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An Examination of Maternal Stress and Secondhand Smoke Exposure on Perinatal Smoking Status

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AN EXAMINATION OF MATERNAL STRESS
AND SECONDHAND SMOKE EXPOSURE
ON PERINATAL SMOKING STATUS

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Nursing
at the University of Kentucky

By

Karen Rae Damron

Lexington, Kentucky

Director: Dr. Kristin B. Ashford, Associate Professor of Nursing

Lexington, Kentucky

2016

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ABSTRACT OF DISSERTATION

AN EXAMINATION OF MATERNAL STRESS AND SECONDHAND SMOKE EXPOSURE ON PERINATAL SMOKING STATUS

The median prevalence of smoking among women of childbearing age in the United States is 22.4%. Of women who identify themselves as smokers in the three months prior to conception, 55% quit during pregnancy; however, 40% of those who quit relapse and return to smoking within six months after delivery. Smoking has been identified as an important means of stress management among smokers in general, and though limited to the perinatal period, pregnancy-specific stress adds to a woman's typical day-to-day stress burden. Little data exists as to the effect of SHS exposure on smoking status during pregnancy and the impact of SHS exposure on the maternal perception of stress is unknown. Due to limited evidence, a critical need exists to examine the relationships of perceived maternal stress, SHS exposure, and perinatal smoking status in order to better understand perinatal smoking behaviors.

The purposes of this dissertation were to: 1) evaluate the literature examining the relationship between the variables of maternal stress, SHS exposure, and perinatal smoking status; 2) determine the reliability and validity of the Everyday Stressors Index (ESI) use in pregnant women; and 3) to investigate the impacts of maternal perception of everyday stress, and SHS exposure on perinatal smoking status.

Evidence obtained from the critical review of the literature supported an association between psychosocial stress and smoking during pregnancy or postpartum. Little information regarding the role of SHS exposure on perinatal smoking status was discovered. Psychometric testing of the ESI demonstrated strong internal consistency reliability, and factor analysis yielded three factors capturing three important domains of everyday stress. SHS exposure emerged as the most significant predictor of smoking status. Persistent smokers/relapsers had the highest ESI scores, followed by quitters, and then nonsmokers. While ESI means decreased in all smoking status groups from the first to the third trimester, the magnitude of decrease was not predictive. A significant interaction effect of SHS exposure in the home and decrease in ESI score occurred in the quit group only with quitters 1.14 times more likely to experience a decrease in ESI score compared to smokers/relapsers.

KEYWORDS: Maternal Stress, Perinatal Smoking, SHS Exposure, Psychometric Properties of Everyday Stressors Index, Urine Cotinine

Karen R. Damron

04/22/16

Date

AN EXAMINATION OF MATERNAL STRESS
AND SECONDHAND SMOKE EXPOSURE
ON PERINATAL SMOKING STATUS

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This dissertation is dedicated to the memory of Ross & Dixie Damron, my mother- and father-in-law, as well as to the memory of my father, Frank Nelson.
I will miss you always.

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“For I know the plans I have for you”, declares the Lord, “plans to prosper you and not to harm you, plans to give you hope and a future.”
Jeremiah 29:11

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Chapter I: Introduction

Background

In spite of more than a decade of moderate declines, rates of smoking during pregnancy remain far too high, with 10% of women reporting that they had continued smoking during the last three months of their pregnancy, according to the 2011 Pregnancy Risk Assessment and Monitoring System (PRAMS) data from 24 states (Centers for Disease Control and Prevention [CDC], 2011). Babies born to women who smoke during pregnancy are more likely to be born premature, have low birth weight, and are at an increased risk for sudden infant death syndrome (U.S. Department of Health and Human Services [USDHHS], 2014). When women who smoke become aware that they are pregnant, 55% will quit during the pregnancy, but 40% of those who quit will relapse and return to smoking within six months of giving birth (CDC, 2011). One year after giving birth, only 20-30% remain successfully abstinent from smoking (Johnson, Ratner, Bottorff, Hall, & Dahinton, 2000; Mullen, 2004).

Secondhand smoke (SHS), a combination of the smoke from the burning end of a cigarette in addition to exhaled smoke, is known to be detrimental to health with no amount, however small, considered to be “safe.” When exposed to SHS, pregnant women, as well as their fetuses, are at risk from more than 4000 chemicals, many of which are toxic (USDHHS, 2014). SHS, despite the existence of “no smoking” sections and smoking bans, is difficult to avoid entirely and is described as a barrier to continued abstinence by pregnant women who have quit (Correa, Simmons, Sutton, Meltzer, & Brandon, 2015; Wen et al., 2015; Yang & Hall, 2014).

Personal stress is a consistent contributor to sustained tobacco use, with the majority of smokers reporting that they smoke as a method of stress management

(Croghan et al., 2006). In a large epidemiological study by Hauge, Torgersen, and Vollrath (2012), pregnant women who reported high levels of anxiety, high levels of relationship discord, or who did not live with a partner, were both more likely to have been smokers prior to conception as well as less likely to quit during pregnancy. Smokers who attempt to quit frequently report feeling more stressed, an unfortunate effect likely due to nicotine withdrawal, with relief found upon a return to smoking (Parrott, 1995; Parrott & Murphy, 2012). During pregnancy, concerns about body image, physical symptoms, and relationship changes, as well as anxiety related to forthcoming labor and delivery add to the typical amount of stress experienced by women on a day-to-day basis (Lobel et al., 2008).

The purposes of this dissertation were to: 1) review, summarize, and evaluate the current research that examined the relationship of maternal stress, secondhand smoke exposure, and perinatal smoking status; 2) determine the reliability and validity of the use of the Everyday Stressors Index (ESI) with pregnant women; and 3) examine the impact of maternal everyday stress and secondhand smoke exposure on perinatal smoking status. Three manuscripts, one addressing each purpose, are presented in Chapters Two through Four.

Summary of Theoretical Framework

In an extension to the theory of planned behavior (Ajzen, 1991), Fishbein (2008) suggested an integrative model of behavioral action that takes into account the influence of background factors, such as demographics and previous behavior, that may or may not be related to behavior. In this model, one of several guiding influences on behavior is described as perceived behavioral control, or the person's belief concerning how easy of

difficult it is for them to perform a certain behavior. Godin, Valois, Lepage, and Desharnais (1992), in a test of the theory of planned behavior in samples of pregnant smokers, found that intention was mainly influenced by perceived behavioral control and attitude. The conjecture that excessive levels of stress, easy access to cigarettes, and exposure to SHS may overwhelm one's perceived behavior control, resulting in either never acting on the intention to quit smoking, or failing to continue to be abstinent (Yzer & van den Putte, 2014) is supported by a study by Yang and Hall (2014) in which postpartum women listed "lack of way to handle stress" and "craving" as the most frequently cited barriers to smoking cessation, as well as by a study by Ben Natan, Golubev, and Shamrai (2010), in which perceived behavioral control was the strongest predictor of intention, and SHS exposure negatively impacted this perceived control.

The integrated model of behavioral action provides a valuable framework for the explanation of how perception of everyday stress and SHS exposure impacts smoking status during pregnancy. To achieve the aims of the study, additional demographic variables (age, race, parity, and education) were added to the construct.

Chapter Overviews

Overview of Chapter Two

Smoking is the most modifiable risk factor for adverse pregnancy outcomes such as premature birth, and low birth weight. Risks during pregnancy include ectopic implantation, and placental complication (CDC, 2011). Evidence also exists that perinatal exposure to SHS increases the risk of lower birth weight and preterm birth (Joya et al., 2014; USDHHS, 2006). Though the incidence of smoking in pregnancy has decreased in recent years, it still remains problematic in the United States, with

approximately 10% of women who smoke continuing throughout pregnancy (CDC, 2011). This percentage varies widely across the nation, from a high of 29% in West Virginia, to a low of 4% in Utah, reporting that they smoked throughout pregnancy (CDC, 2011). The majority of participants included in this study were residents of Kentucky, which at a rate of 22.4%, is more than double the national average and has historically had the second worst rate of perinatal smoking among all other states (Kentucky Department for Public Health, 2013).

The addictive properties of nicotine can make smoking cessation difficult, even in such a highly motivated health-seeking state as pregnancy. Barriers such as SHS exposure, easy access to cigarettes in the home, and relying on smoking as a form of stress management add to this challenge (Saint Onge, Gurley-Calvez, Orth, & Okah, 2014; Yang & Hall, 2014). In Chapter Two, recent literature (published from 2010-2015) relating to potential relationships between perceived maternal stress, SHS exposure, and perinatal smoking behavior was examined, summarized, and evaluated. As a result of this review, the existence of consistent, significant relationships between smoking and stress, smoking and psychological adversity, or smoking and stressors during the perinatal period were upheld. The need for a focus on the role of SHS exposure with respect to perinatal smoking status and as a potential moderator of maternal stress was revealed. Longitudinal studies and biological confirmation of self-reported smoking status were discovered to be lacking in a majority of the articles reviewed, exposing a need for a studies looking at more than one time point and confirming self-report of a socially undesirable behavior with an objective measure.

Overview of Chapter Three

Pregnancy-specific stress, having to do with physical symptoms/bodily changes unique to pregnancy, changes that occur in close relationships, parenting concerns, and anxiety related to the process of labor and delivery has led to the development of no less than 15 pregnancy-specific measures of stress (Alderdice, 2012). The measurement of everyday stress during pregnancy, such as having enough money to meet needs, having employment, getting along with family members, health of self and family, has not received the same attention. In a review of non-pregnancy-specific stress measures used during pregnancy, the majority of measures totaled the number of stressful life events that had occurred, with few measuring perceived stress. The Everyday Stressors Index (ESI), developed by Hall (1983), has shown evidence of reliability and validity when used with single mothers of young children, the population for whom it was developed. In Chapter Three, the result of a psychometric evaluation to determine the reliability and validity of the use of the ESI in pregnant women is reported. A sample of 206 pregnant women in their first trimester was included in this secondary analysis of cross-sectional survey data. Cronbach's α and split-half reliability tests were computed to determine reliability. A series of exploratory factor analyses were then performed to determine the most parsimonious factor structure, and assess construct validity. Based on these psychometric assessments, the ESI was determined to be a reliable and valid instrument, capable of measuring three important domains of everyday stress in the pregnant woman.

Overview of Chapter Four

In Chapter Four, the impact of everyday stress and secondhand smoke exposure on perinatal smoking status was examined. A secondary analysis of data from a

prospective non-experimental study of culturally and ethnically diverse women recruited from three prenatal clinics was conducted (Ashford, O'Brien, McCubbin, Westneat, & Barnett, 2013). In this investigation, 210 pregnant women were assigned to one of three smoking status groups, namely nonsmoker, quitter, or persistent smoker/relapser, based on self-reported prenatal smoking history and urine cotinine results obtained during the first and third trimesters. Stress measured in pregnancy has been previously reported to decrease as gestation progresses (Silveira, Pekow, Dole, Markenson, & Chasan-Taber, 2013; Woods, Melville, Guo, Fan, & Gavin, 2010). Therefore, in addition to examining the impact of stress on smoking status during each of the first and third trimesters, the potential effect of a decrease in stress level as gestation progressed was considered. Third trimester ESI scores were subtracted from first trimester ESI scores and a new ESI decrease variable was created. The prospective impact of the predictor variables of secondhand smoke exposure and the decrease in ESI score from first to third trimester on smoking status were tested in a series of multinomial regression analyses. Results of these analyses determined SHS to be the strongest predictor of smoking status. In addition, a significant interaction of SHS in the home and decrease in ESI was discovered for the comparison of quitters and persistent smokers/relapsers.

Overview of Chapter Five

Chapter Five provides an overview of study findings, and suggests recommendations for future research into the variables studied in this dissertation as well as the additional variables suggested by the integrated model of behavioral action. Further use of this model is also proposed in order to provide a more comprehensive

approach in the study of factors that contribute to persistent perinatal smoking, as well as those that enhance sustained cessation.

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Chapter II: A Review of the Relationship between Psychosocial Stress, Secondhand Smoke, and Smoking during Pregnancy and Postpartum

Background and Significance

Smoking is the most preventable cause of morbidity and mortality in mothers and infants (CDC, 2007). The use of tobacco during pregnancy has well-known detrimental effects on both mother and fetus that include a 20 – 80% greater chance of pregnancy loss, a 1.2 to 1.6 relative risk of preterm delivery, 1.4 to 2.4 relative risk of placental abruption, a relative risk of placenta previa of 1.5 to 3.0, and a 2.0 to 3.0 relative risk of Sudden Infant Death Syndrome (Einarson & Riordan, 2009; Holtrop et al., 2010; Tong et al., 2013).

Though the prevalence of smoking during pregnancy is slowly decreasing, it remains a major health concern (Tong et al., 2013). Data from the Pregnancy Risk Assessment Monitoring System or PRAMS (CDC) for 2011, the most recent available, indicate an overall rate of smoking during the 3 months prior to pregnancy of 22.6%, with a range of 10.6% in New York City to 44.8% in West Virginia. Of the women who indicated that they had smoked during the 3 months prior to pregnancy, 55.3 % reported that they had quit during pregnancy (CDC, 2011), with the greatest percentage of quitters in New York City (82.2%), and the fewest in West Virginia (35.3%). The earlier a woman chooses to quit, the better, since many of the complications, such as placental abruption and placenta previa appear to be nicotine-dose related (Einarson & Riordan, 2009).

Secondhand tobacco smoke adds to the nicotine exposure in the woman who smokes, or is attempting to cut down or quit, and is also a problem faced by the non-smoker. Whether it is active or passive in nature, tobacco is the most common substance

of abuse during pregnancy worldwide (Joya et al., 2014). There is also evidence to support that prenatal exposure to passive smoke can result in lower birth weight as well as an increased incidence of preterm birth. After birth, the effects to the child include an increased frequency of respiratory infections and asthma (Joya et al., 2014).

Stress is an inevitable occurrence in daily life, and smoking is cited as an important stress management method by more than 72% of smokers regardless of gender. Use of smoking as a way to self-medicate for negative mood, though, seems to be more prevalent in women (Croghan et al., 2006). Smokers often report that smoking helps relieve feelings of stress, but, the stress relief smokers attribute to cigarette smoking may actually occur as a result of a reversal of the symptoms of acute nicotine withdrawal (Parrott, 1995). It is unfortunate that these withdrawal symptoms can increase the experience of everyday stress (Parrott, 1995; Parrott & Murphy, 2012). It is also interesting to note that PRAMS data for 2011 report a far lower percentage of women reporting “no stress” in West Virginia (21.6%), a state with a high percentage of smoking behavior, than the percentage of women in New York City (37.1%) reporting “no stress”. This would seem to add support to claims of the use of smoking as a stress management method. The influence of exposure to secondhand smoke on perceived stress is unknown.

Pregnancy, independent of the typical stress experienced on a day-to-day basis, can be a time of increased stress. During pregnancy, the woman may experience stress from a variety of pregnancy-related concerns, such as physical symptoms, bodily changes, relationship and parenting concerns, as well as anxiety about labor and delivery

(Lobel et al., 2008). Though limited to the perinatal period, the experience of pregnancy-specific stress adds to the stress burden of the woman.

The purpose of this article is to examine and evaluate the recent literature relating to relationships between perceived maternal psychosocial stress and smoking behaviors during pregnancy and postpartum, as well as the possible relationship of secondhand smoke, smoking behavior, and stress during pregnancy and postpartum.

Literature Search Strategy

A search for published, peer-reviewed, English language, primary research articles was conducted, using the electronic databases Academic Search Complete, Medline, Cinahl, Psychology and Behavioral Sciences Collection, and PsychINFO. Inclusion criteria were as follows: quantitative or qualitative research studies on the relationship between self-reported, perceived, or psychosocial stress and smoking or exposure to secondhand tobacco smoke during pregnancy or the postpartum period. The search was limited to current literature, published between January 2010 and the present (2015), in order to reflect the most recent knowledge. The search terms *preg* or postpartum; self-reported stress or perceived stress or stress, psychological; and smok* or SHS or passive smoke or environmental smoke or tobacco smoke pollution* yielded 143 articles. After deleting exact duplicates returned by the search, 97 articles remained. Titles and abstracts were then screened for suitability, leaving 32 articles for full text review. Following the full text review, 22 articles remained that met inclusion criteria for this review. Two additional articles were obtained from references found within the articles during review, resulting in 24 articles for inclusion. A diagram of the decision-making process is illustrated in Figure 2.1.

In order to organize the literature, a matrix table was developed and data relevant to the relationship of perceived stress and smoking or secondhand smoke exposure during pregnancy and the postpartum period were extracted. Headings used in the matrix table included: author and year, setting and sample, purpose of the study, stress measure used, smoking definition, and key findings/highlights. The evidence was evaluated and interpreted according to Ryan-Wenger's (1992), *Guidelines for Critique of a Research Report*.

Characteristics of Studies Reviewed

The common purpose of the studies was to examine or describe the relationship between smoking behaviors during pregnancy and/or postpartum and psychosocial factors such as perceived stress. Table 2.1 provides a description of the studies contained in this review. The women were recruited from prenatal clinics, obstetrics and gynecology clinics, obstetric in-patient units, unnamed agencies serving women and children (WIC clinic is named by one study), or had taken part in a randomized national survey mailed to them after a live birth, known as the Prenatal Risk Assessment Monitoring System (PRAMS). Other than the PRAMS survey, which had a mean response time of 116 days postpartum (range 57-307 days), women were approached for recruitment anywhere from late first trimester (mean = 12.4 weeks) to the immediate, in-patient, postpartum period (mean = 1.5 days). The study by Wen et al. (2015), a qualitative study included in this review, recruited women who were up to three years postpartum.

Of the 24 studies reviewed, all were published between 2010 and 2015, in order to reflect the most current state of knowledge. A majority (18) of the studies were from the

United States, with a wide regional representation of the country. The six remaining studies were from France, Germany, Norway, Poland, Romania, and the Netherlands. A total of 426,611 women participated in the 24 studies, with sample sizes ranging from 24 to 182,390. With the exception of only a few studies, a majority of the women were socially disadvantaged.

The design of most of the studies was either descriptive or analytical in nature. Twenty-two studies were quantitative in nature, with one qualitative (Wen et al., 2015), and one mixed methods study (Correa, Simmons, Sutton, Meltzer, & Brandon, 2015). The majority of the studies employed cross-sectional data, with six using longitudinal data (Correa et al., 2015; Hauge et al., 2012; Levine, Marcus, Kalarchian, Houck, & Cheng, 2010; Lynch, Johnson, Kable, Carroll, & Coles, 2011; Polanska, Hanke, Sobala, Lowe, & Jaakkola, 2011; Silveira et al., 2013). Thirteen of the studies performed analyses of secondary data (Beijers et al., 2014; Bennett et al., 2010; Correa et al., 2015; D'Angelo, Williams, Harrison, & Ahluwalia, 2012; Dumont, Parker, Viner-Brown, & Clarke, 2015; Gyllstrom, Hellerstedt, & Hennrikus, 2012; Haskins, Bertone-Johnson, Pekow, Carbone, & Chasan-Taber, 2010; Hauge et al., 2012; Holtrop et al., 2010; Meghea et al., 2014; Saint Onge et al., 2014; Silveira et al., 2013; Woods et al., 2010), and five studies utilized retrospective data (D'Angelo et al., 2012; Dumont et al., 2015; Gyllstrom et al., 2012; Saint Onge et al., 2014; Wen et al., 2015). Of these five retrospective studies, one utilized retrospective interview (Wen et al., 2015), and the other four (D'Angelo et al., 2012; Dumont et al., 2015; Gyllstrom et al., 2012; Saint Onge et al., 2014), used retrospective data from various PRAMS surveys.

Measures Used in Reviewed Studies

Stress Measures: Stress was measured almost exclusively via subjective, self-report measures. Those that utilized a well-known scale, such as the Perceived Stress Scale (PSS), usually gave reference to reported reliability and validity, but not always. This was sometimes specific, such as reporting Cronbach's α , but was sometimes reported simply as "adequate reliability". In some studies, reliability of the measure used was not addressed at all. Two studies analyzed open responses to interview questions (Correa et al., 2015; Wen et al., 2015). One study (Braig et al., 2015) used an objective measure, collecting hair samples from in-patient postpartum women, and measuring hair cortisol concentration (HCC) as a biomarker of chronic psychosocial stress.

Smoking measures: The majority of studies measured smoking behaviors by self-report only. Most of these were yes or no assessments, but also included report of number of cigarettes smoked, identification of self as "current smoker", "former smoker", "non-smoker", or self-report of smoking "everyday", "some days", or "none". One study (Varescon, Leignel, Poulain, & Gerard, 2011) supplemented their information with the Fagerstrom Tolerance Questionnaire (FTQ), a scale developed and validated for use in smokers (Fagerström, 1978), and three (Correa et al., 2015; Holtrop et al., 2010; Levine et al., 2010) used the Fagerstrom Tobacco & Nicotine Dependence (FTND) scale, which is a revision of the FTQ. Correa et al. (2015) collected a pre-cessation FTND retrospectively. Two of the studies objectively validated self-report smoking status by measuring exhaled carbon monoxide (Levine et al., 2010; Varescon et al., 2011), and two studies confirmed smoking status with cotinine levels from urine & serum (Lynch et al., 2011), or saliva (Polanska et al., 2011).

Timing of the measurements varied across studies. As reported previously, most of the studies had only one collection point. With respect to the cross-sectional studies, these points were sometimes specific (i.e. second trimester; between 18-28 weeks; 1-2 days postpartum), but also included collection at non-specific points in pregnancy (participant was “pregnant”). The six longitudinal studies varied, but were specific in their time-point collections. One of the studies (Silveira et al., 2013) collected only at specific points during pregnancy with no postpartum collection point. Of the studies that included post-partum collection points, all but one (Correa et al., 2015) included at least one collection point during pregnancy as well as postpartum.

Data Analysis and Findings from the Studies

Nearly all of the studies found a significant positive association between measures of stress or the existence of stressors and the presence of smoking behaviors. The solitary study (Braig et al., 2015) utilizing an objective stress measure, also found a significant relationship between smoking and higher HCC levels. In contrast to these findings, though, there was no association found between a change in perceived stress and smoking behavior in the longitudinal study by Levine et al. (2010), even as rates of smoking abstinence declined over time. Beijers et al. (2014) found no association between the perceived severity of stressful events and continued smoking, and Woods et al. (2010) reported finding no independent association between antenatal stress and cigarette smoking.

Though postpartum relapse rates were high (65% by 24 weeks post-delivery) in the study by Levine et al. (2010), and no association was found between changes in perceived stress and postpartum smoking relapse, there was a significant association with

successful postpartum abstinence and the length of the abstinent period during pregnancy, with women significantly more likely to remain abstinent postpartum through the final 24 week measure if they had been non-smoking for a longer duration during their pregnancy. In addition to the findings by Levine et al. (2010), there was no association between stressful/negative life events and postpartum relapse found in the studies by Gyllstrom et al. (2012) and Hauge et al. (2011).

An odds ratio of 2.2 (1.3, 3.7) was reported by Silveira et al., (2013) that women smoking greater than 10 cigarettes per day pre-pregnancy would experience high perceived stress in early pregnancy. Maxson, Edwards, Ingram, and Miranda (2012), calculated an odds ratio of 1.76 (1.37, 2.26) that smokers would experience higher levels of perceived stress when compared to non-smokers, and an odds ratio of 1.49 (1.15, 1.93) that quitters would also experience higher levels of perceived stress when compared to non-smokers. Gyllstrom et al. (2012) reported that women with three or more stressful life events in the year prior to delivery were nearly half as likely to quit smoking than women with fewer than three stressful life events (AOR: 0.53, [0.34-0.84], $p = 0.007$). Conversely, the number of stressful events was not associated with quitting in the study by Haskins et al. (2010). Women in a study by Correa, et al (2015) cited stress as the most common reason for relapse during the postpartum period, and Polanska et al. (2011) found women were more than twice as likely to relapse during the postpartum period (OR: 2.5 [1.2, 5.0]) if they agreed with the statement that smoking “helps to cope with stressful situations”.

One of the only studies to consider secondhand smoke described that the number of stressors reported was related to the absence of, or only partial existence of, home

smoking rules. For example, women with one or two stressors had an odds ratio of 1.63 [1.40, 1.89] that they had only partial or no home smoking rules, whereas those with three to five stressors had an odds ratio of 2.30 [1.98, 2.68], and those with six or more stressors were more than three times as likely (OR 3.35 [2.81, 3.99]) as those with no stressors to have only partial or non-existent home smoking rules (Saint Onge et al., 2014). Yang and Hall (2014), in their study on postpartum relapse challenges, found that current smokers were more likely to allow smoking in their homes and to have partners who smoke. Also, exposure to other smokers and easy access to cigarettes was reported to be a barrier to successful abstinence by Wen et al. (2015). Polanska et al. (2011) calculated a near seven-fold increase (OR: 6.9, [3.1, 16.8] in the risk for postpartum smoking relapse if the woman lived in a smoking environment at home compared to those who did not. When women were asked to respond to the query “if you have returned to smoking, please tell us why you think it happened”, social reasons, such as exposure to a spouse or friends who smoke, or situations where smoking is present, were the second most common explanations for relapse cited by women who had returned to smoking (Correa et al., 2015).

Strength of the Evidence

With the exception of six studies (Braig et al., 2015; D'Angelo et al., 2012; Dumont et al., 2015; Gyllstrom et al., 2012; Hauge et al., 2012; Saint Onge et al., 2014) that employed population-based data, a common flaw of the studies was the use of convenience samples. This is a common finding in research with subjects such as pregnant women. While sampling from a population would be preferable, it is not typically feasible, nor affordable, with such a transient state as pregnancy presents. A

criticism of convenience sampling is the inherent problem of sampling bias, and the lack of ability to generalize results to a population. The methods of recruitment of subjects, as well as inclusion and exclusion criteria, are well described across the reviewed studies.

The use of a framework to guide the research was reported by only five of the studies (Auerbach, Lobel, & Cannella, 2014; Lynch et al., 2011; Maxson et al., 2012; Varescon et al., 2011; Wen et al., 2015). The purpose of a theoretical framework is to help determine the variables that are central to the study, to determine the method(s) appropriate for the measurement of the variables, and to provide a framework for interpretation of the results (Ryan-Wenger, 1992). This lack of introduction of a theoretical framework in the majority of the studies is a weakness.

When described, the psychometric properties of scales that were used was either reported as “good,” or “psychometrically sound,” or gave specifics as to reliability and validity. No reliability or validity of measures were reported by ten studies (Beijers et al., 2014; Carrion et al., 2015; D'Angelo et al., 2012; Dumont et al., 2015; Gyllstrom et al., 2012; Haskins et al., 2010; Holtrop et al., 2010; Meghea et al., 2014; Polanska et al., 2011; Saint Onge et al., 2014). Though statistical significance of findings was described in all but the qualitative study, nine of the studies failed to report an a priori alpha (Auerbach et al., 2014; Correa et al., 2015; Haskins et al., 2010; Hauge et al., 2012; Levine et al., 2010; Lynch et al., 2011; Maxson et al., 2012; Saint Onge et al., 2014; Varescon et al., 2011), likely assuming a conventional level of significance ($p < 0.05$).

Findings of a majority of the studies showed consistent significant associations between smoking and stress, smoking and psychological adversity, or smoking and stressors. This was true in spite of differences in socio-economic level, race/ethnicity, or

country in which the research took place. In one of the studies that found no association, the level of stress was measured during late pregnancy and at three points postpartum. The authors of this study speculated that this finding may have been due to high stress levels measured during late pregnancy that remained high throughout the postpartum time points (Levine et al., 2010). Studies by Gyllstrom et al. (2012) and Hauge et al. (2012) also found no association between stress and postpartum relapse. These findings were in contrast to other studies in this review that found a significant association between stress and smoking during the postpartum period. One study that found no association between antenatal stress and smoking, also found no associations between stress and race, marital status, age, or education (Woods et al., 2010). Finally, Beijers et al. (2014) found no association between severity of stress and continued smoking, and Haskins et al. (2010) failed to find a significant association between the number of stressful events and likelihood of quitting, though they did report a significant association between an increased stress score and a decreased likelihood of quitting.

Risk of Bias

The use of self-report measures, particularly when asking about a phenomenon that is socially objectionable, may result in bias due to respondents giving socially desirable responses. This is a risk of studies that do not validate responses with a biological measure. The use of measurement of exhaled carbon monoxide by Levine et al. (2010) and Varescon et al. (2011) lends credibility to their findings, as does the validation of self-report smoking status with a biological measurement of cotinine, as was done in the studies by Lynch et al. (2011) and Polanska et al. (2011). The use of retrospective data in five of the studies increases the risk of recall bias. The inconsistent

timing of measurement across studies, and also the use of cross-sectional data in most of the reviewed studies, increases the risk of observational bias. There is no way to detect change, or lack of it, over time, and a respondent could be having a particularly stressful day at the time of measurement.

In addition to the diversity of the measures used, stress was conceived of in a variety of ways across the studies reviewed. One of the most unique studies in the review, with respect to type of stress considered, looked at race-related stress, and its effect on the smoking status of African American women (Fernander, Moorman, & Azuoru, 2010). In this instance, a significant association was found between the smoking status of African American women and race-related stress, with smokers reporting a greater number of race-related events, as well as having more negative perceptions of those events, than did non-smoking, pregnant African American women. In addition to race-related stress, several other types of phenomena were framed as stress by researchers in this review. These include non-race related everyday discrimination (Bennett et al., 2010), housing instability (Carrion et al., 2015), and incarceration stress (Dumont et al., 2015).

Convenience sampling, though advantageous and expedient to the researcher, has the drawback of potential bias. As a convenience sample is not representative the population of all pregnant women, researchers can only draw incomplete conclusions from their findings. As previously mentioned, this type of sampling is common in the pregnant population, but, nonetheless runs the risk of biased results. Few of the studies in this review utilized a randomly selected, nationally representative sample, so the risk of sampling bias is present across virtually all the studies in this review.

Finally, twelve of the studies analyzed secondary data. The use of secondary data runs the risk that data may be outdated or incomplete; however, with the exception of one study that had data collected as early as 1999, none of the data were collected earlier than 2004. Another potential source of bias in secondary data analysis is that all the variables desired to be studied by the researcher may not be available.

Discussion

The evidence obtained from the studies in this review supports the existence of a significant relationship between smoking during pregnancy with increased levels of stress perceived by the woman or number of stressors identified. These findings are in agreement with previous research which has linked smoking as a means of stress management among smokers, of both sexes, in general (Croghan et al., 2006; Parrott, 1995; Parrott, & Murphy, 2012). Though several of the studies used a sample drawn from a distinct ethnicity or nationality (Beijers et al., 2014; Braig et al., 2015; Fernander et al., 2010; Hauge et al., 2012; Meghea et al., 2014; Polanska et al., 2011; Silveira et al., 2013; Varescon et al., 2011), which potentially limited their generalizability to other populations, their similar findings with respect to an association between perceived stress and smoking lend strength to the overall evidence. Two studies failed to find a significant association between stress and continued smoking during pregnancy (Beijers et al., 2014; Woods et al., 2010).

The relationship between postpartum relapse and stress is less certain, based on this review. While women in one study cited stress as the number one reason for postpartum relapse (Correa et al., 2015), another study demonstrated no parallel increase in the measure of perceived stress even as relapse rates rose in the postpartum period

(Levine et al., 2010). Similarly, no association between stress and postpartum relapse emerged in studies by Gyllstrom et al. (2012) or Hauge et al. (2012).

A primary strength of the study evidence is the limited use of retrospective data, reducing risk of recall bias. Most of the studies used reliable and valid tools for the measurement of stress. Six of the studies collected longitudinal data, with one of them collecting only during pregnancy, two of them collecting data during the postpartum period, and three collecting at points both during pregnancy and postpartum. Two studies confirmed self-reported smoking status with measures of exhaled carbon monoxide, while two other studies confirmed smoking status with a measure of cotinine. One study used a measurement of hair cortisol concentration as a potential measure of stress; elevation in this measure was significantly associated with self-reported smoking.

A limitation of the evidence was the use of convenience samples and cross-sectional data by a majority of the studies. Self-reported smoking status was not confirmed by a biological measure in most of the studies. Several studies used sample populations that were drawn from a specific ethnic or racial group, limiting their generalizability. Four of the studies, only one of which was qualitative, had sample sizes of less than 100 participants. Only five studies related their work to a theoretical framework.

Results of this review suggest that a) smoking during pregnancy is associated with perceived stress or number of stressors; b) the association between stress and postpartum relapse is uncertain; c) little attention has focused on the role of passive smoke as a barrier to abstinence in the pregnant or postpartum woman, or its role as an additional potential stressor; and d) studies focusing on whether stress is associated with a change in smoking status across pregnancy are lacking.

A strength of this review is the use of evidence from recent literature, published in peer-reviewed sources. Limitations of the review were that the articles were reviewed independently by the author and only articles published in English were included.

Recommendations for Future Research

Though smoking or relapse is an oft mentioned behavioral correlate of increased stress, how secondhand smoke mediates this relationship has not received similar attention. Because relapsed quitters mention factors such as a smoking spouse, friends, or situation (Correa et al., 2015; Polanska et al., 2011; Wen et al., 2015), or fail to implement full house smoking rules (Saint Onge et al., 2014; Yang & Hall, 2014), the presence of secondhand smoke may act as an additional stressor outside of the woman's control that must be endured. It could be that temptation, itself, may act as an additional stressor (Wagner, Myers, & McNinch, 1999).

Future research should consider the use of longitudinal studies comparing the association of perceived stress in non-smokers, smokers who quit, and smokers who persist in smoking or relapse during pregnancy, as well as in continued abstainers and those who relapse in the postpartum period. The use of biomarker confirmation of smoking status to strengthen the reliability of findings should be incorporated into future studies. The influence of secondhand smoke on efforts to quit smoking or failure to maintain abstinence during pregnancy and postpartum is in need of further consideration. The use of a theoretic or conceptual framework is recommended to guide future research and also enhance interpretation of results.

Table 2.1

Characteristics of the Studies in Review (2010-2015)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Auerbach, Lobel, M., & Cannella, D. (2014)	USA	165 pregnant women	To identify some of the important psychosocial predictors of health-promoting and health-impairing behaviors in pregnancy.	Revised Prenatal Distress Questionnaire	Prenatal Health Behavior Scale: Health Impairing Subscale includes "smoke cigarettes" (positive response)	Pregnancy-specific stress associated with health-impairing behaviors (eg. smoking).
Beijers, C., Ormel, J., Meijer, J. L., Verbeek, T., Bockting, C., & Burger, H. (2014)	Netherlands	2287 pregnant women	To examine the associations of perceived severity of stressful events with continued smoking and continued alcohol consumption during mid-pregnancy.	47 translated events related to work, finances, family, crime in AVON longitudinal study of parents and children (ALSPAC) questionnaire	Categorized based on self-report to "did you smoke before finding out about current pregnancy?" and "are you currently smoking cigarettes?" -continuous smoker -quit smoking -non-smoker	No association emerged between severity of stressful events and continued smoking. (Note: high quit rate of 72%, and relatively few lower educated women)

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Bennett, I., Culhane, J., Webb, D., Coyne, J., Hogan, V., Mathew, L., & Elo, I. (2010)	USA	4454 multi-ethnic, low income pregnant women	To investigate whether perceived discrimination (framed as a stressor) is associated with depressive symptoms and smoking.	Everyday Discrimination Scale and 13-point objective stress scale (housing, IPV, maternal hardship, and neighborhood danger).	“Yes” response to “after you found out you were pregnant, have you smoked at all?”	Chronic low-level discrimination was significantly associated with continued smoking. Current smokers more likely to report high levels of objective stress ($p < .001$).
Braig, S., Grabher, F., Ntomchukwu, C., Reister, F., Stalder, T., Kirchbaum, C., Genuneit, J., & Rothernbacher, D. (2015)	Germany	768 post-partum women	To examine potential determinants of hair cortisol concentration as a measure of H-P-A axis activity shortly after delivery.	Hair cortisol concentration (HCC); an emerging marker of psychosocial stress	“Yes” response to self-report question	Self-report smoking during pregnancy significantly associated with elevated hair cortisol concentrations.
Carrion, B., Earnshaw, V., Kershaw, T., Lewis, J., Stasko, E., Tobin, J., & Ickovics, J. (2015)	USA	623 pregnant teens & young women (14-21 years)	To identify correlates of housing instability and explore association between housing instability and birth weight	Housing instability (stressor) defined as having moved two or more times in the past year.	“Yes” response to “Did you smoke cigarettes since you have been pregnant?”	Women who were unstably housed were significantly more likely to smoke, to be food insecure and be financially dependent on others (parents).

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Correa, J., Simmons, V., Sutton, S., Meltzer, L., & Brandon, T. (2015)	USA	472 post-partum women	To examine free text responses describing attributions of smoking relapse or maintained abstinence at 1, 8, and 12 months postpartum.	Open-ended response	Smoked 10 or cigarettes/day for at least one year before their pregnancy	Stress was the most frequently cited reason for smoking relapse across all follow-ups.
D'Angelo, D., Williams, L., Harrison, L., & Ahluwalia, I. (2012)	USA	35,980 pregnant women	To describe the characteristics and behaviors of women who recently delivered a live-born infant by health insurance status (Medicaid vs. private) and determine if that status was associated with health conditions that may require follow-up in the postpartum period.	PRAMS – list of 13 possible stressful events (cutpoint of 6 stressors based on previous PRAMS studies)	Maternal self-report of any use in the 3 rd trimester is considered a “smoker”	Medicaid paid deliveries were at higher odds of reporting smoking during pregnancy. AOR 1.85 [95% CI: 1.56, 2.18] Medicaid paid deliveries were at higher odds of reporting 6 or more stressors during pregnancy. AOR 2.48 [95% CI: 1.93, 3.18]

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Dumont, D., Parker, D., Viner-Brown, S., & Clarke, J (2015)	USA	182,390 (4.5% of whom were incar- cerated or had partners who were in the 12 months prior to birth)	To examine the association between exposure to incarceration* (framed as “incarceration stress”) in the year prior to delivery and prenatal smoking behavior *in self or partner	PRAMS – list of potential stressors in the 12 months prior to delivery	Self-report of having smoked 100 cigarettes (or more) in the past 2 years.	Women reporting incarceration* stress had increased odds of reporting smoking same or more at time of interview as before pregnancy. AOR 1.32 [95% CI: 1.14, 1.52] *in most cases, this was partner incarceration
Fernander, A., Moorman, G., & Azuoro, M. (2010)	USA	70 pregnant women	To examine the association between the psychosocial construct of race- related stress and smoking among African-American pregnant women.	Index of race- related stress - brief (IRRS-B) (Cronbach’s α reported at .77 - .92)	“Yes” response to “Do you smoke?”	Significant associations found between the smoking status of pregnant AA women and the frequency and perceptions of overall race-related stress (individual and cultural, but not institutional race- related stress).

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Gyllstrom, M., Hellerstedt, W., & Henrikus, D. (2011)	USA	1416 post- partum recent smokers	To examine the relationship between maternal mood and stressful life events with respect to prenatal smoking cessation and stressful life events and post-partum depressive symptoms with respect to post-partum relapse.	13-item subset of the Modified Life Events Inventory (PRAMS-Minnesota)	<u>Recent smoker</u> : “Have you smoked more than 100 cigarettes in the past 2 years?” (Yes) <u>Continued smoker</u> : smoking 1 or more cigarettes during any time period assessed <u>Cessation</u> : report of “0” for a time period <u>Relapse</u> : report of 1 or more after a period of cessation	Women with an increase in stressful life events were less likely to quit smoking. 3 or more stressful life events in year prior to delivery - AOR 0.53 [0.34-0.84] (p = 0.007) Stress was not found to be associated with relapse in this study.

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Haskins, A., Bertone-Johnson, E., Pekow, P., Carbone, E., & Chason-Taber, L. (2010)	USA	351 pregnant Hispanic women	To examine the association between sociodemographic, health, behavioral, psychosocial, and acculturation variables and quitting smoking at pregnancy onset in a population of Hispanic prenatal care patients in Western Massachusetts	Cohen's Perceived Stress Scale # of events via Modified Life Events Inventory (from PRAMS)	<u>Continued smoker</u> : selection of < 1 cigarette/day or provided a # of cigarettes or packs per day <u>Quitter</u> : positive response to "I did not smoke since pregnancy awareness."	Increased perceived stress score was significantly associated with continued smoking (less likely to quit) AOR 0.60 [0.39, 0.93] (p = 0.02) # of stressful events not associated with quitting
Hauge, L., Torgersen, L., & Vollrath, M. (2011)	Norway	71,757 adult ♀ subjects from Norwegian MoBa cohort study	To investigate how maternal stress, conceptualized as symptoms of anxiety and depression, relationship discord and exposure to negative life events is associated with smoking prior to, during pregnancy, and 6 months postpartum.	Hopkins Symptom Checklist (SCL-15) Relationship discord: 10 items developed for MoBa Negative life events: an 8-item survey	Positive self-report to questions asking if the woman had smoked in the 3 months prior to pregnancy and if they were a current smoker	Symptoms of anxiety/depression associated with smoking before pregnancy, lower likelihood of becoming abstinent, and increased relapse. Effects of negative life events and relationship discord similar, but no significant association with postpartum relapse.

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Holtrop, J., Meghea, C., Raffo, J., Biery, L., Chartkoff, S., & Roman, L. (2010)	USA	2203 pregnant Medicaid eligible women	To examine relationships between continued smoking during pregnancy and perceived stress, depressive symptoms, mental health history, and other demographic and behavioral characteristics in a sample of Medicaid- eligible pregnant women.	Cohen Perceived Stress Scale (PSS-4); score of 5 or more indicative of high stress	<u>Non-smoker</u> : never smoked or not smoking at time of becoming pregnant <u>Quitter</u> : reported smoking upon pregnancy, but quit after learning of pregnancy <u>Continued smoker</u> : those who continue to smoke, including those who cut down Fagerstrom Test of Nicotine Dependence (FTND)	Continuous smokers were significantly more likely to experience high stress than non-smokers. OR: 1.39 [1.00, 1.92] Other comparisons not significant.

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Levine, M., Marcus, M., Kalarchian, M., Houck, P., & Cheng, Y. (2010)	USA	183 pregnant women	To examine the relationship of weight concerns and mood experienced in pregnancy that may affect postpartum smoking relapse	Perceived Stress Scale (PSS)	Required to be abstinent at entry: “Think back to the last time you smoked everyday for at least one month.” Exhaled carbon monoxide (CO) confirmation of non- smoking status	No association found between change in perceived stress and postpartum smoking (examination of PSS means revealed high levels measured in late pregnancy that remained high through 24 weeks postpartum. Weight concerns were significantly associated with postpartum relapse.
Lynch, M., Johnson, K., Kable, J., Carroll J., & Coles, C. (2011)	USA	218 mothers with six month old infants	To examine the impact of smoking in pregnancy on parenting stress.	Short-form Parenting Stress Index (PSI) collected at 6 months PP	Average of the # of cigarettes reported as smoked/day during 3 months prior to conception & during each trimester. ≤ 14 cigarettes = “light smoking” 15 or more cigarettes = “heavy smoking” Confirmation: serum cotinine (birth) urine cotinine (6 mo)	Maternal smoking in pregnancy predicted parenting stress at six months postpartum. PSI positively correlated with average # of of cigarettes per day during pregnancy.

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Maxson, P., Edwards, S., Ingram, A., & Miranda, M. (2012)	USA	1518 pregnant women	To examine psychosocial health profiles of women who smoke during pregnancy compared to profiles of women who do not smoke or successfully quit during pregnancy.	Perceived Stress Scale (PSS) 10-item version (Cronbach's $\alpha = .78$)	Self-reported smoking status: -smokers -non-smokers -quitters (no specific # of cigarettes or time-frame noted)	Women who smoke during pregnancy experience a more negative constellation of psychosocial adversities than women who do not.
Meghea, C., Rus, I., Cherecheș, R., Costin, N., Caracostea, G., & Brînzaniuc, A. (2014)	Romania	474 pregnant women	To assess the differences in birth outcomes between non-smokers, persistent smokers, and women who quit when they learned of pregnancy.	Perceived Stress Scale – 4 (PSS-4)	Self-report positive response to “Do you currently smoke cigarettes?”	Smokers had a higher prevalence of elevated stress during pregnancy compared to non-smokers and women who quit upon finding out about pregnancy.

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Polanska, K., Hanke, W., Sobala, W., Lowe, J., & Jaakkola, J. (2011)	Poland	138 pregnant women (“quitters for pregnancy”)	To identify factors which predispose women to smoking relapse postpartum	No specific stress measure. Self-report of secondhand smoke exposure and partner support in maintaining abstinence.	Self-report smoking status, verified by saliva cotinine (cut-off of 10 ng/mL)	50% relapse rate within three months Smoking environment at home a risk-factor for relapse. OR: 6.9 [3.1, 16.8] More likely to relapse if agree with “smoking is a big pleasure” OR: 12.9 [2.4, 239.3] More likely to relapse if agree with “helps to cope with stressful situation” OR: 2.5 [1.2, 5.0]
Saint Onge, J., Gurley-Calvez, T., Orth, T., & Okah, F. (2014)	USA	118,062 postpartum women	To examine the role of social stressors on home smoking rules among women with infants, with attention on moderating role of smoking status and depression.	Retrospective, population-based survey (PRAMS)	Self-report of “never smoked”, “former smoker”, “current smoker”	Higher levels of reported stress associated with partial or no home smoking rules; an independent association. Smoking reduces effect size of stress, with current smokers more likely to have partial or no home smoking rules.

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Silveira, M., Pekow, P., Dole, N., Markenson, G., & Chasen-taber, L. (2012)	USA	1426 pregnant women	To evaluate correlates of high perceived stress in a group of pregnant Hispanic women.	PSS STAI	PRAMS questions regarding smoking status	Pre-pregnancy smoking associated with perceived stress in early pregnancy; cigarette consumption a correlate of high stress perception across pregnancy; significant decrease in PSS scores as pregnancy progressed.
Varescon, I., Leignel, S., Poulain, X., & Gerard, C. (2011)	France	80 pregnant women	To examine relationships between perceived stress and coping styles in relation to smoking status during pregnancy.	PSS-14 Brief Cope	Exhaled carbon monoxide (CO) (cut-off of ≥ 5 ppm) Fagerstrom Tolerance Questionnaire (FTQ)	Stress scores were significantly higher in smoker group. Smokers more likely to resort to substance use as a coping strategy.

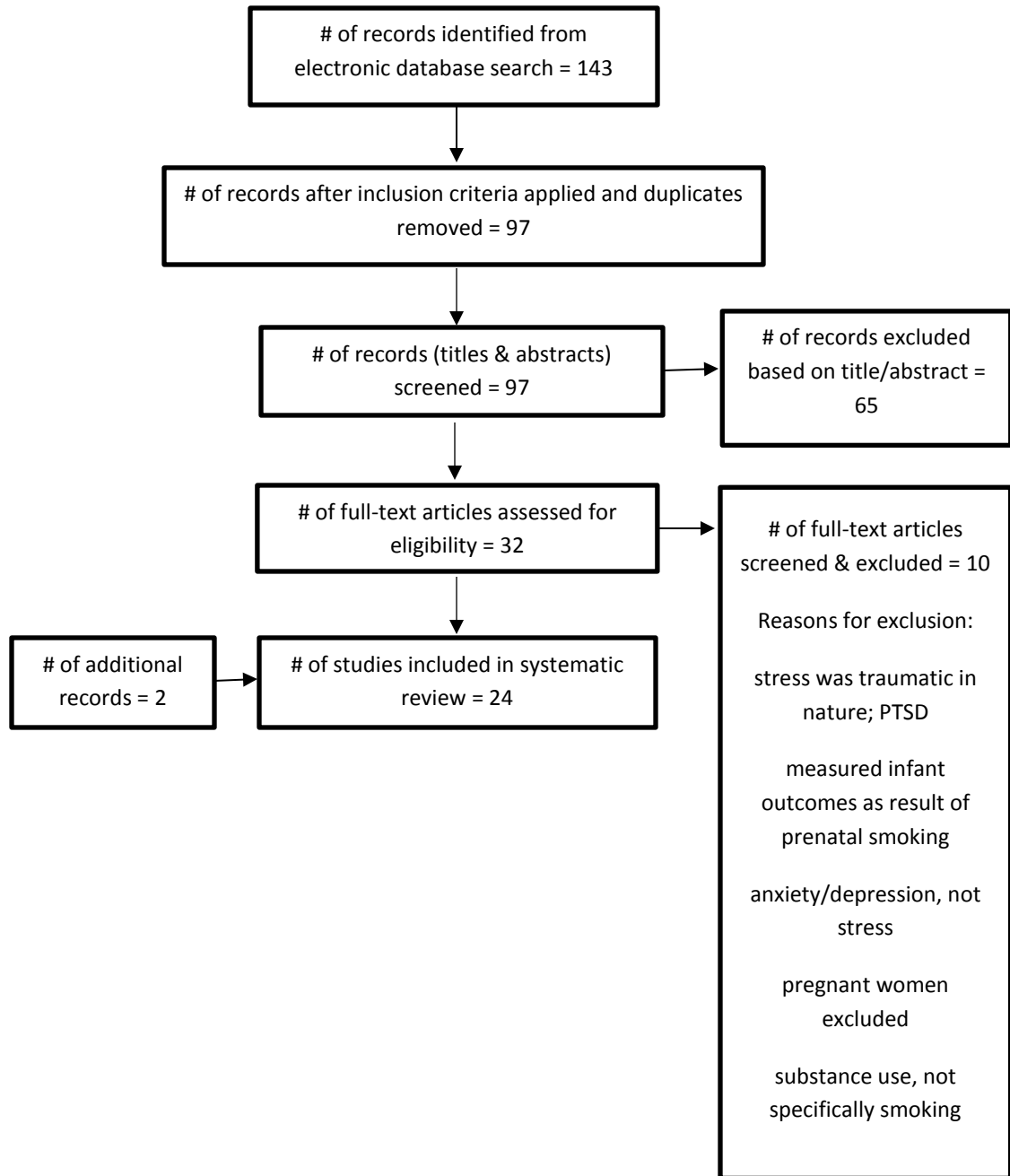
Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Wen, K., Miller, S., Roussi, P., Belton, T., Baman, J., Kilby, L., & Hernandez, E. (2015)	USA	30 postpartum women (up to 3 years postpartum)	To characterize the barriers and facilitators that prevent post- partum relapse and maintain smoking abstinence among a socioeconomic underserved population.	Retrospective, Qualitative Interview	Self-report: “everyday”, “some days”, “none”	Reliance on cigarettes was reported as a primary form of stress management. Exposure to other smokers and easy access to cigarettes a barrier to abstinence. Noted loss of protective status (from secondhand smoke) that was experienced as a pregnant or nursing woman.
Woods, S., Melville, J., Guo, Y., Fan, M., & Gavin, A. (2010)	USA	1522 pregnant women	To identify factors associated with high antenatal psychosocial stress and describe the course of psychosocial stress in pregnancy.	Prenatal Psychosocial Profile Stress Scale	Smoke-Free Families Prenatal Screen – “any current smoking” classified as tobacco use	Significant decrease in mean stress scores from first to second screening. Did not show an independent association between antenatal stress and cigarette smoking.

Table 2.1 (continued)

Article	Setting	N	Purpose	Stress Measure	Smoking Definition	Key Findings/Highlights
Yang, I., & Hall, L. (2014)	USA	24 postpartum women	To compare inpatient current and former smokers on need for smoking cessation assistance, methods used, perceived barriers & exposure to SHS.	Self-report survey	Smoker = any tobacco use in the last 10 months Secondhand smoke items from PRAMS	“Lack of way to handle stress” listed as second most frequent barrier (“craving” was first). Current smokers more likely to allow smoking in their home and have partners or spouses who smoke.

Figure 2.1: Literature Search Decision Diagram



Chapter III: A Psychometric Assessment of the Everyday Stressors Index in First Trimester Pregnant Women

Introduction and Purpose

The negative impact of stress on physical and mental health is well established. Physically, chronic stress can negatively impact the immune system, with more frequent and severe illness resulting. With regard to mental health, sleeplessness, anxiety, and depressed mood are just some of the outcomes of chronic stress (Maldonado, 2014; National Institutes of Mental Health [NIMH], 2016). During pregnancy, maternal psychosocial stress is associated with poor birth outcomes such as low birth weight and preterm delivery, with a greater effect on birth weight than on length of gestation (Kajantie, 2008; Nkansah-Amankra, Luchok, Hussey, Watkins, & Liu, 2010). Stress can be due to a major life event, such as pregnancy, or be more enduring and of the everyday variety, resulting in an assortment of effects. However, the measurement of stress remains problematic. Attention to pregnancy-specific stress has led to the development of at least 15 unique pregnancy-specific stress measurement tools (Alderdice, 2012). These pregnancy-specific measures include consideration of topics such as body image changes, fear of labor and delivery, fear of change in lifestyle, fear of having a mentally or physically handicapped child, and concerns over relationship change and parenting (Alderdice, 2012). Nonetheless, measurement of stress in the form of everyday stress, such as having enough money for basic needs, has not received the same attention during pregnancy. Thus, there is no gold standard for measuring everyday stress in pregnancy. The Everyday Stressors Index, a measurement tool developed by Hall (1983), has shown evidence of reliability and validity when used with single mothers of young children, for whom it was developed. For use in pregnant women, several items having to do with

stress related to children include special instructions for item scoring if the participant is not yet the parent of a child. Thus, the purposes of this study were to: 1) evaluate the internal consistency reliability of the Everyday Stressors Index (ESI) in pregnant women during the first trimester; and 2) examine the factor structure of the ESI in this population.

Background

Despite the association between maternal stress and poor birth outcomes, the mechanism of how stress affects pregnancy and fetal development is poorly understood. During pregnancy, unique immune system changes take place, and the effects of stress on the immune system may differ from the non-pregnant state (Christian, 2012). Coussons-Read et al. (2012), in a study of 173 pregnant women, found uniformly lower levels of serum inflammatory markers (IL-6, TNF- α , CRP) in women who delivered a pregnancy at term, when compared to those who delivered preterm.

Timing of stress may also be a factor. Torche (2011) studied pregnancy outcomes in women exposed to an acute stressor in the form of a major earthquake which occurred in Tarapaca, Chile, in 2005. Lower birth weight and gestational age in infants exposed to the stressor in the first trimester was found, compared to infants either not exposed or exposed after the first trimester. Coussons-Read et al. (2012), in a study of 173 pregnant women, reported overall stress (not pregnancy-specific) experienced early in pregnancy was significantly associated with preterm delivery ($p = .026$), but not when overall stress was experienced late in pregnancy ($p = .061$), or when averaged across pregnancy ($p = .113$).

With respect to timing, it is interesting to note that pre-conception stress has been consistently related to adverse obstetric outcomes (Witt, Litzelman, Cheng, Wakeel, & Barker, 2014). Moreover, while adverse outcomes are more likely in socio-economically disadvantaged women, the reason why this is true is unclear. The strong link of social disadvantage and stress (Gavin, Nurius, & Logan-Greene, 2012), however, indicates that psychosocial stress from everyday sources, outside of those that are pregnancy-specific in nature, is an important area for assessment.

Conceptual Framework of the ESI

In the conceptual framework used by Hall (1983) in the development of the ESI, stressors require adaptation in order to maintain stability (Custer, 1985; Hall, 1983). When too many accommodations are required in response to stress, mental and/or physical health can be negatively affected (Hall, 1983). In addition, evidence of the interconnections among social support, stressors and mental health, and theories supporting the importance of interpersonal relationships provided a backdrop. Everyday stressors were defined by Hall (1983) as “day-to-day problems which worry, upset, or bother an individual,” (p. 38). Her study provided evidence of the relationships of everyday stressors with depressive and psychosomatic symptoms in mothers of young children.

Description of the ESI

Based on review of the literature, consultation with professionals familiar with the day-to-day concerns of young mothers, and the work of Kanner, Coyne, Schaefer, and Lazarus (1981), Hall (1983) initially developed a 22-item scale intended to target the everyday problems of low-income mothers of preschool children. Several items were

adapted from the Daily Hassles Scale, (Kanner et al, 1981). Original factor analysis by Hall (1983) revealed three factors which were labeled family concerns, economic/employment problems, and role overload. Two of the items from the original scale have since been deleted (“feeling tied down”, and “concerns about your own health”).

The ESI is a 20-item, interviewer- or self-administered, paper and pencil scale. The scale takes only 5-10 minutes to administer and requires minimal interviewer training. Women are asked to indicate how much a particular problem worries, upsets, or bothers them from day to day. Response options are (1) *not at all bothered*, to (4) *bothered a great deal*. The scale includes a modification for pregnant women who are not yet parents, instructing them to score any item having to do with stressors related to children as “not bothered” if the participant does not yet have a child. A composite score is obtained by summing the responses to all items; the possible scores range from 20-80. A higher score indicates a higher level of chronic stressors.

Further psychometric testing of the ESI when used with low-income single mothers has shown excellent internal consistency reliability with Cronbach’s α ’s of .80 - .86 reported (Hall, 1990, 2009; Hall, Williams, & Greenberg, 1985; Hall, Kotch, Browne, & Rayens, 1996). Construct validity was previously supported with strong positive correlations with measures of depression, specifically the Centers for Epidemiologic Studies Depression Scale (CES-D, $r = .71$) and the Beck Depression Inventory (BDI, $r = .69$); strong positive correlation with a measure of negative thinking, the Crandall Cognition Inventory ($r = .73$), and negative correlation with a measure of self-esteem, the Rosenberg Self Esteem Scale ($r = -.58$); $p < .0001$ for each (Hall, 2009). In contrast to

the 3-factor structure reported by Hall in 1983, subsequent factor analysis of the ESI when used in a sample of low-income single mothers ($n = 205$) has indicated a 2-dimensional structure; one dimension included stressors in the macro-environment, such as housing, employment, transportation, and the other dimension including lesser stressors such as too many responsibilities and issues relating to children (Hall, 2009). Evidence of previous psychometric testing of the Everyday Stressors Index in pregnant women was not discovered during review of the literature.

Methods

Design

This study was a secondary analysis of cross-sectional data from an unpublished data repository of an ongoing study of pregnant women at three Kentucky prenatal clinics. This study analyzed data collected during the first trimester. The purpose of the parent study was to establish if the presence of prenatal inflammatory markers along with psychosocial and bio-behavioral variables impact preterm birth risk.

Sample and Setting

Data in the original dataset were collected from a convenience sample of women recruited from three prenatal clinics in Kentucky. These clinics include the University of Kentucky Obstetric Clinic, with 1676 annual live births, the Trover Clinic at the Regional Medical Center at Madisonville, in the western part of the state, averaging 941 births annually, and the University Hospital of the University of Louisville, with an average of 2,545 births annually.

The inclusion criteria for the original dataset ($n = 397$) were that the participant be: (1) a pregnant woman ≥ 16 years of age, and (2) that the pregnancy be a singleton

gestation. Women were excluded from the original dataset if they: (1) had a history of Type 1 or Type 2 diabetes, (2) had a history of heart disease, (3) had a current history of illegal or prescription drug abuse, (4) had a second trimester diagnosis of bacterial vaginosis, or sexually transmitted disease, or (5) had an adverse fetal anomaly or condition.

For this secondary analysis, an additional inclusion criterion was that the ESI had been completed before the end of the first trimester, resulting in a sample of 206 pregnant women. Though collection of the ESI was completed at four data points (each of the three trimesters plus six weeks postpartum) in the original study, data collected during the first trimester were chosen primarily because that cohort had the largest number of completed data.

The demographic characteristics of the sample are presented in Table 3.1. The mean age of the participants was 26 years ($SD = 5$; with a range of 16-41 years). Most participants were pregnant for a second time, with a mean gravidity of 2 ($SD = 1.4$). The average ESI score for the sample was 30 ($SD = 8$).

Procedure

Prior to data collection and recruitment, this study was approved by the institutional review boards of the principal investigator's university as well as each hospital/clinic involved. Potential study participants were recruited from each of the clinics while attending a prenatal appointment. Interested participants were then screened by a member of the research team for eligibility. If a woman was eligible, the purpose of the study was explained clearly and completely and written informed consent or assent, with legally authorized representative consent based on age and emancipation status, was

obtained. Participants were informed that they could choose to withdraw from the study at any time.

Questionnaires were formatted in Survey Monkey, a web-based interface for use in data collection. The majority of participants entered data on an iPad, which was checked by a research nurse after completion to ensure that surveys had been submitted. Paper surveys were available for those not comfortable with the web-based format. When paper surveys were used, the data were entered by the research nurse and checked for accuracy by the research manager.

Cronbach's α , a measure of how strongly the items contained in an instrument are intercorrelated, was computed to assess internal consistency reliability. In addition, because a parallel form for the ESI was not available in this sample, further evidence of reliability was computed using split-half reliability testing.

A series of Exploratory Factor Analyses (EFA) was performed using SPSS (Version 21, Chicago, IL) to determine the most parsimonious factor structure for the ESI. Factor analysis is a useful approach to assess construct validity, and empirically justify the dimensions of an instrument (Soeken, 2010).

Results

Reliability

A Cronbach's α of .83 was computed on the sample data, reflecting excellent reliability. A split half-reliability was computed at .74, giving further evidence of reliability.

Construct Validity

Assessment of suitability of the sample for factor analysis revealed a determinant of matrix value of .001, and Kaiser-Meyer-Olkin measure of sampling adequacy of .747, meeting the criteria. Bartlett's Test of Sphericity was significant ($X^2 = 1324.22$, $df = 190$, $p = \leq .001$). The analysis resulted in seven factors with Eigenvalues of greater than 1, which explained 63.7% of the item variance; however, 13 of the 20 variables had communalities of $< .70$. The scree plot was then consulted. The elbow occurred at two factors (Figure 3.1). Therefore, the determination of the most parsimonious factor structure was guided by evaluation of the scree plot.

In this sample, the most parsimonious factor structure for the ESI consisted of a three factor structure for the 20 items. Items $> .35$ were considered for determination of factor loading. Suggestions for factor loading cutoff vary in the literature. One can find levels of at least .30 (Costello & Osborne, 2005) proposed, as well as levels of no less than .40 advised (Matsunaga, 2010). Tabachnick and Fidell (2007), offer .32 as a rule of thumb for minimum factor loading for item retention. Double loading was noted with one item. Item #15, "problems getting along with family", loaded on both factor 1 and factor 2. All items exhibited positive loadings and were retained and assigned to the factor on which they most clearly loaded. Table 3.2 displays factor loadings and the rotated factor matrix.

Based on the content of items that loaded on factor 1, this factor was labeled "basic needs: job, housing, transportation". The basic need for shelter, and food as conceptualized by Maslow (1943), requires that one have the means with which to purchase these needs. This 7-item factor was reliable ($\alpha = .82$) in this sample. The items

which loaded on factor 2 were labeled “family relationships/responsibilities”. These variables describe problems with discipline of children, problems getting along with family, disagreement over discipline of children, as well as not having enough time for one’s own desires. Family systems theory (Bowen, 1966) views the individual as part of a family and presents the view that the motivational force fundamental to human behavior originates with family relationships. Reliability for factor 2 was measured at $\alpha = .76$, and was not improved by removal of the cross-loaded item (“problems getting along with family”) assigned to this factor. Finally, factor 3 was labeled “health/environment” as the items described concerns about the health of children and family members, as well as environmental issues such as neighborhood, schools, friends, and/neighbors. Cronbach’s α was low at .57, indicating a lack of internal consistency amongst items in this factor.

This EFA does support the previously reported multi-dimensional factor structure of the ESI, and meets the criteria to be judged a reliable and valid tool for the measurement of everyday stress in pregnant women.

Discussion

The ESI was developed for, and is purported to measure five areas of stress in low-income single mothers (Hall, 1983): financial concerns, role overload, parenting worries, employment, and problems with relationships. Analysis of its use in pregnant woman has not previously been performed. For use in pregnancy, modification of several items having to do with stress related to one’s children [“problems with your child(ren)’s behavior”, “disagreement with others over discipline of your child(ren)” included the instruction “if no children, check ‘not bothered’]. On one other item

(“concern about your child(ren)’s health”), the women were instructed to “include current children as well as the unborn child.”

A series of EFA were performed to determine the most parsimonious factor structure of the ESI, modified in this way, in this sample of first-trimester pregnant women. A three factor structure, retaining all items, was generated that bore resemblance to the five themes, or areas of stress that the ESI was originally developed to measure. This three-factor structure is also consistent with the three-factor structure reported by Hall (1983), in a study of 114 low-income mothers of young children, although the underlying dimensions of the factors differ. Hall describes her three-factor structure in terms of family concerns, economic/employment problems, and role overload. Items in Hall’s factor labeled “economic/employment problems” most closely resembled items in factor 1 “basic needs: job, housing, transportation”; items in Hall’s factor labeled “role overload” were well represented in factor 2 “family relationships/responsibilities”; finally, most of the items in Hall’s “family concerns” are present in factor 3 “health/environment”. A two-factor ESI, encompassing macro-environment stressors (basic needs, job, housing, transportation), and micro-level stressors (interpersonal and time-related concerns) has also been reported by Hall (2009) in a sample of 205 low-income, single, mothers of young children.

Several limitations should be considered in interpretation of these results. First, the use of secondary data presents the issue of data accuracy. Second, this study used a convenience sample drawn from three prenatal clinics in Kentucky. The exclusion of pregnant women with chronic health conditions, multifetal pregnancy, or adverse fetal anomaly or condition may have contributed to the overall low mean stress score found in

this sample. Also, the majority of the sample was pregnant for the first time and would presumably answer “not at all bothered” on items referring to problems with children. Thus, for these reasons, pregnant women in this sample may not be representative of all pregnant women. Tabachnick and Fidell (2007) offer guidelines with respect to sample size and factor analysis. In their estimation, a sample size of at least 200 would yield results with an estimated reliability categorized as “fair.” When a smaller sample is used, Bartlett’s sphericity test can be applied prior to analysis to determine if the variables are correlated and whether factor analysis is appropriate. At any rate, as sample size increases, reduction of error should follow. Future studies should examine the use of the ESI in a larger sample, with a goal of at least 300 participants (Tabachnick & Fidell, 2007).

Conclusion

Pregnancy is a unique time in a woman’s life. Although pregnancy has its own set of worries and concerns for the pregnant woman, it is the everyday, unavoidable chronic stressors that occupy a significant but not completely understood role in the progression and outcome of pregnancy. Measurement of the everyday stressors that confront the pregnant woman is important to the further our understanding of the effect chronic stressors have on the course and outcome of pregnancy. The ESI performs as a reliable and valid measure that captures three important domains of everyday stressors as experienced by the pregnant woman.

Table 3.1
Characteristics of the Sample (n=206)

	n (%)
Marital Status	
Single/not living with partner	60 (29.1)
Married/living with partner	146 (70.9)
Race	
Caucasian	140 (68.0)
Not caucasian	66 (32.0)
Parity	
No previous birth	100 (61.3)
1 or more term deliveries	63 (38.7)
Missing	43
Education	
< High School	32 (15.5)
High School or more	74 (84.5)
Income	
<20,000	89 (43.2)
20,000 – 39,999	42 (20.4)
>40,000	75 (36.4)
Employment	
No	80 (38.8)
Yes (PT or FT)	126 (61.2)

Table 3.2

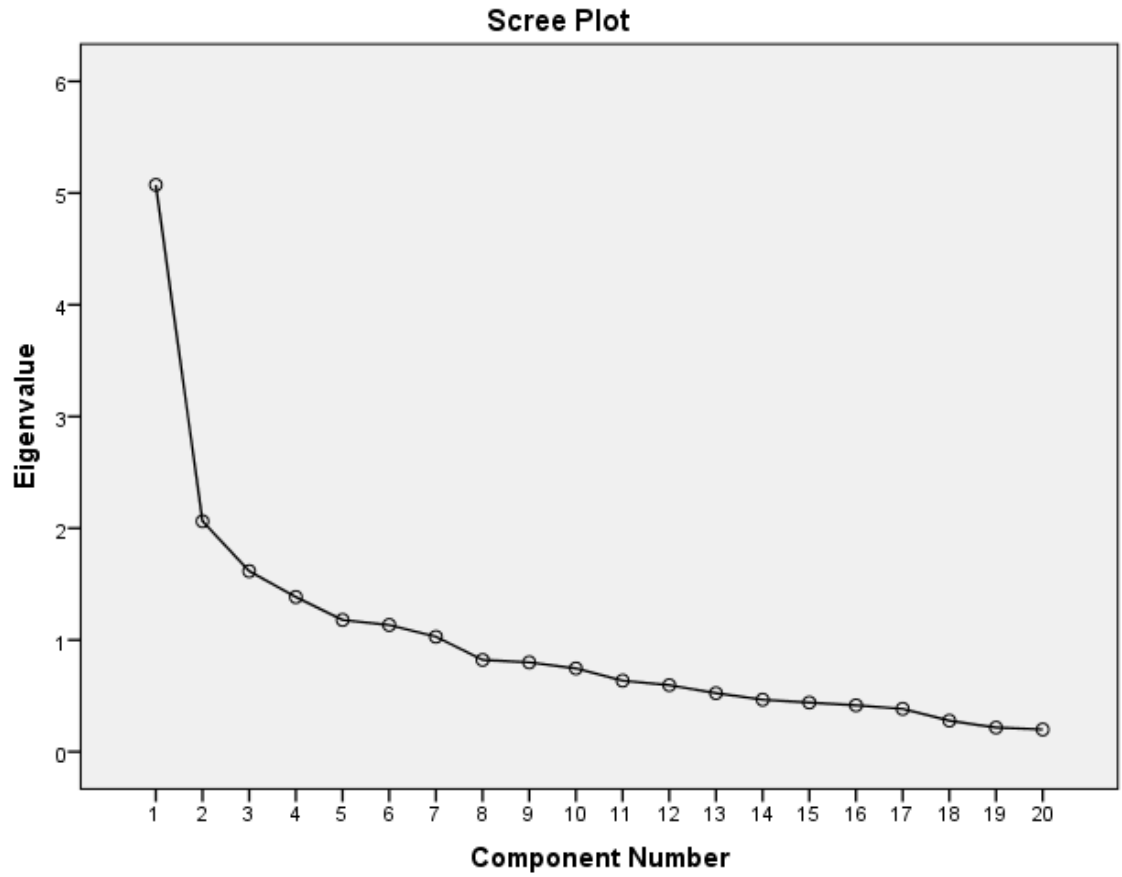
Factor Loadings for Exploratory Factor Analysis With Varimax Rotation of the Everyday Stressors Index

Scale Item	Basic Needs: job, housing, etc.	Relationships /Responsibilities	Health & Environment
trouble finding employment	.81	.02	.03
problems w/job/not having job	.76	.08	-.04
problem with housing	.69	.06	.17
not enough \$ for basics	.63	.30	.27
problems holding a job	.58	.23	.03
problems with transportation	.50	.20	.21
owing money/getting credit	.37	.29	.35
disagreements over kid discipline	.03	.77	-.06
problems with kids behavior	-.21	.73	.10
problems with being married/single	.22	.60	.20
not enough time to do things want to do	.23	.60	-.07
taking care of family-other than kids	.17	.52	-.06
having too many responsibilities	.12	.49	.19
difficulties with kids' dad	.22	.46	.09
problems getting along with family	.38	.46	.31
concerns re: kids' health	.08	-.06	.77
problems w/how kids in school/daycare	-.11	.24	.67
concerns re: family health (not kids)	.13	-.09	.60
problems re: friends and neighbors	.28	.21	.39
feeling safe in neighborhood	.32	.07	.36

Note: Factor loadings > .35 are in boldface.

Figure 3.1

Scree Plot for the EFA of the Everyday Stressors Index in a Sample of Pregnant Women



Chapter IV: Examining the Impact of Everyday Stress and Secondhand Smoke

Exposure on Perinatal Smoking Status

Introduction

Smoking during pregnancy, in spite of moderate declines in pervasiveness (13.3% in 2000 to 12.3% in 2010), continues to be a problem in the United States (CDC, 2013). According to data from the Pregnancy Risk Assessment and Monitoring System (PRAMS), in a survey of women who gave birth in 24 states during the year 2011, the reported prevalence of smoking during the three months prior to pregnancy was 22.6%, with a high of 44.8% in West Virginia, and a low of 11.4% in Utah (CDC, 2011). In the same survey, the prevalence of continued smoking into the third trimester was 10.2% overall, again with a high of 29% in West Virginia, and a low of 4% in Utah (CDC, 2011). Of women who are smoking at the time of conception, most of those who quit will do so soon after they realize they are pregnant. Heil et al. (2014), in a study of the timing of smoking cessation after learning of pregnancy, found that women who changed their smoking behavior typically did so within two days, with limited alteration in smoking habits beyond the first week after recognition of pregnancy. Women who quit or reduced the number of cigarettes smoked tended to have higher educational attainment than those who did not change their behavior (Heil et al., 2014).

PRAMS data from 2011 indicate that 55% of women who smoked in the 3 months prior to conception quit during pregnancy. In spite of the benefits of smoking cessation to the woman and her infant, within the first six months post-delivery, 40% of those who quit relapse and return to smoking (CDC, 2011). A number of socioeconomic and psychosocial factors have been identified as correlates of prenatal smoking, but little

is known about the relationship of the perception of psychosocial stress, secondhand smoke, and smoking behavior in pregnancy.

Background

Pregnancy presents a unique opportunity and motivation for a woman to adopt behaviors that are more health conscious, and is demonstrated by the significant percentage of women who do quit smoking during pregnancy. Nevertheless, many smokers continue to smoke during pregnancy, even though the risks of smoking are well-known and evidence exists that concern about these health risks is prevalent, in spite of a woman's youth or low socioeconomic status (Crittenden, Manfredi, Cho, & Dolecek, 2007). Even though most intend to remain smoke-free after pregnancy, only 20-30% are successfully abstinent one year after giving birth (Johnson et al., 2000; Mullen, 2004).

Stress

Stress has been defined as a process by which "environmental demands tax or exceed the adaptive capacity of an organism, resulting in psychological and biological changes that may place persons at risk for disease" (Cohen, Kessler, & Gordon, 1995). Lazarus (1993) considered psychological stress to be part of a larger theme, namely the emotions, with the various emotions serving as potential responses to stress, based on the individual's appraisal of the stress. He alleged that the reaction to stress wasn't based on the existence of stress alone, but, rather, the significance to the person encountering the stressor.

There is plenty of evidence in the recent literature indicating a significant association between stress and prenatal smoking behavior. Nevertheless, substantial variation in the measurement of stress exists. Witt et al (2014), in a review of studies on

stress and pregnancy outcomes, defined stress according to three domains: environmental, psychological, and biological; however, the similarities of the measures are not well understood. The majority of the studies reviewed by Witt et al. (2014), measured stress in terms of the occurrence or number of life events (environmental domain), with fewer measuring perceived stress, or the psychological domain, and none measuring stress in the biological domain.

The length of gestation has been shown to be inversely correlated with measures of psychological stress by a number of researchers, with measures of perceived stress decreasing as pregnancy progressed (Ruiz, Fullerton, Brown, & Schoolfield, 2001; Silveira et al., 2013; Woods et al., 2010).

Because the significance of the stressor to the person experiencing it was alleged by Lazarus (1993) to have the most important implications with respect to a person's reaction, perceived stress appears to be the most productive domain of stress to explore.

Secondhand smoke

Secondhand smoke (SHS) has been defined as “consisting of exhaled smoke, as well as side-stream smoke that is released from a burning cigarette and has a very similar composition” (Schramm, Scheffler, & Aubriet, 2011). SHS, in addition to being problematic for nonsmokers, adds to the nicotine exposure of smokers and those who are trying to cut down or quit (Joya et al., 2014). In an analysis of PRAMS data from 26 states, Tong, Hutchings, Farr, D'Angelo, and Babb (2014) found that the strongest predictor for the presence of SHS in the home was smoking during and after pregnancy. The consequences of SHS exposure are highlighted by Okoli, Browning, Rayens, and Hahn (2008), who in a secondary analysis of 822 current smokers, found that the number

of sources of SHS had a significant impact on higher levels of nicotine dependence and smoking frequency, as well as fewer attempts to quit smoking and low intention to do so. Exposure to SHS is cited as a barrier to continued abstinence by women who quit smoking during pregnancy (Yang & Hall, 2014).

There is little to be found in the literature regarding the effect of SHS on perception of everyday stress; however a large secondary analysis of data collected between 2004-2010 showed that the probability of having either incomplete or no home smoking rules was generally higher for both smoking and non-smoking women who reported an increase in number of stressors (Saint Onge et al., 2014). In addition, the existence of SHS in her surroundings may act as an added stressor outside of the woman's control (Wagner, Myers, & McIninch, 1999).

Though SHS is a variable of interest in a number of studies of pregnant women, no literature examining to what extent SHS exposure can predict smoking status or what potential effect SHS exposure may have on a measure of perceived stress in pregnancy was found.

Theoretical Framework

Fishbein (2008) suggested an extension to the theory of planned behavior (Ajzen, 1991), known as the integrative model of behavior prediction that takes into account the influence of background factors that may or may not be related to or have influence on certain behaviors. Some of the background factors that might be considered with respect to smoking behavior in pregnancy are age, educational attainment, race, and parity. In this model, human behavior is said to be guided by one's behavioral beliefs (assumptions that a certain behavior leads to certain results), one's attitude toward the behavior

(judgment regarding whether the behavior is good or bad), normative beliefs (a subjective estimation of how significant other wish him or her to act, subjective norms (the person's perception of positive or negative social pressures surrounding the behavior), and perceived behavioral control (the person's belief concerning how easy or difficult it is for them to perform a certain behavior; presence or absence of support); (Ajzen, 1991; Ben Natan et al., 2010).

In a study of how perceived behavioral control may be involved in intent to quit smoking, Yzer and van den Putte (2014) reported that attitudes and perceived norms did influence intention when perceived behavioral control was high, but that this influence was weakened when perceived behavioral control was low. Excessive levels of perceived stress, temptation in the form of easy access to cigarettes or exposure to environmental smoke, and craving due to nicotine withdrawal may all overwhelm one's perceived behavioral control, resulting in either never putting intention into action, or failing to continue the desired behavior (Yzer & van den Putte, 2014). This idea is supported in a study by Yang and Hall (2014), in which postpartum women listed "lack of a way to handle stress" as the second most frequent barrier to continued smoking abstinence, with "craving" as the most frequently cited barrier.

Fishbein (2008) addresses mood and emotion in the integrated model of behavioral action. Lazarus (1993), in his model on stress and coping, considered stress to be part of a larger construct, namely, the emotions with the various emotions serving as potential responses to stress based on the person's appraisal of the significance of a particular stressor. Therefore, perceived stress was abstracted as a construct that is captured in the category of mood & emotions in Fishbein's model.

Fishbein (2008) does not specifically address SHS in the integrated model. In this study, it was conceptualized as an environmental factor that affects perceived behavioral control. The importance of perceived behavioral control as a forecaster of intention in pregnant women with respect to smoking cessation was revealed by Ben Natan et al. (2010) and Godin et al. (1992) in their respective test of the theory of planned behavior in samples of pregnant smokers. Godin et al. (1992) found that intention was mainly influenced by perceived behavioral control and attitude. In the study by Ben Natan et al., perceived behavioral control was the strongest predictor of intention, and exposure to a smoking environment (spouse or friends who smoke), a situation over which the women had no control, negatively impacted their perceived behavioral control of their own smoking behavior while pregnant. This is supported by findings in a study by Wen et al. (2015), in which women cited exposure to other smokers and easy access to cigarettes as a barrier to their abstention efforts. Further support is found in a study in which women cited exposure to a spouse or friends who smoke, or having to be in a situation where smoking is present, as the second most common reason (after stress) for relapse (Correa et al., 2015). Thus, the potential importance of perceived behavioral control when making a behavioral change becomes evident. Figure 4.1 depicts the integrated model of behavioral action and makes apparent variables considered in this study.

The addition of background variables to the theory of planned behavior provides a valuable framework for the explanation of how the perception of everyday stressors and exposure to secondhand smoke is associated with smoking status during pregnancy. See Figure 4.2 for the hypothesized relationships based on this model and tested in this study.

Purpose and Specific Aims

The purpose of this study was to examine the impact of psychosocial and environmental factors on smoking status during pregnancy over time, with measures during the first and third trimesters. Specific aims were to examine the impact the experience of everyday stress during pregnancy has on the smoking status of the pregnant woman and to examine how exposure to secondhand smoke impacts the association between everyday stress and smoking status during pregnancy, controlling for age, race, parity, and educational attainment. The following hypotheses are tested:

H₁: Higher everyday stress scores will be demonstrated by persistent smokers when compared to nonsmokers or spontaneous quitters.

H₂: Women who persistently smoke will be less likely to experience a decrease in stress scores over time when compared to nonsmokers or spontaneous quitters.

H₃: Exposure to secondhand smoke will be more frequently reported by persistent smokers and spontaneous quitters who relapse (included in the smoking group).

H₄: Exposure to secondhand smoke will have a moderating effect on stress scores regardless of smoking status.

Methods

Secondary analysis of data from a prospective non-experimental study of culturally and ethnically diverse women recruited from three prenatal clinics was conducted (Ashford, O'Brien, McCubbin, Westneat, & Barnett, 2013a). The purpose of the original study was to establish if the presence of prenatal inflammatory markers along with psychosocial and biobehavioral variables impacted preterm birth risk. Data used in this study from the original dataset included demographic information (age, race,

gravidity, educational attainment), smoking variables (self-report smoking status, secondhand smoke exposure, urine cotinine), and a psychosocial measure (ESI). Questionnaire data and biological measures were obtained during a prenatal office visit. The collection periods in this study were: 1st trimester, at 5-13 weeks gestation; and 3rd trimester, at 27-36 weeks gestation.

Sample and Setting

Data in the original dataset were obtained from women recruited from three prenatal clinics: the University of Kentucky Obstetric Clinic, located in Lexington, Kentucky (pop. 295,803), with 1676 annual live births, the Trover Clinic at the Regional Medical Center at Madisonville, Kentucky (pop. 19,791), averaging 941 births annually, and the University Hospital of the University of Virginia, in Charlottesville, Virginia (pop. 44,349), with an average of 2545 births annually. These cities represent a variety of populaces, with Lexington being the largest and Madisonville being the smallest (U.S. Census Bureau, 2010). The percentage of persons living below the national poverty rate exceeds the national average of 14.8% in all three cities, ranging from 18.9% in Lexington to 27.5% in Charlottesville, Virginia (2009-2013 data, U.S. Census Bureau, 2014).

The inclusion criteria for the original study were that the participant be: (1) a pregnant woman ≥ 16 years of age, and (2) that the pregnancy be a singleton gestation. Women were excluded from the dataset if they: (1) had a history of Type 1 or Type 2 diabetes, (2) had a history of heart disease, (3) had a current history of illegal or prescription drug abuse, (4) had a second trimester diagnosis of bacterial vaginosis, or sexually transmitted disease, or (5) had an adverse fetal anomaly or condition.

For this secondary analysis, additional inclusion criteria were that the participant had: (1) completed the Everyday Stressors Index in the first and third trimesters, and (2) urine cotinine assessments as measured by NicAlert® in the first and third trimesters. The sample for the present study was 210 women.

Measures

Perceived stress

The Everyday Stressors Index (ESI) was used as a measure of perceived stress. The ESI, developed by Hall (1983), is a structured, self-report 20-item instrument in which respondents are asked to describe how much a particular stressor bothers them on a 4-point Likert scale from 0 (“not at all bothered”) to 3 (“bothered a great deal”). Items on the ESI reflect a variety of sources of everyday stress and include financial worries, role overload, interpersonal conflict, and parenting concerns. The ESI score is obtained by totaling the score for each response, with a cumulative possible score of 0 to 60 possible.

Previous research with the ESI in low-income, single mothers of young children has shown good internal consistency reliability, with reported Cronbach’s α of .80 - .85 (Hall, 1990). Construct and content validity are also supported in the literature (Hall, 1983; Hall et al., 1996). Evidence of prior use of the ESI during pregnancy was not discovered in a review of the literature. For this analysis, two of the ESI items, missing for part of data collection for the original study (“problems with kids in school/daycare”, “problems re: friends and neighbors”) are not included, resulting in an 18-item scale with a cumulative possible score of 0 to 54. Cronbach’s α in the current sample was .83 in the first trimester, and .86 in the third trimester.

Exposure to secondhand smoke

Exposure to secondhand smoke was dichotomized to reflect self-reported exposure or non-exposure to secondhand smoke in the home. Exposure was defined as any answer other than zero hours to the original item which asked “How many hours in a day are you exposed to other people’s tobacco smoke indoors at home?”

Smoking status

Simply asking women to self-identify as smokers is inadequate due to the commonplace deception that is problematic when pregnant women are asked about tobacco use in pregnancy (Russell, Crawford, & Woodby, 2004). To avoid this potential discrepancy, measures of urine cotinine, a metabolite of nicotine, were used to identify tobacco users. Cotinine has a relatively long half-life of 10-20 hours (Lee et al., 2013). For this secondary analysis, positive smoking status was defined as active tobacco use in any form as indicated by urine cotinine of ≥ 100 ng/mL, the cutoff recommended by the manufacturer of NicAlert® urine cotinine testing strips (Nymox Pharmaceutical Corp., 2013).

NicAlert® is a semi-quantitative immunochromatographic assay using monoclonal antibodies to cotinine. The sample strip contains gold particles coated with these monoclonal antibodies. A detectable color change occurs when these particles migrate up the strip in the presence of cotinine. The distance they migrate allows for an accurate measure of the amount of cotinine (Nymox Pharmaceutical Corp., 2013).

The manufacturer states no cross-reactivity of the NicAlert® test strip with nicotinic acid, niacinimide, nicotine, or nicotinic acid n-oxide, substances structurally related to cotinine, at concentrations up to and including 100,000 ng/mL. 3-OH cotinine

is a known cross-reactant with cotinine and shows 12-40% cross-reactivity with cotinine in the NicAlert® assay (Nymox Pharmaceutical Corp., 2013).

NicAlert® test results are expressed as a concentration value from 0-6. Levels above 3, which are equivalent to cotinine concentrations of 100 ng/mL or more, are considered positive evidence of use of tobacco products in the past 48 hours. NicAlert® is intended to determine exposure of an individual to cigarettes, pipes, or chewing tobacco, however secondhand smoke exposure may cause a positive result in non-users of tobacco products (Nymox Pharmaceutical Corp., 2013). Levels of 0-2, which are equivalent to cotinine concentrations of less than 100 ng/mL, indicate that the sample is from a non-user of tobacco products. Therefore, for this secondary analysis, positive smoking status was defined as a result of 3, 4, 5, or 6 on the NicAlert® urine test.

Women were divided into three groups based on their self-reported smoking status during the three months prior to becoming pregnant and their NicAlert® measure of urine cotinine. Nonsmokers were defined as those women with a report of no smoking during the three months prior to pregnancy and a urine cotinine measure of less than 3 at both the first and third trimester collection point. Women with missing preconception smoking information who also had a urine cotinine of less than 3 at both the first and third trimester collection points were included in the nonsmoker group. Quitters were defined as women who reported a positive history of smoking in the three months prior to pregnancy and a urine cotinine measure of less than 3 in the first and third trimester, as well as late quitters ($n = 7$) who demonstrated a urine cotinine of < 3 during the third trimester only. Smokers were defined as women who had urine cotinine of ≥ 3 during the first and third trimester, as well as women who had previously been identified as a quitter

during the first trimester, but had a urine cotinine of > 3 during the third trimester only. These “relapsed quitters” were combined with the smoking group because of their small numbers ($n = 4$).

Demographic characteristics

Age, race, marital status, educational attainment, household income, parity, and pregnancy intention were collected via self-report at the initial, first trimester data collection. For the purpose of demographic group comparisons, race was dichotomized as ‘Caucasian’ versus ‘non-Caucasian’; parity was dichotomized as ‘primiparous’ versus ‘multiparous’, and education was dichotomized as ‘less than high school completion’ versus ‘high school or greater’. These dichotomized variables were included in the regression analyses.

Procedure

Medical Institutional Review Board approvals for the original study were obtained from the University of Kentucky, University of Virginia, and Trover Clinic; the University of Kentucky served as the lead site. An approval of modification request for the original study protocol was obtained for the current study. Potential study participants were recruited from the University of Kentucky College of Medicine Department of Obstetrics and prenatal clinics at the University of Virginia, and Trover Clinic in Madisonville, KY, while women attended a prenatal appointment. Interested participants were screened by a member of the research team for eligibility, and, if eligible, written consent obtained. Participants were free to withdraw from the study at any time.

Demographic data were collected during the first trimester visit. ESI questionnaire data and urine were obtained during a regular prenatal visit during the first and third trimester. The majority of questionnaire data were directly entered into Survey Monkey, a web-based interface, using an iPad. All data entry was evaluated by a research nurse after completion to ensure that all data had been obtained and submitted. Paper surveys were available for those not comfortable with the web-based format. When paper surveys were used, the data were entered by the research nurse and checked for accuracy by the research manager. Missing demographic data were filled in by reviewing information in the electronic medical records. Throughout the collection periods, the data were monitored for quality and completeness by the research manager.

At each data collection time point, a NicAlert® urine assay from a 20-30 mL clean-catch specimen was obtained. The NicAlert® strip was placed into each urine sample for 20 seconds, and the measurement was obtained after the appropriate development time of 10 to 15 minutes after exposure to the urine. The test result (0-6) was recorded and the sample discarded.

Data Analysis

The data were analyzed using SPSS® software, version 22.0 (IBM Corp., 2013). Descriptive statistics using means, standard deviations, and frequency distributions, suitable to the level of measurement, were performed to describe the characteristics of the sample. Differences between the smoking status groups were analyzed using chi-square (X^2) for categorical variables and one-way Analyses of Variance (ANOVA) for continuous variables. Post-hoc comparisons for significant ANOVA effects were

accomplished using Tukey's HSD test. When relevant, effect size was calculated using Cohen's *d*.

The potential impact of the predictor variables of secondhand smoke exposure and the decrease in ESI scores between the first and third trimester (controlling for age, race, education, and parity) on smoking status was tested in a multinomial logistic regression analysis. To represent the decrease in the measure of everyday stress over time, third trimester ESI scores were subtracted from first trimester ESI scores and a new variable was created. The decrease variable was defined this way since stress typically decreases as pregnancy progresses (Silveira et al., 2013; Woods et al., 2010). The variables included in the regression comprised those with a significant association with smoking status in previous chi-square and ANOVA analyses, with the exception of race. Race was nonetheless included because it has previously been reported to be a significant predictor of smoking status (Maxson et al., 2012). While ordinal logistic regression was considered as a possible alternative to multinomial logistic regression (due to the ordered response categories of the outcome variable, including nonsmoker, quitter, and smoker), this technique was not able to be used since the proportional odds assumption was not met. Therefore, the more general multinomial model was applied, and a series of estimates were used to compare the increased or decreased odds for each of the other smoking categories relative to smokers (i.e., persistent smokers/relapsers formed the reference group). Variance inflation factors of the variables were assessed using collinearity diagnostics and were all < 1.2 , indicating a lack of collinearity.

To determine the moderating effect of secondhand smoke on ESI scores, an interaction variable was created between secondhand smoke exposure and decrease in

ESI score, and a second multinomial logistic regression was fit. Odds ratios and confidence intervals were then determined for the following comparisons: the difference in ESI among nonsmokers when they are not exposed to secondhand smoke in the home compared to smokers, the difference in ESI among nonsmokers when they are exposed to secondhand smoke in the home compared to smokers, the difference in ESI among quitters who are not exposed to secondhand smoke in the home when compared to smokers/relapsers, and the difference in ESI among quitters who are exposed to secondhand smoke in the home when compared to smokers. An a priori α of .05 was set to determine the significance of all analyses.

Results

Participant Characteristics

The mean age of the 210 participants was 26.3 ($SD = 5.4$) years. Other sociodemographic and personal characteristics are presented in Table 4.1. The majority was Caucasian, married or partnered, primiparous, and had attained at least a high school education. A majority of the women had a household income level of $< \$40,000$ annually, and slightly more than half reported that the current pregnancy was planned. Of the women in the sample, 137 (65.2%) were nonsmokers, 26 (12.4%) were spontaneous quitters, and 47 (22.4%) were persistent smokers/relapsers; 73 women (44.2%) reported a positive history of smoking during the three months prior to pregnancy. The majority (73.9%) reported that they were not exposed to SHS in their home.

The mean score for the ESI assessed during the first trimester was 8.9 ($SD = 7.1$), with a mean of 7.7 ($SD = 7.3$) in the third trimester. Table 4.2 depicts scores, ranges, and

Cronbach's α for both trimesters. A paired samples t -test was then calculated to compare the mean first trimester score to the mean third trimester score. There was a significant decrease in the ESI score from first to third trimester for the full sample ($t(209) = 2.639$, $p = .009$).

Variables Associated with Smoking Status

The average age of the women differed significantly across the three smoking status groups, $F(2, 207) = 8.677$, $p < .001$. The Tukey's HSD post-hoc comparison revealed that non-smokers, with an average age of 27.3 ($SD = 5.3$), were significantly older than quitters, with an average age of 23.5 ($SD = 3.8$); $p = .002$, and smokers/relapsers, who averaged 24.8 ($SD = 5.5$); $p = .011$. Quitters and smokers did not differ significantly by age ($p = .558$).

Parity also differed significantly across the three smoking status groups, $F(2, 200) = 15.89$, $p < .001$. Post hoc analysis using Tukey's HSD determined that non-smokers, with 0.6 ($SD = 0.9$) previous births, and quitters, with 0.7 ($SD = 0.9$) previous births, had significantly lower parity ($p < .001$ and $p = .002$, respectively) when compared to smokers/relapsers who averaged 1.6 ($SD = 1.7$) previous births. The difference between the parity of non-smokers and quitters was not significant ($p = .854$).

All categorical sociodemographic and personal characteristics were significantly associated with smoking status except race (see Table 4.3). Compared to smokers/relapsers, nonsmokers were more likely to have achieved high school or greater educational attainment, be primiparous, and unexposed to secondhand smoke.

Each of the three smoking status groups experienced a decrease in mean ESI score between the first and third trimester. Mean ESI scores differed across the three

smoking statuses in both the first and third trimesters. This comparison is presented in Table 4.4 and depicted in Figure 4.3. Post hoc analysis using Tukey's HSD revealed that, during the first trimester, nonsmokers scored significantly lower compared to women who had quit smoking during pregnancy ($p = .008$), as well as compared to those who smoked persistently throughout pregnancy ($p = < .001$). The effect size for both of these comparisons was moderate at $-.62$ and $-.65$, respectively. Quitters and persistent smokers did not significantly differ in their first trimester ESI scores ($p = .967$), and in this case the effect size was trivial ($d = -.04$). Post hoc analysis of third trimester ESI score differences revealed that nonsmokers scored significantly lower than persistent smokers ($p = .007$). This effect size was moderate at $-.52$. There were no other significant differences between groups for third trimester scores ($p = .591$, nonsmokers vs. quitters; $p = .427$, quitters vs. smokers). There was a small effect size in both of these comparisons, at $-.20$ and $-.30$, respectively.

Prediction Models

Secondhand smoke exposure in the home was the strongest predictor of smoking status in the multinomial logistic regression model. Those exposed to SHS in the home were nearly 36 times more likely to be smokers than nonsmokers ($p < .001$). Likewise, those exposed to SHS in the home were more than 4.5 times more likely to be smokers/relapsers than quitters ($p = .013$). The magnitude of the decrease in ESI score as pregnancy progressed was not a significant predictor of smoking status for either smoking group comparison.

Parameter estimates indicated that being primiparous was a significant predictor of nonsmokers vs. smokers, but not of quitters vs. smokers. Those who were first time

mothers were 4.5 times more likely to be nonsmokers than smokers ($p = .005$). Age, educational attainment, and race did not significantly influence the odds of any particular smoking status in the model. See Table 4.5 for a summary of the multinomial logistic regression parameter estimates.

In the moderation model, the interaction of SHS in the home and decrease in ESI score was significant for the comparison of quitters and smokers/relapsers ($p = .01$), indicating that secondhand smoke exposure and decrease in ESI score were dependent on each other. Among those with SHS in the home, quitters were 1.14 times more likely to demonstrate a decrease in ESI score over time compared to smokers/relapsers ($p = .04$). There was no decrease in the ESI scores of nonsmokers exposed to SHS in the home compared to smokers/relapsers with SHS in the home ($p = .96$), or in quitters who were not exposed SHS in the home compared to smokers/relapsers without SHS in the home ($p = .13$). Again, being primiparous was significantly more likely in nonsmokers compared to smokers/relapsers, with nonsmokers more than 4 times as likely to be giving birth for the first time. Age also emerged as a significant factor between quitters and smokers/relapsers in the interaction model. Table 4.6 summarizes this model.

Discussion

The high reported prevalence (44.2%) of smoking during the three months prior to pregnancy in this sample is consistent with the most recent available PRAMS data for West Virginia, a neighboring state to Kentucky with similar demographics that participates in PRAMS, which had a prevalence of 44.8% of women who smoked in the 3 months prior to pregnancy (CDC, 2011). The rate of persistent smoking into the third trimester in this sample (22.4 %), while somewhat lower than the 29% rate reported in

2011 West Virginia PRAMS data, was also consistent with the high rates for the region, when compared to the nation as a whole, which had a persistent smoking rate of 10.2% into late pregnancy (CDC, 2011).

Educational attainment significantly differed between smoking groups. This confirms previous findings in the literature, specifically that nonsmokers have higher educational attainment than smokers (Beijers et al., 2014; Maxson et al., 2012), and that women with lower educational attainment are less likely to quit (Bennett et al., 2010; Goedhart, van der Wal, Cuijpers, & Bonsel, 2009; Haskins et al., 2010; Meghea et al., 2014).

Parity also differentiated the groups, with primiparas more likely to be nonsmokers or quitters. Confirmation of this is found in studies by Haskins et al. (2010) and Goedhart et al. (2009), both of which reported an association between having had any previous birth and continued smoking during the current pregnancy. This inclination may be explained by a retrospective study by Okah and Cai (2014), which found that women who had previously given birth were less concerned about the consequences of health compromising behaviors, especially if they themselves had previously participated in that behavior or knew someone who had done so during pregnancy.

Nonsmokers in the current study were more likely to be older than quitters and continued smokers/relapsers. This is in agreement with findings by Meghea et al. (2014) and Maxson et al. (2012) that reported women over 35 to more likely be nonsmokers. Interestingly, Maxson also reported that smoking was more widespread in women aged 20-34 than in women less than age 20, who were more likely to be nonsmokers or quitters. Contrasting this is a report of smoking being more prevalent in older women by

Bennett et al. (2010). This may be explained, though, by the fact that alcohol use and smoking were reported together in that study.

A report of no to SHS in the home was conveyed by 73.9% of the participants, regardless of smoking status. This is quite a bit less than the 94% of PRAMS participants reporting smoke-free homes in the study by Saint Onge et al. (2014). This may be due to the nature of the current study being a convenience sample of women from regions with historically high tobacco use as compared to the population-based PRAMS data.

Race did not differ significantly across the smoking statuses in the current study. This is in contrast to findings by Maxson et al. (2012), who reported the odds of being a quitter rather than nonsmoker were almost twice as high among non-Hispanic black women when compared to non-Hispanic white women. The contrast of these findings may be misleading, though, because all races, other than Caucasian were collapsed into one option (non-Caucasian) in the current study due to the small numbers of Hispanic ($n = 9$) and Asian ($n = 4$) women.

A significant decrease in the measure of perceived stress as pregnancy progressed from the first to the third trimester is supported by previous literature. Woods et al. (2010) found a significant decrease in mean stress scores, using the Prenatal Psychosocial Profile Stress Scale, a scale validated for use in pregnant populations, from the first screening in the early second trimester to the second screening during the third trimester. Silveira et al. (2013) also found a significant decrease in stress scores, using the Perceived Stress Scale, as pregnancy progressed through early, middle, and late pregnancy.

The significantly higher scores obtained from smokers on the ESI at both time points when compared to nonsmokers supports the first hypothesis. Previously, smokers have been shown to score higher on stress than nonsmokers whether it is conceptualized as perceived stress (Holtrop et al., 2010; Maxson et al., 2012; Meghea et al., 2014; Silveira et al., 2013; Varescon et al., 2011), number of stressors (D'angelo et al., 2012), discrimination (Bennett et al., 2010; Fernander et al., 2010), unstable housing (Carrion et al., 2015), or incarceration of self or partner (Dumont et al., 2015). It should be noted that several contrary findings exist as well. For example, Beijers et al. (2014) found no association between severity of stressful events and continued smoking, though the authors attributed this to a high quit rate of 72%, as well as relatively low number of women with low educational attainment. Likewise, Woods et al. (2010) did not find an independent association between antenatal stress and cigarette smoking.

A significant difference in the ESI scores between nonsmokers and quitters that exists in the first trimester is not present in the third trimester, though a small effect size still exists ($d = -.20$). Whether this is a result of their quit status, or whether it is simply due to the overall decrease in ESI score seen across smoking status groups as pregnancy progresses is unclear.

In spite of the differences among the groups with respect to ESI score, persistent smokers/relapsers, though they steadily demonstrated the highest stress scores of the three groups, were no less likely than nonsmokers or quitters to experience a decrease in ESI from the first to the third trimester. The second hypothesis, that persistent smokers would be less likely than nonsmokers or quitters to experience a decrease in stress scores over time, is therefore not supported. A general decline in stress as gestation progresses

is supported in the literature (Guardino & Schetter, 2014; Silveira et al., 2013; Woods et al., 2010); this decline was observed as well in this study, with lower stress scores being observed as gestation progressed regardless of smoking status.

The strong predictive value of SHS exposure on smoking status supports the third hypothesis and is demonstrated in this study by the large percentage of persistent smokers (74.5%) reporting SHS exposure in their home, with corresponding decreases in the reported percentage by quitters (42.3%) and nonsmokers (5.2%). The high percentage of quitters with exposure to SHS in the home is especially concerning given that “craving”, and “having partners, friends, or coworkers who smoke around them at home or in social settings” have been attributed as reasons for returning to smoking by women who have quit (Correa et al., 2015; Yang & Hall, 2014). Polanska et al. (2011), in a study aimed at identifying factors that predispose women to postpartum smoking relapse, discovered that women who lived in a smoking environment were 6.9 [3.1, 16.8] times more likely to return to smoking postpartum than those who do not.

The current study also examined the potential interaction effect of SHS exposure on stress scores among the three smoking statuses. In this model, with respect to the interaction of SHS exposure and decrease in ESI score, the finding that spontaneous quitters exposed to SHS were more likely than persistent smokers/relapsers to have a decline in their everyday stress score was surprising, since exposure to secondhand smoke was hypothesized to have an additive effect on stress. This was not the case, however. So, while the hypothesis that SHS would be more frequently reported by persistent smokers/relapsers is supported, the hypothesis that SHS exposure would moderate stress scores regardless of smoking status is not.

Instead, quitters who were exposed to SHS were 1.14 times more likely to experience a decline in their ESI scores when compared to smokers/relapsers, with no difference between these two groups when SHS was not a factor. Although it is uncertain as to what might explain this finding, a study by Brody et al. (2011) reported that even limited SHS exposure was able to deliver enough of a nicotine dose to the brain to alter its function. The same study found that young people who had never smoked, but were regularly exposed to SHS, were more likely to experience symptoms of nicotine dependence, indicating the potent effects of nicotine even when acquired passively. Conceivably, the exposure to SHS may be responsible for a diminution of symptoms of nicotine withdrawal and the ensuing perception of stress in the spontaneous quitter exposed to SHS. In the same analysis, nonsmokers were significantly more likely to be primiparous when compared to smokers/relapsers, and age was significant between quitters and smokers/relapsers, with quitters more likely to be younger.

Limitations

A limitation of the study was the use of secondary data, without ability to evaluate the quality of the data or collect other pertinent data. For instance, this dataset did not ask any questions related to perceived behavioral control. The use of the ESI, a self-report scale, was a limitation due to individual response styles and social desirability bias. When certain unpopular beliefs or behaviors are being assessed, a respondent may be reluctant to answer in a way that they believe may make a negative impression (Welte & Russell, 1993).

The exclusion of women with a prenatal diagnosis of adverse fetal condition or anomaly may have contributed to the overall low mean stress scores in the sample. Also,

erroneous results due to procedural error in the use of the NicAlert® test strips, possible sample contamination, or failure to perform quality controls on newly opened test strip vials, using a known concentration of cotinine (supplied by the manufacturer) was another possible limitation to consider.

Exposure to SHS, although defined in this study as any amount of exposure to SHS in the home, could come from a number of sources outside of the woman's control, with both those who reported exposure and non-exposure in the home exposed in other settings such as work or public areas where SHS is present.

An additional limitation was the approach taken in defining the smoking status groups, with spontaneous quitters including both those who quit before or during the first trimester measurements as well as those who were defined as smokers during the first NicAlert® measurement but had quit smoking by the third trimester, because of the low number of late quitters. Likewise, women who were defined as quitters during the first trimester, but had relapsed by the third trimester were ultimately included in the persistent smoker group because of an inadequate number of relapsed quitters for analysis.

Conclusions

The present study represents one of the first efforts to examine the effect of perceived stress at more than one point in pregnancy on smoking status and how a change in the level of perceived stress might affect one's smoking status. The effect of exposure to secondhand smoke on the measure of stress particularly when measured in spontaneous quitters, was unanticipated and suggests several recommendations for future research. For instance, because the quit group included both those who quit in the first

trimester as well as the third, it is uncertain whether findings in that group with respect to changes in stress are reliable. The same is true of the persistent smoker group, which also included quitters who had relapsed by the third trimester. Future studies should endeavor to utilize samples large enough to obtain the numbers of participants required to analyze variables that might predict membership in more specific groups, such as late quitters and relapsed quitters. In addition, exploration of other variables suggested by the integrated model of behavioral action, such as perceived behavioral control, may contribute to a more comprehensive approach in the investigation of factors which contribute to persistent prenatal smoking or that enhance sustained cessation.

Table 4.1

Sociodemographic and Personal Characteristics of the Sample of Pregnant Women
(*N* = 210)

Characteristic	Frequency	%
Race		
White	169	80.9
African American	26	12.4
Hispanic or Latina	9	4.3
Asian	4	1.9
Other	1	0.5
Missing	1	
Education		
< High School	22	12.9
High School or >	148	87.1
Missing	40	
Income		
< 20,000	53	32.5
20,000 – 39,999	40	24.5
40,000 and >	70	43.0
Missing	47	
Parity		
None	112	55.2
1 or more term deliveries	91	44.8
Missing	7	
Marital Status		
Single/Divorced/Separated	49	23.3
Married/Living with Partner	161	76.7
Missing	0	
Pregnancy Intention		
Planned	105	52.2
Unplanned	96	47.8
Missing	9	

Table 4.1 (continued)

Characteristic	Frequency	%
Smoked (3 mo) prior to pregnancy		
No	92	55.8
Yes (any amount)	73	44.2
Missing	45	
Smoking Status by NicAlert® 1 st trimester		
Non-smoker	160	76.2
Smoker	50	23.8
Missing	0	
Smoking Status by NicAlert® 3 rd trimester		
Non-smoker	163	77.6
Smoker	47	22.4
Missing	0	
SHS exposure in home		
No	153	73.9
Yes	54	26.1
Missing	3	

Table 4.2

Descriptive Statistics and Cronbach's Alpha for the Everyday Stressors Index*

Trimester Administered	Mean (SD)	Actual Range	Potential Range	Cronbach's Alpha
First (<i>n</i> = 210)	8.90 (7.10)	0 – 31	0 - 54	.83
Third (<i>n</i> = 210)	7.74 (7.26)	0 – 42	0 - 54	.86

*18 items; 2 items were deleted from the scale

Table 4.3

Association of Sociodemographic and Personal Characteristics with Smoking Status

Variable	Smoking Status			X^2	<i>p</i>
	non-smoker (<i>n</i> = 137)	quitter (<i>n</i> = 26)	smoker/relapser (<i>n</i> = 47)		
Education					
< High School	8.6%	9.5%	25.0%	7.68	.022
High School or >	91.4%	90.5%	75.0%		
Parity					
Primipara	64.1%	50.0%	32.6%	13.99	.001
Multipara	35.9%	50.0%	67.4%		
Race					
Caucasian	81.0%	84.0%	78.7%	.30	.861
Non-Caucasian	19.0%	16.0%	21.3%		
SHS in the Home (based on #of hours exposed)					
No	94.8%	57.7%	25.5%	91.94	<.001
Yes	5.2%	42.3%	74.5%		

Table 4.4Comparison of Means (*SD*) of Everyday Stressors Index by Smoking Status

Trimester administered	Smoking Status			<i>F</i>	df	<i>p</i>
	non-smoker (<i>n</i> = 137)	quitter (<i>n</i> =26)	smoker/relapser (<i>n</i> = 47)			
First	7.30 (5.8)	11.65 (8.1)	12.06 (8.5)	11.06	2	<.001
Third	6.74 (7.1)	8.23 (7.5)	10.40 (7.0)	4.69	2	.010

Table 4.5

Summary of Multinomial Logistic Parameter Estimates for Predictors of Prenatal Smoking Status

Predictor	<u>Nonsmokers vs Smokers/ Relapsers (n=139)</u>			<u>Quitters vs Smokers/ Relapsers (n=63)</u>		
	Exp(B)	95% CI	p	Exp(B)	95% CI	p
Age	1.07	[.97, 1.18]	.20	.89	[.77, 1.02]	.09
< HS education	.90	[.21, 3.91]	.89	.32	[.06, 1.89]	.21
No prior birth	4.62	[1.59, 13.38]	.005	1.30	[.37, 4.57]	.68
Caucasian race	.69	[.16, 2.90]	.69	1.27	[.23, 6.88]	.78
ESI decrease	.96	[.89, 1.04]	.30	1.03	[.94, 1.12]	.56
No SHS in home	35.60	[11.18, 113.45]	<.001	4.64	[1.39, 15.49]	.01

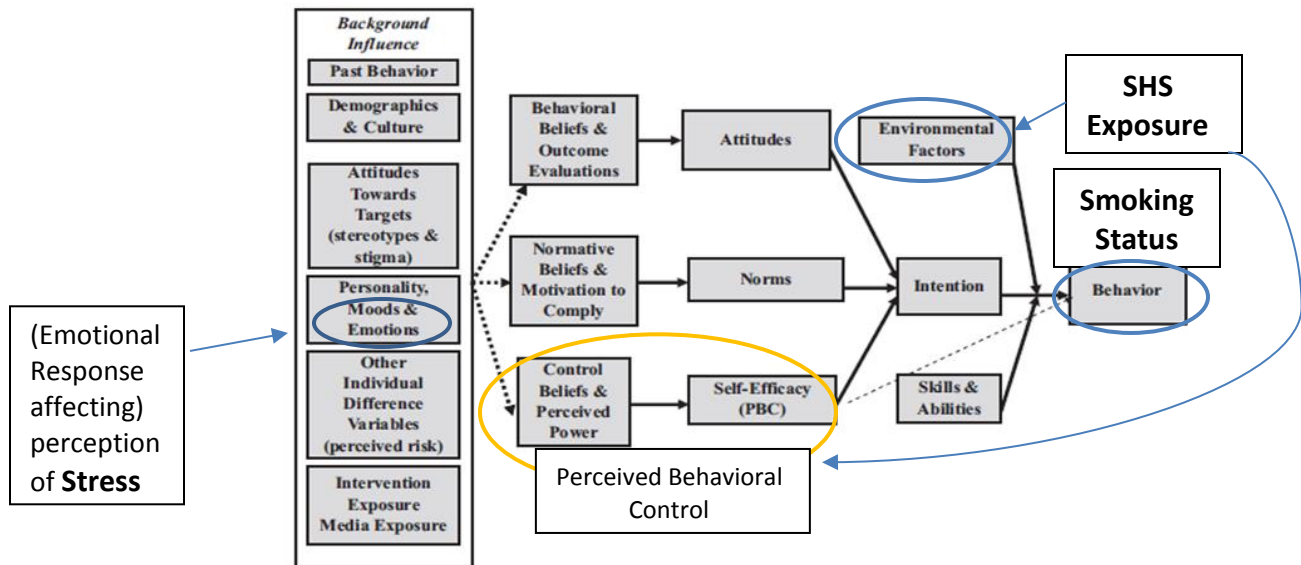
Table 4.6

Summary of Multinomial Logistic Parameters including the Effect of Secondhand Smoke as a Potential Moderator of the Association of Change in Stress and Smoking Status

Predictor	Nonsmokers vs Smokers/ Relapsers (n=139)			Quitters vs Smokers/ Relapsers (n=63)		
	Exp(B)	95% CI	p	Exp(B)	95% CI	p
Age	1.05	[.95, 1.16]	.31	.85	[.74, .99]	.04
< HS education	1.03	[.24, 4.45]	.97	.39	[.06, 2.42]	.31
No prior birth	4.4	[1.48, 13.12]	.008	1.24	[.34, 4.50]	.75
Caucasian race	.77	[.18, 3.32]	.72	1.80	[.31, 10.40]	.51
No SHS in home*	48.89	[14.11, 169.44]	<.001	11.45	[2.47, 53.09]	.002
ESI decrease*	.90	[.81, .99]	.04	.90	[.79, 1.03]	.13
Interaction	1.11	[.95, 1.30]	.20	1.26	[1.05, 1.51]	.01
ESI decrease/ SHS=yes	.997	[.88, 1.13]	.96	1.14	[1.004, 1.30]	.04
ESI decrease/ SHS=no	.90	[.81, .99]	.04	.90	[.79, 1.03]	.13

*OR's for main effects of SHS and ESI difference are not directly interpretable because of their inclusion as an interaction term.

Figure 4.1
Integrated Model of Behavioral Action (variables in this study in **boldface**).



from Fishbein, M. (2008). A reasoned action approach to health promotion. *Medical Decision Making*, 28(6), 834-844. doi: 10.1177/0272989x08326092

Figure 4.2

Proposed relationship of smoking status, perceived everyday stress, and exposure to secondhand smoke during pregnancy

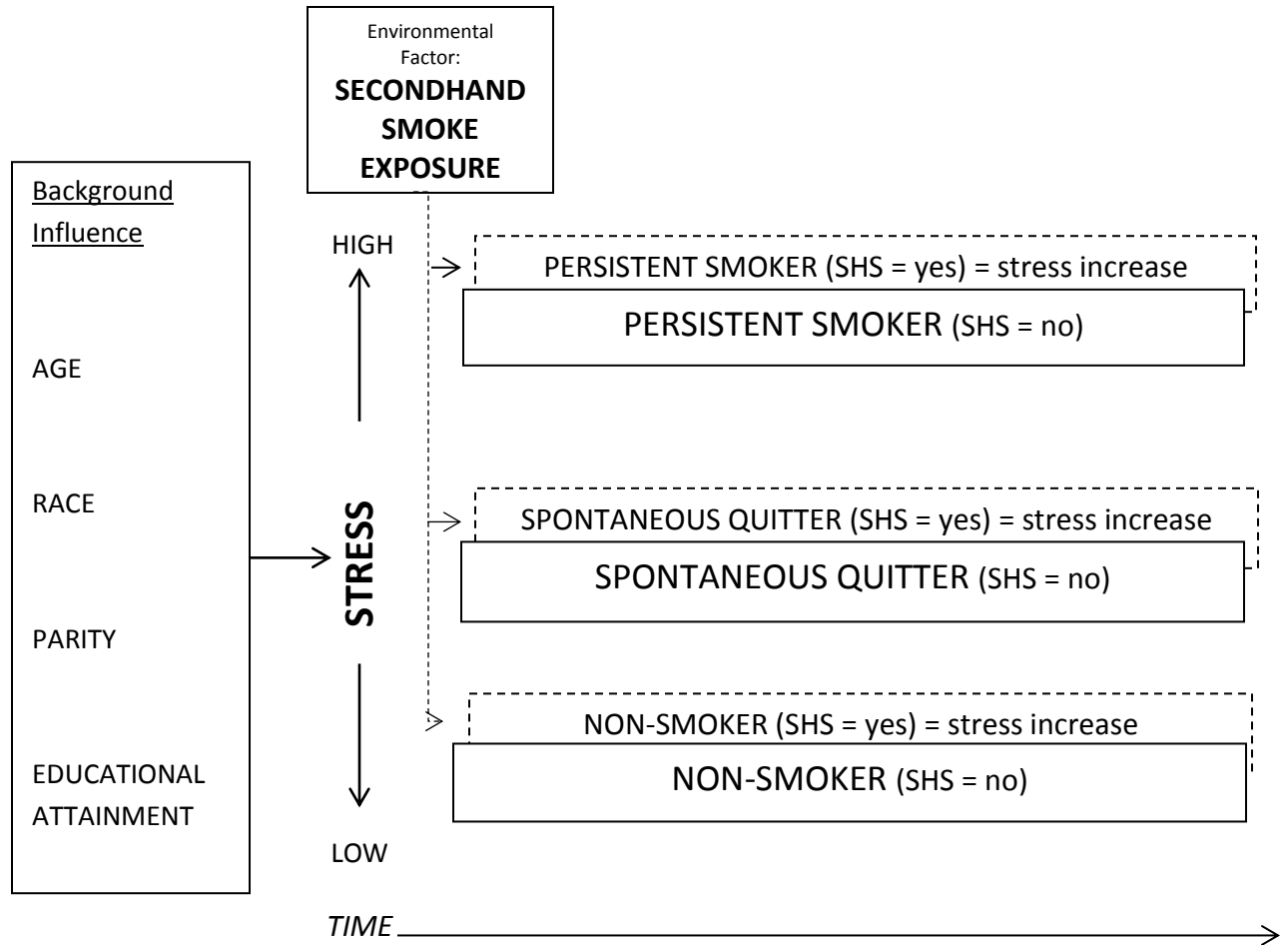
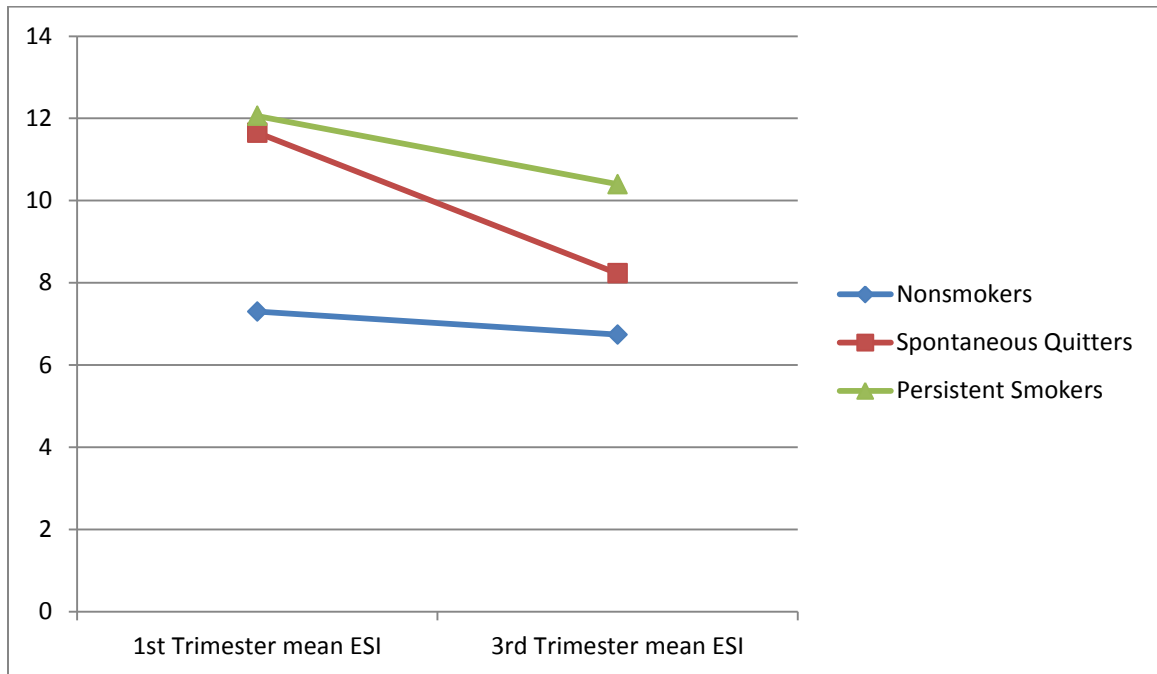


Figure 4.3

Comparison of mean ESI Scores by Smoking Status as Pregnancy Progressed



Chapter V: Conclusions and Discussion

Synthesis of Findings and Implications

The purposes of this dissertation were to: 1) review, summarize, and evaluate the current research that examined the relationship of maternal stress, secondhand smoke (SHS) exposure, and perinatal smoking status; 2) determine the reliability and validity of the use of the Everyday Stressors Index (ESI) with pregnant women; and 3) examine the impact of maternal everyday stress and SHS exposure on perinatal smoking status. In this dissertation, three studies were presented. The first was a critical examination of current literature which studied relationships between the variables of maternal stress, SHS exposure, and perinatal smoking status. Twenty-four English-language, peer-reviewed articles published between 2010 -2015 met inclusion criteria for full review. From this review, an association between smoking during pregnancy and perceived stress or number of stressors was supported. Findings with respect to an association between stress and postpartum relapse were mixed. For example, Yang and Hall (2014), reported “lack of a way to handle stress” as the second most frequent barrier to sustained smoking abstinence in their study of postpartum women, while no association between postpartum relapse and stress was found in studies by Gyllstrom et al. (2011); Hauge et al. (2011); and Levine et al. (2010). Gaps were discovered with respect to the role of SHS on perinatal smoking status as well as its potential role as an additional stressor and resultant impact on maternal stress. Moreover, a lack of longitudinal studies and infrequent use of biomarker confirmation of self-reported smoking status were noted.

In the second study, a psychometric evaluation of the use of the ESI in pregnant women during the first trimester was presented. The ESI is a 20-item questionnaire

developed for use in low income, single mothers of young children. In this population, it has shown excellent reliability and validity (Hall, 1983, 1990, 2009; Hall et al. 1985; Hall et al., 1996). Evidence of previous psychometric examination of the ESI's reliability and validity when used during pregnancy was not discovered during a literature search. ESI scores from 206 women in their first trimester were included in this secondary analysis of cross-sectional survey data. Based on the result of this psychometric testing, the ESI had strong internal consistency reliability when used in first trimester pregnant women, with a Cronbach's α of .83 and a split-half reliability of .74. Construct validity was demonstrated via a series of exploratory factor analyses which yielded three factors that explained 43.8% of the variance in everyday stressors. Based on the content of items which loaded in each factor, these factors were named: 1) basic needs (housing, transportation, and job), 2) family relationships and responsibilities, and 3) health concerns and environment. As a result of this study, the ESI was shown to be a reliable and valid tool for the measurement of everyday stress that captures three important domains of everyday stress as experienced in pregnant women.

The third study examined the impact of everyday stress and SHS exposure on perinatal smoking status. The 210 pregnant women in this study were assigned to one of three smoking status groups based on preset cotinine limits; while exposure to SHS was self-report. Cotinine, a metabolite of nicotine, has a relatively long half-life of 10-20 hours (Lee et al., 2013), therefore giving an objective measure of a woman's nicotine exposure during the previous 2 to 5 days, and avoiding possible response bias. The ESI and urine cotinine measures were obtained in the first and third trimesters. Non-smokers scored significantly lower on the ESI than both quitters and persistent smokers/relapsers

during the first trimester. During the third trimester, nonsmokers scored significantly lower than persistent smokers/relapsers, with the difference between nonsmokers and quitters no longer significant. Though it was hypothesized that persistent smokers/relapsers would be less likely to experience a decrease in stress over time when compared to nonsmokers or quitters, all three smoking status groups experienced a decrease in stress as pregnancy progressed. This decrease as length of gestation increased is consistent with previous research findings (Ruiz et al., 2001; Silveira et al., 2013; Woods et al., 2010).

SHS in the home was unusual in the nonsmoker, with only slightly over 5% of nonsmoking women reporting it. Persistent smokers and relapsers were far more likely to report SHS smoke in the home, with nearly three-fourths of women in this group reporting that they had SHS present in the home. This, too, was supported by previous research which found that home smoking rules were typically partial or non-existent in current smokers (Saint Onge et al., 2014; Yang & Hall, 2014).

In the first multinomial regression performed to determine predictors of perinatal smoking status, the strongest predictor of smoking status was secondhand smoke exposure in the home. Nonsmokers were nearly 36 times more likely to report no exposure to SHS in their homes compared to persistent smokers/relapsers. Quitters, too, were more than 4.5 times as likely to report no SHS exposure in the home, compared to persistent smokers/relapsers. Nonsmokers were 4.5 times more likely to be giving birth for the first time compared to persistent smokers/relapsers. This is consistent with previous research reporting an association with having had a previous birth and continuing to smoke during pregnancy (Goedhart et al., 2009; Haskins et al., 2010).

Although all three smoking groups experienced a decrease in ESI score from the first to the third trimester, with quitters experiencing the biggest change, the magnitude of the decrease was not predictive of smoking status for either smoking group comparison (see Figure 4.3).

A second multinomial regression examined the hypothesized moderation effect of SHS exposure on maternal stress. Mothers in the spontaneous quitter group who were exposed to SHS in the home were 1.14 times more likely to experience a decrease in ESI score when compared to persistent smokers/relapsers who were also exposed to SHS in the home. There was no significant difference in these same groups when SHS was not a factor. This finding of decreased stress among quitters in a SHS exposed environment when compared to smokers/relapsers was unexpected. Previous research on SHS has shown that exposure to the nicotine contained in SHS is adequate to alter brain function (Brody et al., 2011). Additional research is needed to determine why this decrease in stress might occur in quitters who are in an environment of SHS exposure.

Suggestions for Future Research

This is one of the first studies to examine the impact SHS exposure has on smoking status in pregnancy while considering SHS as a potential moderator of stress. Initially, it was intended to also look at ESI in relapsers over time; however, numbers in this study were insufficient to include them in analyses as a separate group. Future studies should strive for larger numbers of women in their sample in order to separate them into additional groups such as relapsers, rather than having to collapse them into larger groups (i.e. persistent smoker/relapser). In order to confirm self-report of smoking behavior and diminish possibility of bias, especially when trying to identify a group that

carries a socially negative label such as “relapser”, the continued use of a biologic confirmation of smoking status is recommended.

The continued use of a framework such as the Integrated Model of Behavioral Action (Fishbein, 2008) is recommended. In addition to the inclusion of environmental factors (such as SHS) as potential influencers of behavior, it also includes such potential study variables as attitude, media exposure, and perceived behavioral control, among others. Media exposure, whether framed as a Surgeon General’s warning, or public health campaign, as to the harmful effects of smoking in pregnancy has been largely responsible for the decreases seen over the past several decades. Similarly, campaigns as to not only the harmful effects of SHS, but also the impact SHS has on continued or relapsed perinatal smoking may have the effect of increasing public awareness as to the sometimes overlooked or discounted impacts of SHS.

Clearly, results of these analyses demonstrate the need for clinicians to address the importance of a smoke-free home to pregnant women. This is clinically relevant because while rates of smoking during pregnancy have shown decline, persistent smoking rates remain unacceptably high, as do postpartum relapse rates. Because SHS exposure is a significant predictor of smoking behavior during pregnancy, pregnant women should be counseled regarding the potential impact SHS exposure has on their cessation efforts during pregnancy and in the postpartum period. In addition to counseling given by their health care provider regarding smoking cessation during pregnancy, the promotion of a smoke-free home and successful postpartum abstinence from smoking behavior has the potential to benefit the health of not only the woman, but her infant as well, for years to come.

Implications for health policy are evident as well. Because smoke-free homes are found more often in urban areas, which are more likely to have smoke-free legislation in place, implementation of smoke-free policies and strengthening of existing ones is an important consideration. Opportunities exist for nurses to engage in nursing policy research aimed at understanding the readiness for change in resistant communities. Pertinent to how to proceed in this area of research are suggested steps by Hahn et al. (2009), which include: coalition formation, in which influential people in a resistant community are identified; influencing public opinion and building demand through media education; and finally, translating and disseminating research findings to those in the community who are responsible for policy-making and implementation.

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Curriculum Vitae

Karen R. Damron

Birthplace: Tacoma, Washington

Education

<u>Institution</u>	<u>Degree</u>	<u>Date Conferred</u>	<u>Field(s) of Study</u>
University of TX El Paso; El Paso, TX	BSN	1983, December	Nursing
Bellarmine University; Louisville, KY	MSN	2003, August	Nursing Education

Certifications and Licensure

January 1990 to present Registered Nurse, Kentucky Board of Nursing

Professional Experience

Dates	Institution and Location	Academic Position
August 1998-present	University of Pikeville, School of Nursing, Pikeville, KY	Associate Professor (current position)
January 1995-May 1997	Pikeville College (now known as University of Pikeville), Division of Nursing, Pikeville, KY	Adjunct Clinical Instructor Skills Lab Coordinator

Dates	Institution and Location	Clinical Position
Jan 1992 – June 1992	Medical Center at Bowling Green, Bowling Green, KY	Staff RN, Women's Medical Surgical Unit
Oct 1986 – Aug 1988	Maine Medical Center, Portland, ME	Staff RN, Neonatal Intensive Care Unit
Jan 1984 – Oct 1986	R.E. Thomason General Hospital (now known as University Medical Center), El Paso, TX	Staff RN, Neonatal Intensive Care Unit, Staff RN, Obstetric Unit

Awards and Honors

- 2015 Recipient of a Graduate Scholarship (Betsy M. Holliday and Eunice S. Milton Scholarship Fund) at the University of Kentucky
- 2014 Recipient of an Appalachian College Association Pre-Doctoral Faculty Fellowship for 2015-2016, (\$26,000)
- 2014 Recipient of a Graduate Scholarship (New Opportunity Fund) at the University of Kentucky
- 2014 Recipient of a Kentucky Opportunity Fellowship at the University of Kentucky (for Fall 2014)
- 2014 Recipient of the University of Pikeville's William Wade and Helen Record Walker Teaching Excellence Award, 1st Place
- 2013 Recipient of a Graduate Scholarship (Betsy M. Holliday and Eunice S. Milton Scholarship Fund) at the University of Kentucky
- 2013 Recipient of a Kentucky Opportunity Fellowship at the University of Kentucky (for 2013-2014 academic year)
- 2010 Mellon Foundation Fellowship to Salzburg Global Seminar, Session #474, Salzburg, Austria

Educational Presentations

- Feb. 2015 Co-Author, Poster Presentation: Morris, C., Adegboyega, A., Damron, K., and Hardin-Fanning, F. "Providers Perceptions of Meaningful Use Mandates". Presented by C. Morris at SNRS 2015 Annual Meeting, Tampa, Florida.
- May 2006 Poster Presenter ("Fun with Pharmacology: The Pharmacology Coffeehouse") and Attendee, Kentucky Nurse Educator Conference presented by the Kentucky Board of Nursing and the Kentucky League for Nursing, Carrolton, Kentucky
- Nov. 2003 Poster Presenter ("Pharmacology in the Associate Degree Nursing Curriculum") and Attendee, National Organization for Associate Degree Nursing (N-OADN) National Conference, Tampa, Florida

Editorial Service

- Oct. 2004 Reviewer, Clinical Drug Therapy: Rationales for Nursing Practice (8th ed), by Abrams, Lammon, & Pennington

Professional Memberships

- 2011-present Association for Women's Health, Obstetric, and Neonatal Nursing
- 2006- present Kentucky League for Nursing
- 2001- present Sigma Theta Tau International (inducted Lambda Psi chapter)