Neurotoxicology and Teratology 70 (2018) 10–17

Contents lists available at ScienceDirect

Neurotoxicology and Teratology

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

Trajectories of pre- and postnatal co-use of cannabis and tobacco predict co-use and drug use disorders in adult offspring

Natacha M. De Genna[a,*], Lidush Goldschmidt[b], Gale A. Richardson[a], Marie D. Cornelius[a], Nancy L. Day[a]

[a] University of Pittsburgh School of Medicine and Western Psychiatric Institute and Clinic (WPIC), 3811 O'Hara Street, Pittsburgh, PA 15213, USA
[b] Western Psychiatric Institute and Clinic (WPIC) at University of Pittsburgh Medical Center (UPMC), 3811 O'Hara Street, Pittsburgh, PA 15213, USA

ARTICLE INFO

Keywords:
Cannabis
Tobacco
Co-use
Polysubstance use
Marijuana

ABSTRACT

Co-use of cannabis and tobacco is increasingly common among women and is associated with tobacco and cannabis dependence and poorer cessation outcomes. However, no study has examined maternal patterns of co-use over time, or the impact of maternal co-use on co-use and drug problems in adult offspring. Pregnant women (M age = 23, range = 18–42; 52% African American, 48% White) were asked about substance use during each trimester of pregnancy, and at 8 and 18 months, 3, 6, 10, 14, 16, and 22 years postpartum. We examined patterns of any maternal cigarette and cannabis use during pregnancy and the postpartum years. As young adults (M age = 22.8 years, range = 21–26), 603 offspring completed the Diagnostic Interview Schedule (DIS). Growth mixture modeling (GMM) was used to identify four maternal trajectories through 16 years postpartum: (1) no co-use (66%), (2) decreasing co-use (16%), (3) postpartum-only co-use (11%), and (4) chronic co-use (7%). Offspring whose mothers were in the decreasing co-use group (co-users primarily during prenatal and preschool periods) were more likely to be co-users than the offspring of non-co-users. Offspring whose mothers were chronic co-users of cigarettes and cannabis were more than twice as likely to have a drug use disorder than young adults whose mothers were not co-users. The results of this study highlight the heterogeneity in maternal co-use of tobacco and cannabis over time, with some women quitting during pregnancy but resuming co-use in the postpartum, and other women co-using during pregnancy but desisting co-use over time. Maternal trajectories of co-use were associated with inter-generational transfer of risk for substance use and dependence in adult offspring.

1. Introduction

Although fewer American women are smoking tobacco cigarettes, the use of cannabis and the co-use of cannabis with tobacco have significantly increased and are especially common among women of reproductive age (Conway et al., 2018; Schauer et al., 2015). From 2005 to 2015, the rate of women this age stating that there was no risk associated with weekly marijuana use tripled (Jarlenski et al., 2017). In fact, pregnant women in the National Survey of Drug Use and Health (NSDUH) were just as likely to be cannabis users as *non-pregnant* women, although they were less likely to be tobacco-only users or co-users of cannabis and tobacco (Coleman-Cowger et al., 2017). However, co-use of cannabis with tobacco during pregnancy is more common than cannabis use alone, and is more common among pregnant young adult, Black, and Hispanic women (Coleman-Cowger et al., 2017; Gray et al., 2010).

In cross-sectional studies, co-use has been linked to both cannabis and tobacco dependence, and to poorer psychosocial outcomes (Agrawal et al., 2012; Montgomery, 2015; Montgomery and Bagot, 2016; Ream et al., 2008; Timberlake, 2009; Wang et al., 2016). Not surprisingly, female co-users are at high-risk of continuing co-use during pregnancy (El Marroun et al., 2008; Ko et al., 2015; Lester et al., 2001). In the National Epidemiological Survey on Alcohol and Related Conditions (NESARC), co-users were at greater risk of Cannabis Use Disorder (CUD) than cannabis-only users (Agrawal and Lynskey, 2009). Thus, pregnant women who use both substances may have greater difficulty quitting cannabis use during pregnancy. Moreover, it is highly likely that many women who co-use tobacco cigarettes and cannabis during pregnancy will continue to do so in the postpartum, and their offspring may thus be at risk of both prenatal and postnatal

* Corresponding author.
E-mail addresses: degennan@pitt.edu (N.M. De Genna), lidush@pitt.edu (L. Goldschmidt), gar@pitt.edu (G.A. Richardson), mdc1@pitt.edu (M.D. Cornelius), nday@pitt.edu (N.L. Day).

https://doi.org/10.1016/j.ntt.2018.09.002
Received 10 May 2018; Received in revised form 13 September 2018; Accepted 14 September 2018
Available online 15 September 2018

(environmental) exposure to maternal tobacco cigarette and cannabis use.

Maternal substance use is a well-known risk factor for offspring substance use and substance use disorders. This risk begins early in life, as prenatal tobacco cigarette exposure predicts cigarette use during adolescence (Agrawal et al., 2010; Cornelius et al., 2000, 2005; De Genna et al., 2016a; O'Brien and Hill, 2014) and risk for tobacco dependence (Buka et al., 2003; De Genna et al., 2017a; Shenassa et al., 2015). Similarly, maternal prenatal cannabis use is linked to cigarette and cannabis use (Porath and Fried, 2005; Sonon et al., 2015) and cannabis dependence (Sonon et al., 2016) in exposed offspring. Even more women use substances in the postpartum than during pregnancy, and many studies have linked postnatal substance use to substance use and Substance Use Disorders (SUDs) in offspring. Maternal substance use is associated with initiation and frequency of substance use during adolescence (e.g., Andrews et al., 1993; Brook et al., 2001; Gilman et al., 2009; Hawkins et al., 1992; Vermeulen-Smit et al., 2015), trajectories of substance use from adolescence to adulthood (Brook et al., 2012; Chassin et al., 1996; Walden et al., 2007), and adult SUDs (Chassin et al., 1999).

Thus, there is a strong link between prenatal exposures to tobacco and cannabis (considered separately) to early initiation of substance use and adolescent risk for tobacco and cannabis dependence. There is a separate literature demonstrating that maternal postnatal substance use is also associated with the initiation and frequency of adolescent substance use, trajectories of use into adulthood, and SUDs. Taken together, these findings suggest that both prenatal and postnatal exposures to maternal cigarette and cannabis use will independently predict substance use and SUDs in offspring. Although co-use of cannabis and tobacco are correlated with poorer psychosocial outcomes and greater risk of dependence on both substances for individuals who co-use, there is a gap in the literature on the effect of maternal co-use of these substances on offspring. It is not clear if maternal patterns of co-using cigarettes and cannabis over time have any impact on adult offspring risk for co-use and SUDs.

Group-based trajectory modeling allows substance use researchers to identify long-term trajectories of use and to determine if specific maternal trajectories of use are associated with other outcomes, such as offspring health and behavior (Nagin, 1999). For example, trajectories of cannabis use in teenage mothers predicted early initiation of sexual intercourse in adolescent offspring, suggesting that maternal substance use may play a role in the inter-generational transfer of risk for early parenthood (De Genna et al., 2015b). Trajectory analyses of maternal tobacco cigarette use have revealed the utility of examining long-term patterns of maternal substance use as risk factors for cigarette use in offspring (De Genna et al., 2016a; Melchior et al., 2010). It is important to investigate the effects of maternal patterns of co-use of cannabis and tobacco on offspring co-use and drug use disorders, controlling for variables that are associated with substance use in both mother and child.

There are many factors associated with exposure to maternal substance use and young adult risk for substance use that need to be considered in multivariate analysis. For example, maternal age and maternal symptoms of depression and hostility predict trajectories of maternal substance use (De Genna et al., 2015b, 2016a, 2017b) so it is possible that the offspring of younger, more depressed and hostile mothers are at greater risk of co-use and drug use disorders. Prenatal alcohol use has been linked to cannabis use in young adult offspring (Sonon et al., 2015), in addition to problem drinking and Alcohol Use Disorders (AUDs) (Alati et al., 2006; Baer et al., 2003). Co-use and drug use disorders in offspring may also be the result of an inherited predisposition to dependence, so it is important to determine if patterns of maternal co-use predict substance use and abuse in adult offspring, above and beyond the effects of maternal tobacco, cannabis, and alcohol use disorders. Offspring neurodevelopment, sex, and educational attainment are also well-known correlates of young adult cigarette and cannabis use. Some investigators report sex-specific effects of maternal prenatal and postnatal cigarette and cannabis use on substance use in offspring (Kandel et al., 1994, 2015; Kandel and Udry, 1999; Porath and Fried, 2005; Roberts et al., 2005; Rydell et al., 2012; Sullivan et al., 2011), so sex differences should also be examined.

Despite women's increasing co-use of cannabis and tobacco and recent interest in group-based trajectory modeling of co-occurring substance use (e.g., Brook et al., 2012; Green et al., 2017; Liu and Mumford, 2017), no previous analysis has focused on trajectories of co-use of cigarettes and cannabis in mothers. The goals of this study are to (1) identify and describe trajectories of any maternal co-use of tobacco cigarettes and cannabis, and (2) to determine if specific trajectories of any maternal co-use during gestation and postpartum periods are associated with adult offspring risk for co-use and drug use disorders. Based on the extant literature on trajectories of prenatal and postnatal maternal use of single substances (De Genna et al., 2015a, 2015b, 2016b, 2017b; Liu et al., 2016; Liu and Mumford, 2017; Mumford and Liu, 2016; Tran et al., 2015a, 2015b; Tucker et al., 2006), we hypothesized that there would be distinct trajectories of maternal co-use of tobacco cigarettes and cannabis across the prenatal and postpartum periods, with different patterns of pre- and postpartum desistance. As maternal substance use is known to predict substance use in offspring, we hypothesized that the adult offspring of chronic co-users would be more likely to be co-users themselves, and more likely to develop a drug use disorder by age 22. We did not have a hypothesis for sex-specific effects of maternal co-use trajectories on offspring co-use and drug use disorder, as this was an exploratory analysis.

2. Methods

2.1. Study design

Pregnant women (18 and older) were recruited in their 4th or 5th prenatal month from a teaching hospital in Pittsburgh, PA from 1982 to 1985 as part of two cohort studies. Women reported on their substance use twice during pregnancy and at delivery, 8 and 18 months, and 3, 6, 10, 14, 16 and 22 years postpartum. Other maternal substance use, demographic characteristics, and psychosocial factors were also assessed at each phase. Demographic characteristics, substance use, and psychiatric disorders were assessed in the young adult offspring during the 22-year visit. This study was approved by the University of Pittsburgh Institutional Review Board.

Eighty-five percent of the women who were approached agreed to participate in the studies, with no differences in maternal age, income, or race between those who participated and those who refused. Two cohorts were selected from the initial sample, pregnant adult women who: 1) drank 3 or more alcoholic drinks per week and a random sample of women who drank less often or not at all were selected for a study of prenatal alcohol use (AA06390: PI N. Day), and 2) used marijuana at the rate of 2 or more joints per month and a random sample of women who used marijuana less often or not at all were chosen for a study of the effects of prenatal marijuana use (DA03874: PI N. Day). More details on the parent study designs are available in previous publications (e.g., Day et al., 1989; Day et al., 1991). Women could be in one or both samples. These two studies combined had 763 adult women with live-born singleton offspring.

At the 22-year postpartum visit, 608 offspring were assessed (80% of the birth cohort). There were 30 refusals, 56 lost to follow-up, 29 moved out of the area, 18 unavailable due to institutionalization (jail or rehab), 11 had died, 8 unable to participate due to low IQ, and 3 had been adopted and were no longer part of the study. The 22-year sample did not differ in maternal socioeconomic status, race, prenatal marijuana, tobacco, or alcohol use from the 155 who were not assessed at this time point. Five cases seen at age 22 were removed from this analysis due to extensive missing maternal substance use data, for a final sample size of 603.