Drug and Alcohol Dependence 188 (2018) 209–215

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

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

Full length article

Prenatal exposures to tobacco and cannabis: Associations with adult electronic cigarette use

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ARTICLE INFO

Keywords:
Prenatal exposures
Prenatal tobacco
Electronic cigarettes
Tobacco dependence
Cannabis
Prenatal cannabis

ABSTRACT

Introduction: Prenatal exposures to tobacco and cannabis are associated with combustible cigarette use. This study evaluated pathways from these prenatal exposures to adult electronic cigarette use. We tested whether there were indirect effects of these prenatal exposures via childhood behavior dysregulation, early tobacco use, and adolescent tobacco dependence.

Methods: Telephone interviews were conducted with 427 adult offspring (22–33 years old) from 3 prenatal cohorts with trimester-specific data on exposures to tobacco, alcohol, and cannabis. The offspring were 59% Black and 41% White (61% female). Prenatal exposures included quantity/frequency of tobacco, alcohol, and cannabis use by mothers during the first trimester. Using logistic regression and structural equation modeling, we examined the effects of gestational exposures on adult electronic cigarette use via early cigarette use (prior to age 14), controlling for covariates of combustible and electronic cigarette use.

Results: There were no effects of childhood behavioral dysregulation on electronic cigarette use. However, there was a significant indirect effect of prenatal exposures to tobacco and cannabis on electronic cigarette use via early adolescent combustible cigarette use and adolescent risk for tobacco dependence.

Conclusions: One implication of these findings is that the inter-generational risk for tobacco use conferred via gestational exposures to tobacco and cannabis generalizes to novel products such as electronic cigarettes. These results have implications for public health, as more women use cannabis and co-use cigarettes and cannabis during pregnancy.

1. Introduction

In the Population Assessment of Tobacco and Health (PATH) study, twice as many adults (18 and over) as youth (12–17 years old) reported electronic cigarette use in the past 30 days (Kasza et al., 2017). Other demographic correlates of electronic cigarette use include race/ethnicity, male sex, and educational attainment (Kasza et al., 2017; Chou et al., 2017). The best predictor of electronic cigarette use, however, is history of combustible cigarette use (Farsalinos et al., 2017; Glasser et al., 2016; Ramo et al., 2015; Vardavas et al., 2015). Most adults who have tried electronic cigarettes report that they used them to cut down or quit smoking combustible cigarettes (Glasser et al., 2016; Rutten et al., 2015). In the National Epidemiological Survey on Alcohol and Related Conditions (NESARC), electronic cigarette use in adults was associated with tobacco dependence (Chou et al., 2017), and in other population surveys with nationally representative samples, recent quitters were the most likely to have tried electronic cigarettes (Zhu et al., 2017). Thus, regular use of electronic cigarettes among adults likely represents smoking cessation attempts among the tobacco dependent.

Prenatal use of cannabis has increased 62% in the past decade (Brown et al., 2017), and prenatal co-use of cigarettes with cannabis is three times more common than prenatal cannabis use alone (Coleman-Cowger et al., 2017). Prenatal exposure to combustible cigarettes and cannabis are well-known risk factors for combustible cigarette use. Offspring prenatally exposed to tobacco are more likely to become combustible cigarette smokers (Agrawal et al., 2010; Cornelius et al., 2000, 2005; De Gennaet al., 2015; Goldschmidt et al., 2012) and to use multiple substances by adolescence (Goldschmidt et al., 2012) than those who were not exposed. They are also more likely to be tobacco dependent compared to offspring without prenatal exposure to tobacco (Buka et al., 2003; De Genna et al., 2017; Shenassa et al., 2015).

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https://doi.org/10.1016/j.drugalcdep.2018.03.045
Received 22 December 2017; Received in revised form 26 March 2018; Accepted 28 March 2018
Available online 05 May 2018
0376-8716/

Similarly, offspring prenatally exposed to cannabis are more likely to use combustible cigarettes and cannabis (Porath and Fried, 2005; Sonon et al., 2015) and become cannabis dependent (Sonon et al., 2015, 2016) than those not exposed. Therefore, it is likely that prenatal exposures to tobacco and cannabis will also predict electronic cigarette use, although this has not yet been demonstrated in the literature.

There may be indirect pathways from prenatal exposures to tobacco and cannabis and adult electronic cigarette use. Prenatal exposures to tobacco and cannabis are linked to childhood behavioral dysregulation. For example, there is a large literature linking prenatal tobacco exposure to externalizing behavior problems (Ashfordet al., 2008; Brion et al., 2010; Cornelius et al., 2007, 2011, 2012; Day et al., 2000; Orlebeke et al., 1997, 1999) that, in turn, predict early cigarette use (Brook et al., 2008; Lynskey and Fergusson, 1995; King et al., 2004). There are recent cross-sectional data linking externalizing behavior problems in adults to electronic cigarette use (Conway et al., 2017). Prenatal cannabis exposure has been linked to child depressive symptoms (Sonon et al., 2016; Gray et al., 2005), which are a correlate of adolescent combustible cigarette use (Brown et al., 1996; Escobedo et al., 1998; Windle and Windle, 2001). More recently, depressive symptoms have also been linked to electronic cigarette use in adolescents and college students (Bandiera et al., 2016, 2017; Lechner et al., 2017; Leventhal et al., 2016). Therefore, we hypothesized that there would be an indirect pathway from prenatal exposures to tobacco and cannabis to adult electronic cigarette use via childhood behavioral dysregulation.

Combustible cigarette users and those who have recently quit have the highest rates of electronic cigarette use (Zhu et al., 2017). Therefore, early and persistent combustible cigarette use may mediate the association between prenatal exposures to tobacco and cannabis and adult electronic cigarette use. We hypothesized that there would be an indirect pathway from prenatal exposures to adult electronic cigarette use via adolescent risk for tobacco dependence. To date, there are no prospective reports linking prenatal exposures to cigarettes and cannabis with adult electronic cigarette use.

The goal of this study was to investigate pathways from prenatal exposures to tobacco and cannabis to electronic cigarette use in young adult offspring. We used data collected across several decades from three prenatal cohorts designed to examine the long-term effects of prenatal substance use. We hypothesized that young adults with prenatal exposures to tobacco and cannabis would be more likely to have used electronic cigarettes, controlling for demographic covariates and other correlates of tobacco use, than those without such exposures. We tested direct and indirect pathways (via childhood behavioral dysregulation, early adolescent cigarette use, and tobacco dependence) from prenatal tobacco and cannabis exposure to adult electronic cigarette use with structural equation models.

2. Material and methods

Young adult offspring from three prenatal cohorts were contacted and asked to participate in the current study. The three original studies were part of a consortium of studies designed to determine the long-term effects of gestational exposures to tobacco, alcohol, and cannabis on offspring. Pregnant mothers reported on their first trimester substance use at their fourth month of gestation, and in two of the studies at the end of the second trimester and at delivery. In the third study, data on the second and third trimesters were collected at delivery. All prenatal phases of the studies were approved by the Magee-Womens Hospital IRB. All postnatal phases were approved by the University of Pittsburgh IRB. In all three studies, mothers and offspring were seen at 6, 10, 14, and 16 years postpartum for intensive assessments. All three studies recruited pregnant women from the same hospital and used many of the same measures and personnel. The young adult offspring from these three studies were recruited to participate in a brief telephone survey of electronic cigarette use for the current study.

2.1. Procedure

Offspring were mailed letters describing the current study and then recruited by telephone. If the participant was not immediately available to complete the telephone survey, an appointment was scheduled for a later date. The study was described to participants, who had the opportunity to ask questions about the study and then provide verbal consent. The survey took an average of 30 min to complete. In addition to questions about electronic cigarette, combustible cigarette and other substance use, participants were asked to provide basic demographic information.

2.2. Sample

The three original prenatal cohorts were comprised of mothers and offspring. Two studies included women 18+ years of age for studies of the effects of prenatal alcohol (AA006666, PI: Day) and cannabis exposures (DA003874, PI: Day) for a combined birth sample of 763 recruited from 1982 to 1985. For more information, see Day et al. (1989, 1990, 1994). The third cohort included adolescent mothers (≤ 18 years of age) who were recruited from 1990 to 1995 to study the effects of prenatal alcohol and tobacco exposure (birth sample = 413; AA008284; DA009275, PI: Cornelius). For more information, see Cornelius et al. (1994, 1995).The adult mother cohorts were oversampled for alcohol and cannabis use, ensuring that at least half of those samples included women who drank at least 3 drinks/week (in the alcohol cohort) while pregnant or used cannabis at least 2 times/month while pregnant (the marijuana cohort). The adolescent mother cohort enrolled all pregnant adolescents at the clinic regardless of their substance use. There was a full range of gestational substance exposures in all three cohorts. A new dataset combining these birth cohorts was created to ensure adequate numbers of offspring exposed to prenatal substances to determine long-term effects. We circumvent much of the between-subject heterogeneity characteristic of merged cohort data because the participants from all three cohorts were drawn from the same hospital, assessed using the same measures, and interviewed by the same personnel (Curran and Hussong, 2009).

Of 1176 offspring in the combined birth cohorts, 427 were assessed for the current study as part of a study on electronic cigarette use. More female than male offspring were interviewed at this assessment. Their mothers were slightly older and more educated than the offspring who were not assessed. However, as seen in Table 1, these offspring did not differ from the offspring who were not seen with respect to gestational exposures to tobacco, alcohol, or cannabis.

2.3. Measures

2.3.1. Demographic variables

Maternal race and offspring date of birth were available for each participant. Offspring reported their highest level of educational

Table 1
Offspring from the birth cohorts who were and were not assessed in the current study.

	Not assessed (n = 749)	Assessed (n = 427)	p-value
Maternal race (% Black)	58.6	54.8	ns
Maternal age (years)	20.4 (4.7)	21.1 (4.4)	$p < 0.01$
Maternal education (years)	11.0 (1.7)	11.4 (1.6)	$p < 0.01$
Offspring sex (% male)	57.1	39.6	$p < 0.01$
First trimester cigarette use (mean cigarettes/day)	7.0 (10.1)	7.0 (10.3)	ns
First trimester alcohol use (mean drinks/day)	0.54 (1.3)	0.50 (1.1)	ns
First trimester cannabis use (mean joints/day)	0.32 (0.9)	0.26 (0.7)	ns