Drug and Alcohol Dependence 153 (2015) 59–65

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Effects of prenatal cocaine exposure on early sexual behavior: Gender difference in externalizing behavior as a mediator

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ARTICLE INFO

Article history:
Received 26 March 2015
Received in revised form 2 June 2015
Accepted 3 June 2015
Available online 9 June 2015

Keywords:
Prenatal cocaine exposure
Early sexual behavior
Gender difference

ABSTRACT

Background: Prenatal cocaine exposure (PCE) is associated with increased risk for externalizing behavior problems; childhood externalizing behavior problems are linked with subsequent early sexual behavior. The present study examined the effects of PCE on early sexual initiation (sexual intercourse prior to age 15) and whether externalizing behavior in preadolescence mediated the relationship.
Methods: Three hundred fifty-four (180 PCE and 174 non-cocaine exposed; 192 girls, 142 boys), primarily African-American, low socioeconomic status, 15-year-old adolescents participated in a prospective longitudinal study. Adolescents' sexual behavior was assessed at 15 years using the Youth Risk Behavior Surveillance System. Externalizing behavior was assessed at 12 years using the Youth Self-Report.
Results: Logistic regression models indicated that adolescents with PCE ($n = 69$, 38%) were 2.2 times more likely (95% CI = 1.2–4.1, $p < .01$) to engage in early sexual intercourse than non-exposed peers ($n = 49$, 28%) controlling for covariates. This relationship was fully mediated by self-reported externalizing behavior in girls but not in boys, suggesting childhood externalizing behavior as a gender moderated mediator. Blood lead level during preschool years was also related to a greater likelihood of early sexual intercourse (OR = 2.6, 95% CI = 1.4–4.7, $p < .002$). Greater parental monitoring decreased the likelihood of early sexual intercourse, while violence exposure increased the risk.
Conclusions: PCE is related to early sexual intercourse, and externalizing behavior problems mediate PCE effects in female adolescents. Interventions targeting externalizing behavior may reduce early sexual initiation and thereby reduce HIV risk behaviors and early, unplanned pregnancy in girls with PCE.

1. Introduction

Early sexual initiation has been associated with an increased risk of unintended teen pregnancies (O'Donnell et al., 2001) and sexually transmitted infections including HIV (Kaestle et al., 2005). Data from the 2006–2010 National Survey of Family Growth indicated that 14% of females and 18% of males had sexual intercourse by their 15th birthday (Finer and Philbin, 2013). Substantial research has documented that childhood behavior problems (aggression, antisocial behavior, delinquency) predict subsequent early initiation of sexual intercourse (Ramrakha et al., 2007; Skinner et al., 2015). The current study examines the contribution of prenatal cocaine exposure (PCE) to early sexual initiation given accumulating evidence of teratogenic effects of PCE on externalizing behavior (Ackerman et al., 2010; Bada et al., 2011; Buckingham-Howes et al., 2013; Lambert and Bauer, 2012; Min et al., 2014a, 2014b; Minnes et al., 2010).

Maternal substance use during pregnancy continues to be a serious public health problem, with approximately 214,000 infants exposed to illicit drugs, including cocaine, in utero each year in the United States (Substance Abuse and Mental Health Services Administration, 2014). PCE disrupts the monoaminergic neurotransmitter system (dopamine, norepinephrine, serotonin) in the prefrontal cortex, affecting emotional and behavioral arousal and regulation, stress response, and executive function (Thompson et al., 2009), all of which are risk factors for engaging in early sexual behavior (Goldenberg et al., 2013; Khurana et al., 2012). The neurobehavioral teratology model (Vorhees, 1989) posits that the damage to the developing central nervous system incurred prenatally due to exposure to teratogens can extend through later periods of development, suggesting that PCE effects may be expressed

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http://dx.doi.org/10.1016/j.drugalcdep.2015.06.009
0376-8716/

differently across development, including externalizing behavior in childhood and/or early sexual behavior in adolescence. The model also posits that long-term developmental outcome is affected by the timing, duration, and dose of the teratogen in utero, with environmental context exacerbating or mitigating early teratogenic effects. Additionally, some teratogenic effects may not be evident until the cognitive or behavioral domains implicated are emergent.

To date, three studies from two prospective cohorts have investigated the effects of PCE on adolescent sexual behavior (Conradt et al., 2014; De Genna et al., 2014; Lambert et al., 2013). First trimester PCE was a significant predictor of early sexual intercourse, with most PCE effects occurring between the ages of 13 and 18 when rates of initiation of sexual intercourse were approximately 10% higher among adolescents with PCE (De Genna et al., 2014). They also found that the effect of PCE was fully mediated by marijuana and alcohol use prior to age 15, but not by caregiver-reported externalizing behavior at age 7. In another cohort, PCE was associated with early (≤age 14) onset of oral sex, but not with penetrative sex, which was partially mediated by caregiver-reported attention problems at age 13 (Lambert et al., 2013), while prenatal poly-drug exposure including cocaine was related to behavioral dysregulation at ages 13/14, which predicted sexual intercourse by age 16 only in boys (Conradt et al., 2014).

Establishing the causal effect of PCE on early sexual behavior is complicated due to multiple biological and environmental confounders, including high levels of prenatal exposure to other substances such as alcohol (Larkby et al., 2011), tobacco (Maughan et al., 2004), and marijuana (Goldschmidt et al., 2000), elevated lead (≥10 μg/dL) levels (Lane et al., 2008; Min et al., 2009; Singer et al., 2008), delayed pubertal development (Bennett et al., 2015), poor quality of the home environment (Lewis et al., 2011; Singer et al., 2008), caregiver postpartum substance use and psychological distress (Minnes et al., 2010) and adoptive/foster care placement (Singer et al., 2004). Further, family conflict (Fosco et al., 2012), violence exposure (Frank et al., 2011), poor attachment to caregiver (Warner et al., 2011), and inadequate parental monitoring (Min et al., 2014a, 2014b), all reflecting the interpersonal developmental contexts in which adolescents transact (Cicchetti and Rogosch, 2002), may heighten the drug exposed adolescent's vulnerability.

The present study examines the effects of PCE on early sexual initiation, defined as sexual intercourse prior to age 15, and whether externalizing behavior in preadolescence mediates the relationship. We previously reported significant PCE effects on adolescents' self-reported externalizing behavior at age 12 in both boys and girls (Min et al., 2014b). The data reported in the current paper were drawn from the same cohort. Building on previous studies linking PCE with externalizing behavior and externalizing behavior with early sexual behavior, we hypothesized that: (1) adolescents with PCE would be more likely to experience sexual intercourse before age 15 than non-cocaine exposed (NCE) adolescents, controlling for the effects of other risk factors and (2) externalizing behavior would mediate the relationship between PCE and sexual intercourse before age 15. Because a significant proportion of PCE adolescents in this sample were placed in non-kinship adoptive/foster care with lower lead levels and better quality home environments, we also explored the impact of such placement on early sexual behavior. Since normative expectation for sexual activity may differ by gender (e.g., norms may encourage sex for adolescent boys but not for adolescent girls; Martin, 1996) and there are mixed findings of PCE by gender interaction on behavioral adjustment (e.g., Carmody et al., 2011; Delaney-Black et al., 2000; Minnes et al., 2010), we explored gender as a potential moderator of PCE and externalizing behavior effects on early sexual initiation.

2. Methods

2.1. Sample

This study included 354 (180 PCE, 174 NCE) 15-year-old adolescents recruited at birth from an urban county hospital and their birth mothers or current caregivers. Pregnant women were recruited into the study if they had a urine toxicology screening ordered by the hospital due to: (1) lack of prenatal care; (2) a history of involvement with the Department of Human Services; (3) appearance of intoxication; or (4) self-reported substance use during pregnancy. A nurse recruiter approached all screened women ($N = 647$) immediately before or after infant birth. Of these 647 women, 54 were excluded, 155 refused to participate, and 23 did not come to the enrollment visit. Reasons for exclusion included maternal psychiatric history, low maternal intellectual functioning indicated in medical chart review, HIV-positive status, maternal chronic medical illness, and infants' Down syndrome, fetal alcohol syndrome, or congenital heart defect.

Maternal and infant urine samples and infant meconium were obtained shortly before or after infant birth and analyzed for cocaine and other drug metabolites, including benzoylecgonine, meta-hydroxybenzoylecgonine, cocaethylene, cannabinoids, opitates, phencyclidine, amphetamines, and benzodiazepines. A total of 415 newborns and their birth mothers were enrolled at birth, of which 218 infants were identified as cocaine-exposed based on positive screens of maternal and infant urine, infant meconium, or maternal self-report to hospital or research staff. Infants who were negative on all indicators of prenatal cocaine exposure were identified as NCE, but they may have been exposed to other substances (i.e., alcohol, tobacco, marijuana). Infants exposed to cocaine were further classified as being either heavier or lighter exposed. The heavier PCE group was defined a priori as >70th percentile for cocaine use, which corresponded to ≥216 ng/g benzoylecgonine in meconium screening or ≥17.5 units used ("rocks" of cocaine worth $20 each)/week by maternal self-report.

Since birth, 12 (9 PCE, 3 NCE) enrolled children died from sudden infant death syndrome (4 PCE, 2 NCE), cardiopulmonary arrest (1 PCE), pneumonia (1 PCE), accidental asphyxia (1 PCE), respiratory distress syndrome (1 PCE, 1 NCE), and unknown illness (1 PCE). The present study utilizes data from 354 adolescents who completed sexual behavior assessment at age 15, representing 88% retention of the 403 living participants in the original study. Of the 49 adolescents not included in these analyses (19 drop-out, 17 lost contact, 1 low intellectual functioning (IQ < 50), 12 missing data), the 29 PCE adolescents were not different from PCE adolescents who participated in the study. The 20 NCE adolescents not included in the analyses were more likely to be white, have birth mothers who were older, more likely to be married, and had lower psychological distress compared to the participating NCE adolescents. No difference was found by PCE status between the 354 participants and the 49 nonparticipants, although the nonparticipants were more likely to be white and male.

2.2. Procedure

Subjects and their mothers/caregivers were assessed shortly after birth and at follow-up visits conducted at ages 6, 12, and 18 months and 2, 4, 6, 9–12, and 15 years of age. This study was approved by the Institutional Review Board of the participating hospital. Written informed consent was obtained at each visit from the child's parent or legal guardian and written child assent was obtained beginning at age 9. A Certificate of Confidentiality was obtained from the U.S. Department of Health and Human Services to further protect the sensitive nature of the data acquired from caregivers and subjects during each phase of the study. Participants were given a monetary stipend for each assessment visit, along with lunch and assistance with transportation costs if needed.

2.3. Measures

2.3.1. Prenatal drug exposure. At the newborn visit, birth mothers were interviewed regarding their substance use during the month prior to becoming pregnant and during each trimester of their pregnancy. They were asked to recall the number of cigarettes per day and marijuana joints smoked per week, and the number of drinks of beer, wine, or hard liquor consumed per week, with each drink equivalent to 0.5 oz. of absolute alcohol. For cocaine, the number of "rocks" consumed and the amount of money spent per day were noted. For each drug, the frequency of use was recorded on a Likert-type scale ranging from 0 (not at all) to 7 (daily use). Frequency was multiplied by the amount used per day to compute an average use score for the month prior to pregnancy and for each trimester. These scores were then averaged to obtain a total score of prenatal exposure for each drug. At each follow-up visit, the substance use assessment was updated with the child's current caregiver to obtain a measure of their recent drug use in the past 30 days.

2.3.2. Early sexual behavior. At the 15-year follow-up visit, age at first time of sexual intercourse was assessed using one item from the Youth Risk Behavior Surveillance System (YRBSS; Centers for Disease Control and Prevention, 2009). Early sexual behavior was defined as any sexual intercourse before 15 years of age.