs that could decrease risky behaviors among early developing girls.

Conclusion

The current study provides further evidence that girls who develop earlier than their peers are at heightened risk for deleterious outcomes. Because it is not possible, or advisable, to alter pubertal development among children who are clinically within the “normal” range of development, it is critical to determine modifiable mediating factors that may aid in the prevention of these negative outcomes. As with previous research, we found that an earlier age of sexual debut was associated with a higher likelihood of teenage childbearing. There is a continued need for comprehensive sexual education in the United States in order to delay first sexual intercourse and provide sexually active girls with the information needed to prevent pregnancy. Our findings also provide evidence of the importance of substance use behaviors, both perceived peer use and individual use, in early adolescence in explaining how girls' early pubertal timing can lead to higher risk for teenage childbearing. In particular, substance use in early adolescence was found to mediate the relationship between early pubertal development and age of sexual debut. This provides additional support for the need for comprehensive substance use prevention in late childhood/early adolescence. In addition, providers should be screening for behavioral risk taking among early developing girls at ages that may be traditionally considered “too young” for risk taking. Furthermore, prevention programming should be tailored for parents of early developing girls to help families navigate the potential psychosocial risks associated with their pubertal development. These comprehensive prevention efforts may be beneficial in breaking the link between girls' early pubertal timing and teenage motherhood.

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Biographies

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Fig. 1. Analytic model of peer and individual factors in adolescence explaining the relationship between girls' pubertal timing and teenage childbearing

All paths control for all covariates.

+, - indicate hypothesized positive (+) or negative (-) direct pathway

Fig. 2. Unstandardized coefficients (b) and standard errors (SE) of significant direct effects at the 95% confidence level

Participants' substance use at ages 12-14, perceived peer substance use at ages 12-14, and having an older first sex partner were correlated in the model. All paths controlled for age at Wave 1, race/ethnicity, mother's education, whether the participant's mother had her first birth before age 20, and father absence during youth (prior to or at Wave 1). Standard errors are within parentheses. Nonsignificant pathways are indicated with a dashed line.

Significant direct pathways are indicated with a solid line. Control variables and correlations of mediators are not shown for simplicity.

^a $p < .05$.

^b $p < .005$.

Unweighted Descriptive Characteristics of Analytic Sample and Bivariate Relationships with Timing of Menarche and Teenage Childbearing (N=2,066)

Table 1

	On time or later menarche (≥ 1 SD below mean)	Early m e narche (>1 SD below mean)	First birth ≥ 20 years old	First birth <20 years old	χ^2
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	χ^2
All ^c	1,776 (86.0)	290 (14.0)	1,747 (84.6)	319 (15.4)	
Age at first birth					
20 years old	1,513 (86.6)	234 (13.4)			3.87 ^a
<20 years old	263 (82.5)	56 (17.6)			
Race/ethnicity					
Non-Hispanic white ⁽¹⁾	918 (91.3)	88 (8.8)	912 (90.7)	94 (9.3)	61.31 ^b
Non-Hispanic black ⁽²⁾	423 (79.1)	112 (21.0)	411 (76.8)	124 (23.2)	2.3
Hispanic ⁽³⁾	362 (81.4)	83 (18.7)	354 (79.6)	91 (20.5)	1
Maternal education					
Did not graduate HS ⁽⁴⁾	380 (84.1)	72 (15.9)	336 (74.3)	116 (25.7)	80.12 ^b
HS diploma only ⁽²⁾	624 (85.0)	110 (15.0)	611 (83.2)	123 (16.8)	2.3
Some college ⁽³⁾	743 (89.0)	92 (11.0)	773 (92.6)	62 (7.4)	1.3
Mother's age at first birth					
20 years old	1,226 (86.9)	185 (13.1)	1,263 (89.5)	148 (10.5)	76.52 ^b
<20 years old	429 (84.3)	80 (15.7)	374 (73.5)	135 (26.5)	
Father absence in youth					
No	1,019 (88.2)	137 (11.9)	1,038 (89.8)	118 (10.2)	55.18 ^b
Yes	753 (83.3)	151 (16.7)	704 (77.9)	200 (22.1)	
Older first sex partner					
No (≥ 1 SD above mean age difference)	1,055 (85.4)	180 (14.6)	1,067 (86.4)	168 (13.6)	8.57 ^b
Yes (>1 SD above mean age difference)	188 (84.7)	34 (15.3)	175 (78.8)	47 (21.2)	
	<i>M</i> (<i>se</i>)	<i>M</i> (<i>se</i>)	<i>M</i> (<i>se</i>)	<i>M</i> (<i>se</i>)	<i>t</i>

	On time or later menarche (≥ 1 SD below mean)	Early menarche (>1 SD below mean)	First birth 20 years old	First birth <20 years old	χ^2
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Age at wave 1 interview (years)	13.14 (0.02)	13.13 (0.05)	13.14 (0.02)	13.15 (0.04)	-0.32
Age at menarche (years)	12.73 (0.02)	10.25 (0.05)	12.42 (0.03)	12.19 (0.07)	2.88 ^b
Age at first sex (years)	16.31 (0.05)	15.02 (0.12)	16.52 (0.05)	15.04 (0.07)	13.67 ^b
Age at first child (years)	21.36 (0.11)	20.81 (0.25)	22.85 (0.09)	17.32 (0.07)	36.25 ^b
Wave 1 Substance Use Index (0-3 scale)	0.60 (0.02)	0.73 (0.06)	0.58 (0.02)	0.85 (0.06)	-4.71 ^b
Wave 1 Peer Substance Use (1-5 scales)					
Currently smoke	2.22 (0.03)	2.45 (0.08)	2.20 (0.03)	2.54 (0.08)	-4.49 ^b
Get drunk 1x/month	1.67 (0.02)	1.88 (0.07)	1.66 (0.02)	1.92 (0.07)	-4.01 ^b
Have used illicit drugs	1.88 (0.03)	2.11 (0.07)	1.85 (0.03)	2.24 (0.07)	-5.47 ^b

Abbreviations: HS, High School.

^a $p < .05$.^b $p < .005$.^c Not all groups total to 2,066 due to missing data.^{1,2,3} Different numbered superscripts indicate significant ($p < .05$) group comparisons based on pairwise χ^2 tests.

Table 2
Unstandardized coefficients (b) and 95% confidence intervals (CI) of indirect effects (b_1*b_2 , $b_1*b_2*b_3$)

pathway	b_1*b_2		b	CI
1	early menarche → substance use →	age at first sex	-.042	-.073, -.013
2	early menarche → perceived peer substance use →	age at first sex	-.016	-.034, -.002
3	early menarche → older first sexual partner →	age at first sex	.000	-.009, .008
4	substance use →	age at first sex → first birth before age 20	.161	.115, .213
5	perceived peer substance use →	age at first sex → first birth before age 20	.047	.009, .088
6	older first sexual partner →	age at first sex → first birth before age 20	-.006	-.046, .034
pathway	$b_1*b_2*b_3$		b	CI
7	early menarche → substance use →	age at first sex → first birth before age 20	.014	.003, .024
8	early menarche → perceived peer substance use →	age at first sex → first birth before age 20	.005	.000, .011
9	early menarche → older first sexual partner →	age at first sex → first birth before age 20	.000	-.003, .003