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Co-use of tobacco and marijuana during pregnancy: Pathways to externalizing behavior problems in early childhood

Stephanie A. Godleski[a,*], Shannon Shisler[b], Rina D. Eiden[d], Marilyn A. Huestis[c]

[a] College of Liberal Arts, Rochester Institute of Technology, 18 Lomb Memorial Drive, Rochester, NY 14623, USA
[b] Research Institute on Addictions, University at Buffalo, The State University of New York, 1021 Main Street, Buffalo, NY 14203, USA
[c] Institute of Emerging Health Professions, Thomas Jefferson University, 1020 Walnut Street, Philadelphia, PA 19107, USA
[d] Department of Psychology, University at Buffalo, The State University of New York, 204 Park Hall, Buffalo, NY 14260, USA

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ABSTRACT

Use and co-use of tobacco and marijuana during pregnancy are associated with the development of social, cognitive, and behavioral problems for infants and children. However, less is known about the potential developmental impact of the use of tobacco and marijuana in tandem. The present study examined an etiological model for the development of externalizing behavior problems (EBP) in early childhood in a high risk sample (N = 247) of mother-infant dyads with prospective data from pregnancy to 36 months of child age. Co-use during pregnancy and continued maternal tobacco and marijuana use from infancy through early childhood were investigated. Although direct pathways from exposure during pregnancy to EBP were not significant, there was a significant indirect pathway from prenatal tobacco use to EBP via lower breastfeeding duration to lower maternal warmth/sensitivity to EBP, and a pathway from higher maternal affective dysregulation to higher EBP. These results highlight the importance of considering cascading effects of substance use during pregnancy on parental processes within the context of developmental risk and protection.

1. Introduction

Smoking tobacco products during pregnancy is a significant public health concern. Between 8.4 and 15.4% of women in the United States smoke tobacco products during their pregnancies, with particularly high rates for at-risk women who are younger, unmarried, and less educated (13–14%; Curtin and Matthews, 2016; SAMSHA, 2014). Further, cigarettes are the most commonly used substance during pregnancy (CDC, 2014; NSDUH, 2005), despite efforts directed at disseminating information regarding the negative impact of persistent smoking. Cigarettes are particularly harmful, as in addition to nicotine, cigarette smoke contains over 7000 chemical compounds (CDC, 2014). Exposure during both the prenatal and postnatal period increases the risk for negative developmental and health outcomes for children (ACOG, 2010, 2017).

1.1. Co-use of tobacco and marijuana during pregnancy

Understanding the influences of co-use of tobacco and marijuana during pregnancy has important public health implications as marijuana has increasing societal and legal acceptance (Wilkinson et al., 2016) and use of marijuana is increasing in the general population and among pregnant women (NIDA, 2016; SAMSHA, 2017). Further, rates of smoking cigarettes during pregnancy remained stable despite declines in use by women who are not pregnant (SAMSHA, 2014). Reported frequency of marijuana use during pregnancy varies widely [e.g., 1.8% (Ebrahim and Gfroerer, 2003); 2.9% (El Marroun et al., 2008); 10% (Linn et al., 1983); 29.3%; (Mark et al., 2016)]. Discrepancy in rates is likely due to methodological assessment of use, the timing of assessment as many women cut down on use later in the pregnancy, and the time frame in which the data were collected given the recent major shifts in marijuana perception and use (e.g., Wilkinson et al., 2016). Tandem marijuana and tobacco use during pregnancy is particularly high and suggests the need to consider tandem use separately from tobacco or marijuana use only. For example, rates of using both marijuana and tobacco are as high as 45% of those reporting marijuana use (Chabarria et al., 2016) and 84.5% of those reporting tobacco use during pregnancy (El Marroun et al., 2011). Women also are increasingly reporting marijuana as a problem substance for them during pregnancy (McCabe and Arndt, 2012) and rates of marijuana use for adult women are on the rise for women of reproductive age (Brown et al., 2017; SAMSHA, 2014, 2017). Further, the potency of the main

* Corresponding author.
E-mail address: saggsh@rit.edu (S.A. Godleski).

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psychoactive component of marijuana (i.e., delta-9-tetrahydrocannabinol or THC) increased since the 1990s (e.g., Mehmedic et al., 2010). Tobacco use during pregnancy is the most common, followed by co-use with marijuana, and marijuana use only occurring the least frequently (Coleman-Cowger et al., 2017). Given the stability of tobacco use and the rising frequency of marijuana use during pregnancy, investigating co-use is paramount.

Prenatal exposure to tobacco poses risk for later developmental sequelae in both early and later developmental periods, particularly externalizing behavior problems (EBP), including inattention, oppositional behavior, emotional instability, and physical aggression (e.g., Coles et al., 2012; Cornelius and Day, 2000; Wakschlag et al., 2002). Importantly, continued tobacco use during pregnancy may co-occur with marijuana use and this co-use may increase the risk for adversity above the impact of tobacco or marijuana exposure alone (Chabarria et al., 2016; Gray et al., 2010a). Evidence suggests that marijuana exposure is associated with lower birth weight (Gunn et al., 2016), can be harmful to embryonic development as early as 2 weeks after conception, and can affect fetal brain development before a woman even recognizes she is pregnant (Psychoyos and Vinod, 2013). In regards to brain morphology, tobacco exposed children demonstrated cortical thinning, especially in the frontal and superior parietal cortices (El Marroun et al., 2016; Toro et al., 2008), while co-exposed children had thicker frontal cortices (El Marroun et al., 2016) indicating altered neurodevelopmental maturation in regions involved in higher order processing. Determining the specific impact of prenatal marijuana exposure can be challenging due to the frequent co-use of tobacco (Gunn et al., 2016). For example, some past research on the impact of prenatal marijuana exposure on EBP incorporated marijuana use only and co-use together (e.g., El Marroun et al., 2011; see Gunn et al., 2016). Indeed, marijuana exposure during pregnancy is also associated with dysregulation, attentional and executive function deficits, impulsivity, and EBP (for reviews see Fried and Smith, 2001; Huizink, 2014). However, it is less common for research to particularly examine the impact of co-use on externalizing outcomes (e.g., El Marroun et al., 2011) despite evidence that that co-use may exacerbate risk (Chabarria et al., 2016; Coleman-Cowger et al., 2017; Emery et al., 2016; Gray et al., 2010a). As such, understanding the influence of co-use during pregnancy on the development of EBP is an important area for research.

Research on the developmental outcomes of co-use of tobacco and marijuana during pregnancy is limited (e.g., Porath and Fried, 2005; Richardson et al., 1995). However, given the high prevalence of this co-use pattern, elucidating the impact that co-use can have on child development is critical. Despite consistent findings regarding the associations between prenatal exposure to tobacco and marijuana leading to externalizing behavior, little is known about the mechanisms of these relationships or the unique contributions of co-use. Further, continued maternal use during the postnatal period is associated, particularly in the case of tobacco use, to child and adolescent EBP (for review see Cornelius and Day, 2000; Herrmann et al., 2008). In particular, both direct pathways (i.e., from prenatal exposure to EBP) and indirect pathways that may influence development, such as continued postnatal use and parenting, need to be considered together (e.g., D'Onofrio et al., 2008; Knopik et al., 2012; Massey et al., 2016), especially in light of evidence from behavior genetic studies indicating that maternal smoking effects on EBP may be explained by family level variables (D'Onofrio et al., 2008). However, this conclusion may be premature given evidence from research designs integrating sophisticated measurement of prenatal substance exposure with genetically informative designs indicating unique effects of tobacco use during pregnancy on EBP beyond family level effects (Estabrook et al., 2016). These recent discussions suggest that sophisticated measurement of complex behaviors is important and that models examining EBP need to have strong measurement of both substance use and family processes. However, the role of co-use has not been addressed in these discussions. Therefore, the purpose of the present study is to investigate the cascading impact of co-use of tobacco and marijuana during pregnancy on subsequent maternal parenting (i.e., breastfeeding and warmth and sensitivity) and behavior (i.e., affective dysregulation and continued marijuana and tobacco use) in infancy and ultimately the development of child externalizing behavior in early childhood. In addition, given that sex difference results on the impact of prenatal tobacco and marijuana exposure on later problem behavior are not consistent and may depend on the specific behavioral outcome and sample assessed, as well as the study design and methods (e.g., Coles et al., 2012; El Marroun et al., 2011; Hutchinson et al., 2009; Massey et al., 2016), the current study sought to explore potential sex differences in the prediction of EBP.

1.2. Maternal characteristics

Maternal dysregulated and antisocial behavior may be associated with higher child EBP through shared genetic risk that was well articulated in previous studies (e.g., Knopik et al., 2009; Leve et al., 2010; Schmitz et al., 1994). However, they also provide the context for parental decisions and processes that have a direct effect on child behaviors. Indeed, higher maternal dysregulation may make engaging in positive parenting practices more challenging, beyond any associations with substance use. Mothers who use tobacco and marijuana during their pregnancies often experience higher levels of demographic risk (e.g., younger age; Chabarria et al., 2016), delinquent behavior (El Marroun et al., 2008), and anger and affective dysregulation (Chabarria et al., 2016; Eiden et al., 2011; Ludman et al., 2000). In addition to the potential direct effect of exposure, maternal smoking during pregnancy is associated with negative parenting practices (Wakschlag et al., 2002), such as conflictual parent-child relationships (Brook et al., 2000) and harsh discipline (Tandon et al., 2013). Mothers who smoke were less nurturing (Fergusson et al., 1998), had higher levels of insensitivity, and lower levels of warmth (Massey and Compton, 2013; Massey et al., 2015; Schuetze et al., 2006). Less is known about the parenting practices of mothers who use marijuana during their pregnancies. In turn, harsh parenting practices and negative parent-child interactions are associated with EBP outcomes for children, such as dysregulation (Eiden et al., 2011) and aggression (e.g., Dodge et al., 2006; Loeber and Hay, 1997). High affective attunement and warmth/sensitivity in the first years of life may be a particularly protective developmental factor through adulthood and predict lower levels of social difficulties, including dysregulation and EBP (Raby et al., 2015). Early experiences in infancy with warmth and sensitivity, including physical contact, were significantly implicated in positive developmental outcomes, such as through neural development and genetic expression that could directly impact an infant's regulatory, stress reactivity, and attentional processes (Moore et al., 2017; Tremblay and Cote, 2009). For children already at risk due to prenatal exposure, poor parenting practices and negative parent-child interactions may create a context that increases the risk for EBP; whereas positive experiences with warmth and sensitivity could help to buffer the direct impact of prenatal exposure.

1.3. Breastfeeding in the context of maternal substance use

Breastfeeding is a particularly important early experience that serves a protective role for infant development (Horta et al., 2007) and maternal health (Chung et al., 2007; U.S. Department of Health and Human Services, 2011). The Center for Disease Control and Prevention (2009) recommends breastfeeding even when a mother continues to smoke; however, women who smoke report breastfeeding for shorter durations and being less likely to intend to breastfeed and to initiate breastfeeding than non-smoking women (Liu et al., 2006; for review see Amir, 2001; Amir and Donath, 2002; Horta et al., 2001). In fact, a dose-response relation between number of cigarettes smoked and duration of breastfeeding was demonstrated (see Amir and Donath, 2002). Importantly, caution regarding continued smoking and breastfeeding is expressed and the recommendation is for women to cease their use of