Addictive Behaviors 39 (2014) 1408–1413

Contents lists available at ScienceDirect

Addictive Behaviors

Posttraumatic stress disorder, smoking, and cortisol in a community sample of pregnant women

William D. Lopez [a,1], Julia S. Seng [b,*]

[a] University of Michigan School of Public Health, 415 Washington Heights, Ann Arbor, MI 48109, United States
[b] University of Michigan School of Nursing, 204 S. State Street, G120 Lange Hall, Ann Arbor, MI 48109, United States

HIGHLIGHTS

- Among women who smoke in pregnancy, those with PTSD have the highest cortisol levels.
- This study shows additive effects of smoking and PTSD on pregnancy cortisol.
- Research on PTSD somatic experience, smoking, and cortisol might inform intervention.
- PTSD-specific smoking cessation strategies may help more pregnant women quit smoking.

ARTICLE INFO

Available online 12 May 2014

Keywords:
Tobacco use
Pregnancy
PTSD
Cortisol
Trauma

ABSTRACT

Background: The prevalence of posttraumatic stress disorder (PTSD) in the United States is higher among pregnant women than women generally. PTSD is related to adverse birth outcomes via physiological and behavioral alterations, such as smoking.
Methods: We utilize salivary cortisol measures to examine how traumatic stress, smoking and the hypothalamic–pituitary–adrenal axis interact. Pregnant women (n = 395) gave cortisol specimens as part of a cohort study of PTSD and pregnancy at three health systems in the Midwestern United States. Women were divided into three groups: nonsmokers, quitters (who stopped smoking during pregnancy), and pregnancy smokers. Mean cortisol values at three points, sociodemographics, trauma history, and PTSD were compared across groups. We assessed the association of smoking group and PTSD with late afternoon cortisol levels.
Results: Smokers, quitters, and nonsmokers differed on demographic risk factors and PTSD symptom load. Late afternoon and bedtime cortisol measures were significantly positively correlated with smoking in pregnancy, with smokers with PTSD presenting the highest cortisol levels. Regression analysis showed that smoking in pregnancy was associated with higher late afternoon cortisol in an additive manner with PTSD symptoms.
Conclusions: Smoking appears to have a different relationship with cortisol level for those with and without PTSD. This is the first study to show additive effects of smoking and PTSD on cortisol levels in pregnant women. Since high cortisol, smoking, and PTSD have been shown to adversely affect perinatal outcomes, and since those continuing to smoke in pregnancy had the highest PTSD symptom load, PTSD-specific smoking cessation programs in maternity settings are warranted.

1. Introduction

1.1. Posttraumatic stress disorder, smoking, and pregnancy complications

The prevalence of posttraumatic stress disorder (PTSD) in the United States is twice as high among pregnant women than women generally (Seng, Low, Sperlich, Ronis, & Liberzon, 2009). PTSD is related to pregnancy complications, including ectopic pregnancy and spontaneous abortion (Seng et al., 2001), and in a recent prospective study, predicted shorter gestation and lower birth weight (Seng, Kane Low, Sperlich, Ronis, & Liberzon, 2011). These adverse outcomes may result via physiological or behavioral alterations stemming from the traumatic experience or from PTSD (Seng et al., 2001). PTSD is also associated with cigarette smoking while pregnant (Lopez, Konrath, & Seng, 2011), a behavioral alteration with adverse perinatal outcomes (Cnattingius, 2004). Given that PTSD has only recently been determined to be a risk factor for adverse perinatal outcomes, studies of potential physiological and behavioral pathways are needed. The purpose of this study is to augment previous findings that (1) PTSD is associated with elevated cortisol across the day in pregnant women (Seng et al., under review)

* Corresponding author. Tel.: +1 734 647 0152.
E-mail addresses: wdlopez@umich.edu (W.D. Lopez), jseng@umich.edu (J.S. Seng).
[1] Tel.: +1 313 444 5874.

http://dx.doi.org/10.1016/j.addbeh.2014.04.027
0306-4603/

and (2) women with PTSD are more likely to continue smoking during pregnancy (Lopez et al., 2011).

1.2. Pregnancy, smoking, and PTSD

Smoking is well known to affect the HPA axis, with smoking associated with acute increases in cortisol (Kirschbaum, Scherer, & Strasburger, 1994; Kirschbaum, Wust, & Strasburger, 1992) and smokers presenting higher basal cortisol concentrations across the day (Badrick, Kirschbaum, & Kumari, 2007; Direk, Newson, Hofman, Kirschbaum, & Tiemeier, 2011; Field, Colditz, Willett, Longcope, & McKinlay, 1994; Steptoe & Ussher, 2006). Though approximately 16% of pregnant women in the United States smoke (Substance Abuse and Mental Health Services Administration, 2013), few studies have considered cortisol concentrations among pregnant smokers, with some studies excluding smokers from sampling or analysis (e.g., Kaasen et al., 2012; La Marca-Ghaemmaghami et al., 2013; Voegtline et al., 2013), not mentioning cigarette use (e.g., Valladares, Peña, Ellsberg, Persson, & Högberg, 2009), or controlling for smoking without further investigation (e.g., Bolten et al., 2011). Smoking prior to pregnancy increases the odds of infertility, and smoking while pregnant is associated with negative perinatal health outcomes (see Cnattingius, 2004 for a review on smoking and pregnancy), including low birth weight (Brooke, Anderson, Bland, Peacock, & Stewart, 1989), a major determinant of neonatal health (McCormick et al., 1990).

Causes for maternal smoking are difficult to establish. Smoking in general occurs at higher rates in low-income populations (Dube et al., 2010), and addiction-related factors, such as the number of cigarettes smoked prior to pregnancy (Olsen, 1993; Severson, Andrews, Lichtenstein, Wall, & Zoref, 1995), a history of heavy smoking, and an earlier age at first use (Cnattingius, 2004) also appear to influence continued smoking during pregnancy. Perceptions of more life stress, stressful life events during pregnancy, perceived lack of control over life, and having an unemployed partner are also related to smoking while pregnant (Bullock, Mears, Woodcock, & Record, 2001; Dejin-Karlsson et al., 1996).

Studies with pregnant survivors of sexual abuse trauma (Grimstad & Backe, 1998) and with pregnant women with PTSD (Morland et al., 2007; Smith, Poschman, Cavaleri, Howell, & Yonkers, 2006) find associations of abuse history and PTSD with smoking during pregnancy. In comparisons of women who continue to smoke during pregnancy with those who quit, Lopez et al. (2011) find that pregnant smokers are more likely to have current and lifetime PTSD diagnoses, have more instances of previous abuse trauma, and are more likely to endorse having used tobacco to "cope with emotions or problems."

1.3. Cortisol alterations: PTSD and pregnancy

Individuals with PTSD experience alterations to stress regulation systems, including the hypothalamic–pituitary–adrenal (HPA) axis (Selye, 1956). Attempts to understand alterations to the HPA axis when stress disorders are of interest utilize cortisol as a measure of HPA axis functioning (Marin, Martin, Blackwell, Stetler, & Miller, 2007). These have yielded mixed results, with some studies finding no difference in basal cortisol levels of those with and without PTSD (Altemus & Cloitre, 2003; Halbreich et al., 1989; Tucker et al., 2004), while others found lower (Yehuda, 2001) or higher levels (Lindauer, Olff, van Meijel, Carlier, & Gersons, 2006).

Among pregnant women, research on the relationships between stress and cortisol has similarly yielded mixed results. Obel et al. (2005) find higher evening levels of salivary cortisol in late pregnancy among women who experienced stressful life events. Valladares et al. (2009) find higher levels of salivary cortisol associated with partner violence during pregnancy and maternal stress. On the other hand, Bolten et al. (2011) find no differences in salivary cortisol concentrations based on pregnancy or non-pregnancy related distress, and Voegtline et al. (2013) find that self-report of mental distress is not associated with significant variation in salivary cortisol among pregnant women. Data from our studies of pregnant women, including findings from this data set published elsewhere (Seng et al., under review) and previous preliminary work (Seng, Low, Ben-Ami, & Liberzon, 2005), have found flatter diurnal curves among women with PTSD (i.e., lower morning peak and higher late afternoon and bedtime levels). Obel et al. (2005) find the highest evening cortisol levels among stressed women who also smoked. Unclear patterns may be due to factors co-occurring with PTSD that may influence cortisol concentrations, such as smoking (Olff et al., 2006).

Pregnancy itself alters HPA axis functioning, with the placenta and fetus contributing to maternal circulating cortisol, especially in late gestation (Challis & Patrick, 1983; Challis, Sprague, & Patrick, 1983). For this reason, pregnancy-specific studies of the effects of PTSD and smoking on cortisol levels are needed. Methods that consider altered protein binding (Vining, McGinley, Maksvytis, & Ho, 1983) by using salivary cortisol and that consider the gestational increase by collecting specimens prior to the rise will have the greatest likelihood of providing results comparable to studies with non-pregnant women.

1.4. The current study

Trauma-informed smoking cessation programs seem strongly warranted, especially in the context of maternity care, where the adverse outcomes of smoking are so personally and economically costly to mothers and children. A better understanding of the physiological relationships among smoking, PTSD, and the HPA axis could provide information to bolster such efforts.

A first step toward addressing these relationships can be accomplished with a secondary analysis of data from the STACY Project (NIH R01 NR008767, PI: Seng), a psychobiological study of the effects of PTSD on pregnancy outcomes. These data include diurnal salivary cortisol levels collected prior to 25 weeks gestation from a demographically diverse community sample of women in prenatal care who were well-characterized in terms of trauma history and PTSD diagnosis.

We proceed with two research questions: 1) Is smoking status associated with increased salivary cortisol concentrations among pregnant women? 2) Is this relationship affected by PTSD, and if so, how? We take into account three distinct smoking groups: nonsmokers, quitters, and pregnancy smokers.

2. Data and methods

2.1. Description of the parent study

This study is a secondary analysis of a sub-sample of data from a prospective, three-cohort study of the effects of PTSD on pregnancy outcomes (NIH NR008767, PI: Seng). Questionnaire data for this analysis are from the initial survey conducted prior to 28 week gestation. Procedures for the parent study (Seng et al., 2009) and for cortisol collection (Seng et al., 2008) are described briefly below.

2.2. Recruitment and interview

Obstetric clinic nurses in eight maternity clinics at three health systems in the Midwestern United States determined eligibility (age18 or older, expecting a first infant, able to speak English without an interpreter, and gestational age fewer than 28 weeks) from new patient history and invited women to take part in a telephone survey about "stressful things that happen to women, emotions, and pregnancy." An organization specializing in survey research (DataStat, Ann Arbor, Michigan) conducted the interviews from August 2005 through October 2007. Interviewers verified eligibility and continued with a verbal informed consent process before explaining the Certificate of Confidentiality. All involved health systems granted Institutional Review Board