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Prenatal marijuana exposure predicts marijuana use in young adulthood

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ABSTRACT

Background: Studies have reported effects of prenatal marijuana exposure (PME) on cognitive and behavioral outcomes. An earlier publication from this study found that PME predicted early onset of marijuana use and frequency of marijuana use at age 14. No study has reported the effects of PME on marijuana use in young adulthood. This is a developmental period when substance use peaks, and by which, initiation of substance use has largely occurred.
Methods: Subjects were from a longitudinal cohort. Women were interviewed initially in their fourth prenatal month and women and their offspring were followed through 22 years. Significant covariates of offspring marijuana use at 22 years were identified and controlled for using ordinal logistic regression.
Results: PME predicted marijuana use in the offspring at 22 years after controlling for significant covariates. Prenatal alcohol exposure, offspring race, gender, and age were also significant predictors, but family history of substance abuse or disorder, and sociodemographic and psychological characteristics of the mother and offspring were not. This association was not moderated by gender or race.
Conclusions: PME is associated with subsequent marijuana use in young adulthood after considering the effects of other significant factors. These findings have important implications for public health given the recent trend toward legitimization of marijuana use.

1. Introduction

Data from the U.S. National Survey on Drug Use and Health (NSDUH) show that, among those 18 to 25 years of age, 52% have ever used marijuana, 32% have used marijuana within the past year, and 19% have used in the past month (SAMHSA, 2013). The use of marijuana peaks in the early 20s, which overlaps with the average age of first birth (23 years) (Martinez et al., 2012). This, together with the recent increase in marijuana use (SAMHSA, 2013), an increase in the strength of marijuana (Mehmedic et al., 2010), and the legalization of marijuana in several states, makes marijuana use during pregnancy a significant concern. It is not known whether prenatal exposure to marijuana predicts marijuana use among the offspring in young adulthood.

Use of marijuana during pregnancy has been shown to disrupt the endogenous cannabinoid system (ECS) in the developing fetus, which is important in the development of the CNS and is associated with progenitor cell migration and differentiation, neuronal migration, development of axonal pathways, and the creation of functional synapses (Gaffuri et al., 2012; Wu et al., 2011). When an exogenous cannabinoid such as marijuana is consumed, the main psychoactive ingredient, delta-9-tetrahydrocannabinol (THC), enters the mother's bloodstream and crosses the placenta (Sundram, 2006). THC interacts with the cannabinoid receptors in the ECS and affects brain development, putting the offspring at risk for problems with emotion regulation, memory, and depression (Jutras-Aswad et al., 2009). The research described in this manuscript addresses whether prenatal marijuana exposure (PME) is associated with increased use of marijuana in the offspring.

There are two birth cohorts with published findings on long-term outcomes of PME: the Maternal Health Practices and Child Development (MHPCD) Study and the Ottawa Prenatal Prospective Study (OPPS). These studies have found that PME predicts deficits in memory and attention, increases in impulsivity and hyperactivity, and symptoms of anxiety and depression in childhood, as well as delinquent behavior in adolescence (Day et al., 1994, 2011; Fried et al., 1992; Fried and Watkinson, 1990, 2001; Goldschmidt et al., 2000, 2004; Gray et al., 2005; Leech et al., 1999). In addition, findings published from the MHPCD cohort demonstrated that PME significantly predicted early onset of marijuana use, defined as initiation of marijuana in the

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offspring by age 14, as well as the frequency of marijuana use (Day et al., 2006). In the OPPS study, PME predicted age of initiation of marijuana, but did not predict frequency of marijuana use in offspring between the ages of 16 and 21 years (Porath and Fried, 2005). Additionally, in this report, an interaction was found with gender; males initiated marijuana at a faster rate than females.

Other factors also influence marijuana initiation and use. Environmental and genetic factors, marijuana and other substance use by the mother or father, family conflict, change in maternal marital status, parental supervision and control, and peer marijuana use predict increased substance use, including marijuana use (Agrawal and Lynskey, 2006; Day et al., 2006; Hayatbakhsh et al., 2008, 2009; Perkonigg et al., 2008; Richardson et al., 2013; von Sydow et al., 2002). Characteristics of the individual including psychological status and behavior also play significant roles in the onset of substance use (Hayatbakhsh et al., 2009; Kilpatrick et al., 2000; Perkonigg et al., 2008).

These analyses will explore the effects of PME on marijuana use in young adulthood. This association is important because levels of substance use are highest during young adulthood (Spoth et al., 2009). It is also a time when the offspring are reproducing and are at risk of prenatally exposing another generation to marijuana. We hypothesize that: 1) PME will predict offspring marijuana use in early adulthood; 2) the association between PME and offspring use will remain significant after controlling for other factors that are significantly associated with marijuana use in young adulthood; and 3) the relations between PME and offspring marijuana use will be moderated by gender and race.

2. Method

2.1. Sample description

The data for this study come from the Maternal Health Practices and Child Development (MHPCD) study at the University of Pittsburgh. This is a longitudinal study of the effects of prenatal exposure to marijuana and alcohol on offspring development. Participants were recruited from the prenatal clinic at Magee-Womens Hospital in Pittsburgh, PA. Recruitment took place from 1982 to 1985. To be eligible, women had to speak English, be at least 18 years of age, and in their fourth or fifth gestational month. There were 1360 women who completed the initial interview. The refusal rate was 15%.

After the initial interview, two cohorts were selected. One was composed of women who used marijuana at least two times per month in the first trimester and a random sample of those women who reported they used marijuana less often or none at all. The second was composed of women who drank three or more alcoholic drinks per week in the first trimester and a random sample of those women who drank less than this amount or not at all. Sampling was done with replacement, allowing women to be eligible for both cohorts. Both studies followed the same protocol, which allowed the study cohorts to be combined for analysis. The combined cohort was 829 women, with 48% overlap between the alcohol and marijuana cohorts.

The women enrolled in the MHPCD study were interviewed again in their seventh gestational month. Subsequent assessments of mothers and offspring were conducted at birth, and at 8 and 18 months, 3, 6, 10, 14, 16, and 22 years of age. At each phase of data collection, information was gathered about maternal psychological, social, and environmental factors, demographic status, substance use, and the cognitive, behavioral, psychological, and physical development of the offspring.

The birth cohort consisted of 763 live singleton infants. Loss of participants from the enrolled cohort of 829 women resulted from 8 mothers who refused the delivery assessment, 16 pairs were lost to follow-up, and 21 pairs moved out of the area. Other exclusions included 18 offspring due to early fetal death, 2 offspring due to multiple gestation birth, and one offspring was placed for adoption and could not be followed. Only mother–child pairs who completed the assessment at birth were selected for follow-up.

At the 22-year phase, 608 offspring participated in the assessment, representing 80% of the birth cohort. Of the 155 who did not participate, 30 refused, 3 had been adopted and could not be located, 18 were institutionalized in either jail or a rehabilitation facility, 56 were lost to follow-up, 29 moved out of the area, 11 died, and 8 could not participate due to low cognitive functioning. In addition, 14 offspring had incomplete data and 5 were excluded because they reported that they had not used marijuana but tested positive for the substance on a urine screen. This resulted in a final sample size of 589, representing 77% of the birth cohort. Those who were included in the analysis did not differ from those who were not included in the analysis ($n = 174$) based on first trimester maternal characteristics including age, race, education, marital status, household income, and substance use.

3. Measures

3.1. Demographic status

Maternal age, education, employment, and income were assessed at each phase. Offspring gender was ascertained by physical exam at birth. Race was self-reported by the offspring during the 22-year assessment.

3.2. Substance use

The mothers provided information about their marijuana use at each interview. Assessments during pregnancy covered the previous trimester. At follow-up phases, the past year was evaluated. Questions measured usual, maximum, and minimum quantity and frequency of marijuana, hashish, and sinsemilla (Day and Robles, 1989). The quantities of hashish and sinsemilla were converted to account for their higher THC content. One joint of sinsemilla was equal to two joints of marijuana; one joint or bowl of hashish was equal to three joints of marijuana (Gold, 1989; Hawks and Chiang, 1986). A blunt was coded as four joints. Marijuana use was calculated as average daily joints (ADJ: number of joints/week × 4 weeks/month ÷ 31 days/month). An ADJ of 0.4 is equivalent to using three joints per week and an ADJ of 0.89 is equivalent to using one joint per day. First trimester marijuana use was used in these analyses because the prevalence of marijuana use decreased substantially across pregnancy, from 41% in the first trimester to 18% in the third trimester. For descriptive analyses, use was defined as no use, <3 times per week, and ≥3 times per week. At 22 years, marijuana use among the offspring was measured with the same questions used for the mothers.

Measurement of alcohol use was done with parallel questions as above for marijuana and was defined as the average number of drinks or average daily volume (ADV). Cigarette use was expressed as the number of cigarettes smoked per day. Use of other illicit drugs excluding marijuana, such as amphetamines and barbiturates, was dichotomized as use/no use due to the low frequency of use in this sample.

Covariates were identified from the literature and prior findings of this cohort. We used maternal age, race, years of education, and household income from the first interview. The mothers completed the Center for Epidemiological Studies-Depression Scale (CES-D; Radloff, 1977), an assessment of depressive symptoms, and the State-Trait Anxiety Inventory (Spielberger et al., 1970) that assessed anxiety and hostility.

At 22 years, the offspring reported whether their mothers, fathers, or siblings had a history of problems with alcohol or drugs. A dichotomous variable for family history of problematic use was created to represent the presence of problems in first degree relatives. Offspring also provided information about their age, education, occupation, income, and their use of other substances.

Informed consent was obtained from the mothers at each phase of the study and from the women and their offspring at 22 years. This study was approved by the Magee-Womens Hospital Human Subjects Review Board and by the Institutional Review Board of the University of Pittsburgh. A Certificate of Confidentiality was also obtained from