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FACTORS INFLUENCING THE RELATIONSHIP BETWEEN
SOCIOECONOMIC STATUS AND PRENATAL SMOKING

By

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B.S.N., Rutgers University, 1996
M.S.N., University of Louisville, 2013

A Dissertation
Submitted to the Faculty of the
School of Nursing of the University of Louisville
in Partial Fulfillment of the Requirements
for the Degree of

Doctor of Philosophy

Department of Nursing
University of Louisville
Louisville, Kentucky

May 2014

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A Dissertation Approved on

April 14, 2014

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DEDICATION

I dedicate this dissertation to the two most important men in my life...

my father, Dr. Yong Jin Yang and my husband, Dr. Kevin Park.

Thank you for your love, support, and most of all, for believing in me.

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This dissertation is the culmination of a four year journey. It was most definitely not a solo effort and I would like to take this opportunity to thank those who have provided me with assistance along the way.

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ABSTRACT

FACTORS INFLUENCING THE RELATIONSHIP BETWEEN
SOCIOECONOMIC STATUS AND PRENATAL SMOKING

Irene Yang

April 14, 2014

The prevalence of prenatal smoking is highest among women from low socioeconomic status (SES) backgrounds. The adverse effects of smoking on pregnancy outcomes are widely known and current intervention efforts appear to have reached their maximum effectiveness. Improving interventions, particularly for those who are most vulnerable to this behavior demands a deeper and more contextualized understanding of contributing factors.

The purpose of this dissertation was to explore factors that influence the relationship between SES and prenatal smoking. This was done in three ways: a critical review of literature on prenatal smoking in low SES women; an examination of the state of nicotine dependence measurement with a psychometric evaluation of three nicotine dependence measures; and a study testing psychosocial variables as mediators and moderators of the relationship between SES and prenatal smoking.

The critical review of literature showed that the profile of the low SES prenatal smoker is similar to that of the broader prenatal smoking population. More contextualized characteristics included: unique sources of stress; living in a working class-neighborhood; higher rates of alcohol consumption, substance abuse, and physical

abuse; and issues with access to care. In the next manuscript, the psychometric properties of the most commonly used measures of nicotine dependence in perinatal smoking studies -- the Fagerström Test for Nicotine Dependence and two of its derivatives – were examined. Of these three measures, the Heaviness of Smoking Index is the briefest and demonstrated strong predictive validity for behavioral and biomarker indices. Cotinine measurements by saliva or urine are recommended as a helpful way to validate self-reports. In the final manuscript, a data-based study of 371 pregnant women, six predictors of prenatal smoking status were identified: SES, secondhand smoke exposure, race, parity, chronic stressors, and depressive symptoms. Chronic stressors, the quality of the primary intimate relationship, and depressive symptoms were mediators of the relationship between SES and prenatal smoking.

The findings of this dissertation support the widely held belief that prenatal smoking is a complex phenomenon. Truly effective prevention and intervention approaches must address relevant psychosocial factors and future research must consider the multifactorial and interrelated nature of factors that influence prenatal smoking behavior.

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CHAPTER I

INTRODUCTION

The primary purpose of this dissertation was to explore factors that influence the relationship between socioeconomic status (SES) and prenatal smoking. In addition to this introductory chapter, the dissertation consists of three manuscripts and a concluding chapter that summarizes and links the findings of the three manuscripts. First, a critical review of the literature on prenatal smoking in low SES women was conducted to identify characteristics associated with prenatal smoking that are unique to that population and to identify relevant research and practice considerations. Next, the state of measurement of nicotine dependence was examined and the psychometric properties of three nicotine dependence measures commonly used within perinatal women were evaluated. Finally, hypotheses based on the Gallo and Matthews (2003) Reserve Capacity Model were tested in a sample of pregnant women to identify psychosocial factors that might mediate or moderate the relationship between SES and prenatal smoking.

Decades of research have highlighted the adverse effect of smoking on pregnancy outcomes ranging from preterm birth, intrauterine growth restriction, low birth weight, fetal demise, and Sudden Infant Death Syndrome (USDHHS, 1989, 2001, 2004). In addition to the physical consequences of prenatal smoking, the fiscal impact of newborn hospitalizations due to prenatal smoking in 2004 was approximately \$122 million, not

including additional healthcare costs from smoking related pregnancy complications or infant exposure to secondhand smoke (SHS) (Adams, Melvin, Raskind-Hood, & Galactionova, 2011).

Although national prenatal smoking rates fell dramatically in the 1990's (Adams, Melvin, & Raskind-Hood, 2008), the decline has slowed significantly since 2000 (Tong, Dietz, Morrow, D'Angelo, Farr, & England, 2013). Furthermore, the decline in prenatal smoking prevalence has not been uniformly distributed across the population (Graham, Inskip, Francis, & Harman, 2006). Geographic variations exist with the prevalence of prenatal smoking ranging from 4.5% in Vermont to 30.5% in West Virginia (Tong et al., 2013). Most notably, the overall decline in prenatal smoking is markedly less pronounced among female disadvantaged populations (Graham et al., 2006). The prevalence of smoking is highest among those with the least socioeconomic resources, while those with the most resources have the greatest smoking cessation success (Barbeau, Krieger, & Soobader, 2004).

Literature that illustrates this disparity in pregnant smokers is abundant. Prenatal smoking is prevalent among low-income women (Goodwin, Keyes, & Simuro, 2007; Tong, Jones, Dietz, D'Angelo, & Bombard, 2009) with less education (Goodwin et al., 2007; Kahn, Certain, & Whitaker, 2002), and lower occupational status (Hansson, Lendahls, and Petersson, 1999; Penn & Owen, 2002). The effectiveness of current prenatal smoking cessation interventions is limited. A recent meta-analysis of 72 controlled smoking cessation intervention trials during pregnancy indicated that the combined effect of the interventions to improve prenatal smoking cessation was only 6% (Lumley, Chamberlain, Watson, Dowswell, Oliver, & Oakley, 2009). Focusing research

and intervention efforts on those most vulnerable to the behavior may be an effective strategy of decreasing prenatal smoking prevalence. Improving interventions for women from low socioeconomic status (SES) backgrounds requires the identification of factors that contribute to prenatal smoking behavior.

In addition to SES indicators, other demographic variables associated with prenatal smoking include age, marital status, and race. Prenatal smokers are more likely to be younger (Holtrop, Meghea, Raffo, Biery, Chartkoff, & Roman, 2010), unmarried (Goodwin et al., 2007), and White (Ockene, Ma, Zapka, Pbert, Valentine, & Stoddard, 2002). High levels of exposure to SHS and nicotine dependence increase the risk of prenatal smoking (Ockene et al., 2002). Women who smoke during pregnancy perceive more stress in their lives than those who quit (Bullock, Mears, Woodcock, & Record, 2001). Prenatal smokers have a higher rate of depressive symptoms than nonsmokers (Linares Scott, Heil, Higgins, Badger, & Bernstein, 2009). Research also suggests that low levels of social support are associated with prenatal smoking. The demographic variable, marital/cohabitation status, for instance is frequently used as an indicator of support and is strongly associated with prenatal smoking. Unmarried women are more likely to be prenatal smokers (Goodwin et al., 2007; Penn & Owen, 2002).

Chapter Two presents a critical review of the literature on prenatal smoking in low SES women. The purposes of the review were to identify characteristics associated with prenatal smoking that are unique to low SES women and to identify research and practice considerations important for this population. Generating knowledge of new and unique variables, in addition to reinterpreting traditional variables so that they are

relevant to low SES women is essential to the development of effective interventions and policies that will help pregnant women achieve abstinence.

Reliable and valid measures are essential to conduct research that yields meaningful, comparable, and translatable findings. Selecting reliable and valid measures, however, can be challenging, particularly when the variables are latent constructs that are difficult to measure. Nicotine dependence is one such variable. Nicotine dependence is a strong predictor of persistent prenatal smoking, yet there is no clear conceptual understanding of nicotine dependence, the role it plays in smoking persistence, or how it should be measured in pregnant and postpartum women. Chapter Three explores conceptual definitions of nicotine dependence and provides an overview of the state of the measurement of this concept. The Fagerström Test for Nicotine Dependence and two of its derivatives are the most commonly used measures of nicotine dependence in perinatal smoking studies. These measures are described and their psychometric properties are evaluated. Recommendations for new directions in the measurement of nicotine dependence among perinatal women are given in this chapter.

Chapter Four presents a study of potential psychosocial mediators of the relationship between SES and prenatal smoking status based on the Gallo and Matthews Reserve Capacity Model (Gallo & Matthews, 2003). The Reserve Capacity Model is a framework that explains cognitive and emotional pathways between low SES and health behaviors/outcomes. The model suggests that low SES environments can be stressful and reduce the bank of tangible, interpersonal, and intrapersonal resources (reserve capacity) an individual has to manage stress. This increases vulnerability to negative emotions and cognitions, which then leads to health behaviors and intermediate physiological pathways

that ultimately result in morbidity and mortality. The Reserve Capacity Model was chosen for its emphasis on psychosocial pathways linking SES and health behaviors.

Secondary analysis of cross-sectional and longitudinal data was conducted to identify predictors of prenatal smoking status at the third trimester of pregnancy. A sample of 371 pregnant women was divided into three groups: nonsmokers, spontaneous quitters, and persistent prenatal smokers. Three psychosocial variables were the focus of investigation: chronic stressors, depressive symptoms, and the quality of a woman's primary intimate relationship. The quality of a woman's primary intimate relationship has not been previously studied in the prenatal smoking context. These three psychosocial variables were evaluated as a mediator or moderator of the relationship between SES and prenatal smoking status. Additional multivariate regression analyses were conducted to evaluate the ability of the psychosocial variables to independently predict prenatal smoking status, controlling other known predictors of prenatal smoking status.

Chapter Five provides an overview of Chapters Two through Four, integrates the findings of the three manuscripts, and summarizes research and practice recommendations based on the three manuscripts.

CHAPTER II
FACTORS ASSOCIATED WITH PRENATAL SMOKING STATUS IN WOMEN
WITH LOW SOCIOECONOMIC STATUS:
A CRITICAL REVIEW OF LITERATURE

Introduction

The purposes of this paper are to review studies that investigated prenatal smoking in low SES women to identify characteristics associated with prenatal smoking that are unique to low SES women and to identify research and practice considerations that can be tailored to their context. Tobacco use is the leading cause of preventable disease, disability and death in the United States (Centers for Disease Control and Prevention [CDC], 2011). Prenatal women are not spared the impact of tobacco use. Although smoking rates in the last two decades among pregnant women in the U.S. have seen an overall decline from 18.4% to 13.8% (Tong et al., 2009), subgroups of pregnant women remain at risk. Individuals of low socioeconomic status (SES) are especially at risk for smoking behavior. The prevalence of smoking is highest among those with the least socioeconomic resources (income, education, and employment), while those with the most resources have the greatest smoking cessation success (Barbeau et al., 2004). The literature that illustrates this disparity in pregnant women is abundant. Prenatal smoking is prevalent among low-income women (Goodwin et al., 2007; Tong et al., 2009) with less education (Goodwin et al., 2007; Kahn et al., 2002), and lower levels of occupational status (Hansson et al., 1999; Penn & Owen, 2002).

Several variables emerged over decades of prenatal smoking research as strongly associated with smoking behavior. These include parity (Lagerberg & Magnusson, 2013; Schneider, Huy, Schütz, & Diehl, 2010), marital/cohabitation status (Goodwin et al., 2007; Penn & Owen, 2002), second hand smoke exposure (SHS) (Ockene et al., 2002; Schneider et al., 2010), and stress (Crittenden, Manfredi, Cho, & Dolecek, 2007; Schneider et al., 2010). Depression (Linares et al., 2009; Meghea, Rus, & Rus, 2012), nicotine dependence (Crittenden et al., 2007; Meghea et al., 2012) and social support (Bullock, Mears, Woodcock, & Record, 2001; DeJin-Karlsson, Hanson, Ostergren, Ranstam, Isacson, & Lagerberg, 1996) were also linked with prenatal smoking.

Fewer studies focus on identifying factors that place pregnant women of low SES at risk for smoking. The purposes of this paper are to review studies which investigate prenatal smoking in low SES women to identify characteristics associated with that behavior that are unique to low SES women and to identify research and practice considerations important for low SES pregnant smokers.

Literature Search Strategy

The literature for this critical review was found by searching three different databases: CINAHL, Medline, Pubmed, and PsychInfo. A variety of combinations of the following search terms were used: “smoking,” “tobacco use,” “pregnancy,” “pregnant,” “prenatal,” “socioeconomic,” “low income,” “rural,” “Medicaid,” “risk factors,” and “predictors.” Searches were limited by time period (1999-2014), English language, peer reviewed articles, and geographic region (United States). A total of 274 studies were collected from the three databases. All titles and abstracts were reviewed for the following eligibility criteria: (1) the study sample was pregnant women; (2) the

primary population of interest had a defining characteristic that identified it as low SES (e.g., low income, low education, on Medicaid, use of Women's Infant Children's [WIC] Program); and (3) behavior of interest was prenatal smoking or prenatal smoking cessation. Studies that examined smokeless tobacco use, postpartum smoking behavior, or SHS exposure exclusively were excluded. Studies that provided characteristics describing the sample, but not distinguishing smokers from nonsmokers were also excluded. Intervention studies were included, but reviewed only to identify factors associated with prenatal smoking in low SES women. Twenty-three articles met the inclusion criteria for the review. Twelve additional articles identified from automated database recommendations and from a review of reference lists of the twenty-five selected articles were included. A total of 35 articles were reviewed to determine the following key elements of each study: purpose; design/sample; and risk factors, predictors, or characteristics associated with prenatal smoking in low SES pregnant women.

Results

Overview

The 35 studies reviewed encompassed a wide variety of research designs. The majority were non-experimental descriptive studies including population based surveys of large state level databases, data gathered from a chart review, secondary analyses of smoking cessation interventions, and cross-sectional surveys. There were nine randomized controlled trials of prenatal smoking cessation interventions. Two qualitative studies, one an ethnographic analysis, and one a naturalistic descriptive study were also included.

Studies that used data from state level databases focused on low SES women using income (less than the federal poverty level) or Medicaid insurance (eligibility or coverage for prenatal care) as an indicator. Other than data collected from state level databases, participants for the studies were predominantly recruited from WIC clinics, public/community prenatal/health clinics, and large urban hospitals. One study accepted referrals from obstetric providers, and one study recruited participants from a smoking cessation intervention program.

Sample sizes varied greatly depending on the study design. The range was 15 participants for one of the qualitative studies to hundreds of thousands for studies of state level data. Six out of the 35 studies had an ethnic or minority focus and compared two ethnic/minority groups or examined a regional minority within the subcategory of low SES pregnant women.

Characteristics Associated with Prenatal Smoking in Low SES Women

The majority of factors associated with prenatal smoking in low SES women uncovered in this review mirrored factors associated with prenatal smoking in the broader population.

Demographic Variables. Racial composition of the participants varied depending on whether or not the study had an ethnic/minority focus. Overall, low SES prenatal smokers in the studies were predominantly White. This is consistent with 2008 national level data for women smokers by race which indicated that 22% of non-Hispanic, White women smoked compared to 17% of non-Hispanic Black women (Pleis, Lucas, & Ward, 2009). There was one exception in the studies reviewed. Webb, Culhane, Mathew, Bloch, and Goldenberg (2011) reported that the majority of their sample of first-time and

pre-pregnancy smokers was Black; however, this may be a function of the region in which their study was conducted.

The overwhelming majority of women in the studies reviewed were not married. This is consistent with existing literature; pregnant women are less likely to smoke when they are married or co-habiting with a partner (Goodwin et al., 2007; Penn & Owen, 2002). Nichter et al. (2007) noted one important consideration for low SES pregnant women. Marital status was a “fluid and transient category” in their sample of prenatal smokers (p. 751). Several married participants no longer lived with their spouses or lived in unstable relationships. Several women had multiple partners with whom their relationships shifted frequently.

Although unemployment is frequently used as an indicator of low SES, low SES pregnant women were employed in several of the studies. Of the eleven studies with data on employment status, four studies showed that the majority of women were employed. Rates of employed women ranged from 54% (Song & Fish, 2006) to 81% (population based survey of Medicaid insured women) (Petersen, Garrett, Melvin, & Hartmann, 2005). This may suggest that low SES maternal smokers are “working poor” (Adams, Melvin, Raskind-Hood, 2008, p. 1121). The relationship of employment to smoking status may have more to do with employment type rather than unemployment versus employment.

Pickett, Wakschlag, Rathouz, Leventhal, and Abrams (2002) examined an extension of this idea by evaluating local-area characteristics and their association with prenatal smoking status. They found that neighborhood social class, measured as the proportion of working-class residents, was related to prenatal smoking. Working-class

was defined using the U.S. Census classification of occupations and included jobs such as administrative support, sales, service, operator, and laborer occupations. Working-class women living in working-class neighborhoods were almost twice as likely to smoke during pregnancy compared to women in middle-upper class families living in non-working class neighborhoods (Adjusted OR = 1.88, 95% CI = 1.25-2.82). Furthermore, as the proportion of working-class residents in a neighborhood increased, there was a four-fold increase in the odds of prenatal smoking. Thus, the neighborhood environment may influence prenatal smoking in low SES women.

Although many studies use high school graduation as a marker for low versus high education, participants in several studies reviewed had a minimum of a high school education. Of the 27 studies that measured education level, 15 studies indicated that the majority of participants had a minimum of a high school degree. Proportions of pregnant smokers with greater than a high school degree ranged from 54.9% (Woodby, Windsor, Snyder, Kohler, & DiClemente, 1999) to 90% of pregnant smokers (Pickett et. al., 2002). This suggests that a high school education may no longer be an appropriate cut-off for using education level as an indicator of low SES in prenatal smokers.

Parity varied across studies, but the majority of women composing the study samples were multiparous which is consistent with the broader prenatal smoking literature (Lagerberg & Magnusson, 2013; Schneider et al., 2010). Perhaps a more important related variable is unintended pregnancy. In their studies of prenatal smokers, both Adams et al. (2008) and Cluss, Levine, and Landsittel, (2011) reported that low SES women have high rates of unintended pregnancy.

In summary, many of the demographic factors associated with prenatal smoking in low SES women are similar to those found in the general prenatal population. A few differences were noted. Marital status is a fluid concept in this population. Several studies reported that the majority of low SES prenatal smokers were employed and had at least a high school education. This may require a change in the way demographic characteristics are assessed in this group of women. In addition, neighborhood environment was introduced as a variable unique to this population.

Nicotine Dependence/Consumption. Nicotine dependence is a strong predictor of persistent prenatal smoking. In the majority of studies reviewed, nicotine dependence was measured by the number of cigarettes per day (CPD) smoked. In other studies, it was assessed as the time to first cigarette of the day (TTF). These two items comprise the Heaviness of Smoking Index, a derivative of the Fagerström Test for Nicotine Dependence (FTND). Other measures of nicotine dependence found in the reviewed studies include the FTND, the DSM IV criteria for nicotine dependence, and years of smoking history.

Regardless of the measure used, prenatal smokers with a low SES were moderately nicotine dependent at baseline assessment which usually occurred at a prenatal visit. Mean CPDs reported ranged from 8.3 (Pletsch, 2002) to 10.97 (Crittenden et al., 2007). One exception was observed: In a comparison of White and Latina participants, White participants had a CPD of 14 (compared to 9.7) (Roberts-Clarke, Morokoff, Bane, & Ruggiero, 2002).

As is common in the wider prenatal literature, pre-pregnancy nicotine dependence level predicted smoking cessation in low SES women (Higgins, Heil, Badger, Skelly,

Solomon, & Bernstein, 2009; Morasco, Dornelas, Fischer, Oncken, & Lando, 2006; Nichter et al., 2007; Wakschlag et al., 2003). Women with higher levels of pre-pregnancy dependence (i.e., more CPD and TTF < 30 minutes) were less likely to quit smoking (Ockene et al., 2002). Pre-pregnancy salivary cotinine levels also predicted smoking cessation during pregnancy as did years of smoking history (Woodby et al., 1999).

One pattern identified in the reviewed studies was a significant drop in nicotine dependence levels after pregnancy recognition. Dornelas et al. (2006) found that the majority of women in their sample reduced their CPD from 20.8 to 10 or fewer after pregnancy recognition. This pattern was evident across studies (e.g., Adams et al., 2008; Homish, Eiden, Leonard, & Kozlowski, 2012; Nichter et al., 2007; Solomon & Flynn, 2005). This reduction is likely related to high perceptions of smoking risk to both mother and fetus (Morasco et al., 2006; Nichter et al., 2007). Even women who were unable to quit expressed concern about the effect of smoking on their fetus and struggled over self-perceptions of being a “bad mother” (Nichter et al., p. 761). For some women, this was enough to motivate them to reduce their smoking (Nichter et al., 2007).

In summary, one possibly unique facet of nicotine dependence in low SES women is a decline in number of cigarettes smoked with pregnancy recognition. This speaks to the powerful motivation that pregnancy provides and reinforces the idea that pregnancy presents a critical window for smoking cessation interventions.

SHS Exposure. Consistent with the wider prenatal literature, studies focused on low SES women showed that SHS exposure is closely associated with prenatal smoking and predictive of persistent prenatal smoking. The majority of participants in the

reviewed studies lived with at least one other smoker and had friends and family who smoked (Bullock, Everett, Mullen, Geden, Long, & Madsen, 2009; Higgins et al., 2009; Ockene et al., 2002; Roberts-Clarke et al., 2002). Half of women in one study allowed smoking in the home (Higgins et al., 2009). One-third of the women in another study were exposed to SHS every day (Homish et al., 2012). This exposure, particularly if it was in the home and with the partner, decreased the odds of prenatal cessation (Bullock et al., 2009; Higgins et al., 2009; Homish et al., 2012).

Unhealthy Behavior Variables. Three studies suggested a relationship between alcohol consumption or illicit drug use and prenatal smoking. Low SES prenatal smokers were more likely to engage in pre-pregnancy binge drinking (Adams et al., 2008). One study reported that 18% of participants used marijuana in the past and 12% had used cocaine, crack, and/or heroin in their lifetime (Dornelas et al., 2006). Substance use and prenatal smoking were strongly associated (Jesse, Graham, & Swanson, 2006; Patterson, Seravalli, Hanlon, & Nelson, 2012). Low SES Black pregnant women had four times the odds of substance abuse if they were smokers (Jesse et al.). Another unhealthy behavior found in this literature review was lack of prenatal care. Irregular prenatal care attendance was independently and significantly associated with prenatal smoking (Patterson et al., 2012).

In summary, the relationship of illicit drug use and alcohol consumption with prenatal smoking indicated a need for more thorough screening for substance abuse/alcohol consumption in prenatal smokers. Because poor prenatal care has been associated with prenatal smoking, monitoring prenatal visit attendance and assessing for

any barriers a woman has to regular attendance are important considerations for low SES smokers.

Psychosocial Variables. Just as it is in the literature pertaining to the broader population, stress is linked to smoking in low SES pregnant women. Mean stress levels in low SES pregnant women ranged from moderate (Crittenden et al., 2007) to high (Holtrop et al., 2010). Consistent with the broader literature, a low level of stress was a predictor of spontaneous smoking cessation (Higgins et al., 2009). Women who agreed they had too many other problems in life to stop smoking were less likely to spontaneously quit (Ockene et al., 2002).

The majority of the studies that measured stress used the 4- and 10- item Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). One of these studies, however, reported mean scores that were inconsistent with the range of this scale (Bullock et al., 2009). Ockene et al. (2002) also used the PSS-4, but used it in combination with other items to create a “Mood Score;” interpretation details were not given in the publication. They do suggest, however, that “worse mood or emotional well-being” was related to decreased likelihood of spontaneous cessation (p. 156). Finally, one study did not identify a recognizable scale, instead calling it “a stress rating scale” and describing it as measuring increased levels of stress in the week prior to the study (Higgins et al., 2009, p. S102).

Perhaps more notable from the literature on stress and low SES prenatal smokers are the sources of stress reported. Low SES women are more likely to report stress from a physical fight, or drugs, and more likely to report an average of three or more stressors compared to their higher income counterparts (Adams et al., 2008). Other sources of

stress for low SES women include parenting challenges, living in disruptive home environments, violent neighborhoods, a lack of social support, and personal health problems beyond those related to pregnancy (Pletsch, Morgan, & Pieper, 2003). Perceived safety and self-reported neighborhood violence were both significantly correlated with perceived stress (Patterson et al., 2012).

Depressive symptoms were significantly associated with prenatal smoking (Nichter et al., 2007; Patterson et al., 2012). Most of the studies used the Beck Depression Inventory. Other measures included the Centers for Epidemiologic Studies–Depression scale, the Diagnostic Interview Schedule, the Edinburgh Postnatal Depression Scale, and the Mental Health Index-5. Studies reported a range of mean depression scores indicating mild to high levels of depressive symptoms among prenatal smokers (Bullock et al., 2009; Higgins et al., 2009; Jesse et al., 2012; Stotts, DeLaune, Schmitz, & Grabowski, 2004).

Psychiatric disorders and their association with prenatal smoking may be an important consideration for this population. In a study examining the association between prenatal tobacco use and psychiatric disorders in low SES women, 26% had at least one psychiatric diagnosis (Flick et al., 2006). Major depressive disorder was the single most prevalent diagnosis next to nicotine dependence. Compared to nonsmokers, persistent prenatal smokers had significantly greater odds of having bipolar disorder, PTSD, social phobia, drug abuse, anxiety disorder, behavior disorder, and affective disorder. Notably, most of the women with a psychiatric diagnosis had not undergone treatment in the past year (Flick et al., 2006).

Sources of stress provide a window into the complex context of low SES pregnant smokers. The link between psychiatric disorders and persistent smoking in low SES pregnant women has important implications. Awareness of this connection and identification and appropriate treatment of psychiatric diagnoses may not only provide much needed mental health treatment, but also improve prenatal smoking cessation.

Social Support. Reviewed studies indicate that low SES prenatal smokers have low or even averse levels of social support (Bullock et al., 2009). Compared to higher SES women, they are more likely to be abused before and during their pregnancy (Adams et al., 2008). Rates of ever experiencing abuse ranged from 16% to 22% (Jesse et al., 2006; Nichter et al., 2007); 10% of women reported abuse during pregnancy (Jesse et al.). Women who were able to quit smoking had stable living arrangements with encouragement to quit smoking, whereas persistent smokers had lives marked by a lack of control and a lack of social and financial support (Nichter et al.)

Social support was measured in only five out of the 37 studies. The evidence on social support as a predictor of prenatal smoking is not clear. Abuse was a predictor of persistent prenatal smoking for African American low SES women, but not for White women (Jesse et al., 2006). Support, as measured by how much encouragement a woman receives from friends and family to quit smoking, did not predict prenatal smoking cessation in low SES women (Woodby et al., 1999).

The inconsistency in findings across studies may be due to differences in the conceptual definitions and measures used to assess social support. This construct also is multidimensional. It is possible that social support interacts with other variables related

to prenatal smoking rather than being directly linked. This factor clearly warrants more research in the prenatal smoker population.

Problem Behavior. Past or present problem behavior may be a factor in prenatal smoking among low SES women. Wakschlag et al. (2003) reported that persistent smokers exhibited a significantly higher prevalence of problem behaviors than nonsmokers. Problem behaviors included: running away from home, initiating fights as a teen, aggressive relationships, dropping out from high school, history of arrest, late prenatal care, and teen birth, to name a few. Most behaviors demonstrated a linear pattern, with non-smokers having the lowest level of the problem behavior, followed by spontaneous quitters, and then persistent smokers. This study suggests that adaptive and interpersonal problem behaviors significantly increase the risk of pregnancy smoking.

Access to Care Issues. Access to prenatal care is vital for pregnant smokers to receive appropriate cessation interventions and education. Adams et al. (2008) found that the majority of smokers (both low and high income) lived in areas with lower ratios of physician per woman compared to non-smokers. This has direct implications to the access a woman has to a provider. In the studies reviewed, low SES women ranged in their level of health insurance coverage from primarily uninsured (Adams et al.; Cluss et al., 2011) to primarily Medicaid insured (Ockene et al., 2002). Either option poses prenatal care access challenges for low SES women. Uninsured women who become eligible for Medicaid often face the time consuming process of applying for their Medicaid card, thus delaying onset of prenatal care. Also, Medicaid coverage does not guarantee prenatal smoking cessation coverage. Petersen et al. (2006) found that of 15 states, 53% did not include prenatal smoking cessation in their coverage, 33% had some

coverage (meaning pharmacotherapies or counseling), and only 13% had extensive coverage (pharmacotherapies AND counseling). These insurance issues combined with lack of transportation to prenatal care (the primary barrier to prenatal care listed by low SES women) are critical factors in understanding prenatal smoking.

Research and Practice Considerations for Low SES Prenatal Smokers

Concerns with Current Practice

Current high rates of prenatal smoking in low SES women suggest that one area for investigation is patient–provider interaction. In fact, Petersen et al. (2005) found that in a population of low SES pregnant smokers, discussion of smoking with providers was *inversely* associated with prenatal smoking cessation. Women who spoke with their providers about smoking during pregnancy were 30% *less* likely to quit. This may suggest that provider interventions are not effective with this population and point to the need for tailored interventions for prenatal smokers.

Petersen et al. (2005) also uncovered several characteristics that decreased the likelihood of a provider discussing smoking with a woman. Light smokers, those with some college education, with at least one previous child, or with one previous low-birthweight baby were less likely to have a provider speak with them about smoking cessation. This is a concern for this population, especially in light of the fact that the literature shows that many pregnant smokers reduce their smoking initially in response to learning of their pregnancy. Providers may be interpreting this “light smoking” as a sign that intervention is not needed.

Future Practice and Policy Considerations

The multitude of factors identified in this review suggest that smoking cessation should have a multi-level approach which considers individual, psychosocial, and environmental level variables targeted to low SES women of childbearing age.

Individual level interventions may begin with a new understanding of the trajectories of prenatal smoking behavior. The typical categorization of prenatal smoker status is non-smoker, spontaneous quitter, and persistent prenatal smoker. Nichter et al. (2007) suggested that a more nuanced characterization of prenatal smokers would be helpful in understanding the variation in quitting patterns and harm reduction that low SES women engage in. To that end, Eiden, Homish, Colder, Schuetze, Gray, and Huestis (2013) uncovered distinctions in the trajectories of prenatal smoking status in low SES women. They identified four trajectories for low-income pregnant smokers. Non/light smokers had the least change in smoking trajectory. Nonpersistent moderate smokers displayed sharp declines in smoking between 3 and 5 months corresponding with pregnancy recognition. Persistent moderate smokers exhibited a gradual decline in smoking over time. Persistent heavy smokers showed an initial sharp drop in smoking followed by a period of increased smoking between the second and third trimester. This analysis illustrates that pregnant smokers are not a uniform group and that static measures of smoking and interventions to address smoking may not be effective. Eiden et al.'s results suggest the possibility of timing interventions to match the natural flow of self-initiated smoking reduction. In addition, persistent heavy smokers may require additional support at the end of the second trimester when they start to exhibit an increase in CPD.

The Transtheoretical Model of Change (TTM) is a commonly used theoretical framework in health behavior research that combines both the subjective internal process of change along with more objective environmental influences and processes (Prochaska & DiClemente, 1982). Several of the studies reviewed tested TTM concepts in low-income prenatal women and lend insight into practice directions.

Assessment of the stage of change of low SES prenatal smokers in two studies suggested that they have minimal intention to quit (Ruggiero, Tsoh, Everett, Fava, & Guise, 2000; Stotts et al., 2004). Pregnant smokers compared to non-pregnant smokers had a less negative attitude toward their smoking, more temptation in habit-related situations, and less use of experiential processes of change (Ruggiero et al., 2000; Scheibmeir, O'Connell, Aaronson, Gadowski, 2005). This suggests several important avenues of interventions for low SES women: using stage appropriate interventions; increasing awareness of the negative effects of smoking; educating on strategies to help manage habit-related or situational temptations to smoke; and providing emphasis on increasing experiential processes of change, for example, consciousness raising and environmental re-evaluation (Ruggiero et al., 2000).

Broader approaches may include policies aimed at increasing educational attainment for young girls. Higgins et al. (2009) suggested that this would have the potential to significantly impact prenatal smoking rates with additional direct and indirect benefits on other chronic health conditions.

Broader policy measures also include issues of insurance because insurance coverage and reimbursement policies directly affect access to healthcare services for low SES pregnant women. The effect from the implementation of the Affordable Care Act

(ACA) with its mandate for insurance companies to cover smoking cessation services for pregnant women remains to be seen. For increased reimbursement to be successful, there needs to be increased capacity for delivery of smoking cessation interventions, ongoing training of providers, and assignment of specific staff to provide smoking cessation counseling (Petersen, 2006). There is a need for innovative interventions that target at-risk groups. Providers also need to be made aware of changes in reimbursement. McMenamin et al. (2004) found that only 58% of providers who accept Medicaid were aware of coverage for pharmacotherapy and only 23% were aware of coverage for counseling. Whether or not providers are aware of the new ACA mandate and whether or not states have the capacity for this kind of delivery will, in part, determine outcomes.

Concerns with Current Research and Future Directions

A fundamental issue with current research on low SES prenatal smoking is in understanding the construct of SES. SES reflects different aspects of social stratification. It is typically operationalized in prenatal smoking research as univariate measures of income, education, or employment status, but in reality it is a multidimensional construct that subsumes many different variables. Measuring SES in research poses challenges. Composite measures of SES are not frequently used, but should be considered. Pragmatic research considerations are also important. Decisions about how to collect SES data may depend on what kind of data are available, the time that is available, or a desire for comparability with previous research (Adler & Ostrove, 1999; Oakes, n.d.).

Two considerations are critical, particularly for research pertaining to prenatal smoking. Research goals must be clear. Univariate measures may lend themselves to clearer policy implications. For example, if low levels of education are the indicator of

prenatal smoking, policy implications can be directed toward improving education levels. Composite levels of SES are harder to transform into practical implications (Oakes, n.d.). Secondly, if univariate measures are used, they require a clear understanding of the social context of the population under study. For example, this review suggests that unemployment may not be the best SES indicator for prenatal smoking because in several studies, a majority of the participants were working for pay. Social contexts are fluid, therefore parameters around social and even demographic variables may change. Examples like this stress the importance of choosing univariate indicators wisely. SES is a difficult concept to capture. Future prenatal health research may benefit from conceptual development of the SES construct specifically for this context.

Low SES women are not a homogenous group. Only a few of the studies reviewed examine differences in subgroups within the low SES population. More studies like that of Jesse et al. (2006) examining differences between Black and White low SES prenatal smokers or Song and Fish's (2006) examination of characteristics of Appalachian prenatal smokers will further our understanding of the diversity within this population.

Research participation must also reflect this diversity. Among women receiving Medicaid, Asian and Hispanic women were less likely to enroll in an intervention trial (Ruggiero, Webster, Peipert, & Wood, 2003). The women were also less likely to enroll in a program if they were recent quitters or had reduced their smoking. Ensuring a sufficient sample of underrepresented groups will require creative research approaches.

An item for further consideration and research is the investigation of first-time smoking in low SES pregnant women. Webb et al. (2011) found that 10% of women

who had not previously smoked began smoking either during pregnancy or postpartum. Associated characteristics mirror risk factors for prenatal smokers and include low SES indicators, stressful life events (like a recent utility shutoff), depressive symptoms, and higher levels of perceived stress. There is little research on this population of women. Further research is warranted, especially since these women may be missed by prenatal providers in terms of smoking cessation/prevention interventions.

An important consideration both for research and practice is biomarker verification of smoking status. Webb, Boyd, Messina, and Windsor's (2003) study of smoking status verification in low-income pregnant smokers revealed that approximately 70% of women had urine cotinine levels inconsistent with their self-report status. Self-report may not be a reliable indicator of smoking status in the low-income pregnant population. Providers who rely on self-report may miss important opportunities to provide interventions to prenatal women smokers. Researchers who use self-report in this population risk unreliable results. The majority of studies in this review measured smoking status using some form of biochemical verification. The most predominant was salivary cotinine, followed by urine cotinine. Four studies used carbon monoxide testing and nine studies relied on self-report.

Conclusion

Many of the variables associated with low SES prenatal smokers in these reviews are long-standing determinants of maternal smoking found in the general prenatal smoking literature. This review adds new perspectives to some of these existing variables. Traditional variables of marital status may need to be reinterpreted in a low SES context where marital relationships are much more fluid. Stress, known to be

strongly associated with prenatal smoking looks different in a low SES context when factors like perceptions of neighborhood safety are incorporated. Variables that have not been common in prenatal smoking literature, like abuse, problem behavior, and lack of transportation were uncovered in this review.

The Clinical Practice Guidelines published by the United States Department of Health and Human Services acknowledge that low SES individuals “bear a disproportionate burden from tobacco” and that reducing this disparity “is an important part of improving the overall health of the American public” (Fiore et al., 2008, p. 151). Targeting research and intervention efforts on this subpopulation who are at greatest risk may be the best use of scarce research and healthcare dollars and result in the most meaningful and cost-effective improvement in prenatal smoking rates (Adams et al., 2008).

Table 1

Studies of Prenatal Smoking in Low SES Women

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Adams et al., 2008	Use PRAMS data to compare low-income and high income prenatal smokers on prevalence, quit and relapse rates; economic, socio-demographic characteristics, access, stress, and risk behavior patterns	<ul style="list-style-type: none"> • Descriptive comparative design • State-level population-based surveillance data from the CDC • Survey of maternal behaviors, experiences in 21 states. 	<p>Compared to higher income smokers, more low-income smokers reported:</p> <ul style="list-style-type: none"> • Uninsured pre-pregnancy • Clinic as usual source of care • Transportation as barrier to prenatal care • Pre-pregnancy binge drinking • Stress related to physical fights and drugs • Abuse before and during pregnancy
Bullock et al., 2009	Test the combination effect of a nurse delivered telephone intervention and mailing intervention on prenatal smoking cessation	<ul style="list-style-type: none"> • RCT • $N = 695$ low-income rural pregnant smokers attending WIC clinics 	<ul style="list-style-type: none"> • Majority of sample: Caucasian, married, and multiparous • Most reported serious intention to quit during the pregnancy and in the next 30 days. • Most women's nicotine dependence level decreased early in pregnancy. • High levels of perceived stress, depression • Low levels of social support, both general and from partner

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Caine et al., 2012	Evaluate impact of prenatal education by case managers on breastfeeding and smoking cessation	<ul style="list-style-type: none"> • Longitudinal prevalence design • Healthy Start program data ($n = 512$) and County Health Department birth certificate data ($n = 55247$) for Jan. 2007 to Dec. 2009 	<p>Predictors of prenatal cessation in the third trimester:</p> <ul style="list-style-type: none"> • Advanced education • Breastfeeding on discharge from hospital • Enrollment in Healthy Start
Cluss et al., 2011	Describe results of a community based, evidence-informed dissemination intervention for low-SES pregnant smokers.	<ul style="list-style-type: none"> • Descriptive study • $N = 856$ • 90% Medicaid or uninsured • 93% current smokers and 7% recent quitters 	<p>Factors associated with cessation:</p> <ul style="list-style-type: none"> • Race, age, nicotine dependence • Number of intervention sessions attended
Crittenden et al., 2007	<ul style="list-style-type: none"> • Assess how pregnancy and exposure to clinic smoking interventions affected smoking outcomes through mediators of perceived stress and health concerns • Smoking outcomes were abstinence, stage of readiness, motivation, action, self-efficacy, and confidence 	<ul style="list-style-type: none"> • Longitudinal cohort design • $N = 943$ low SES smokers from public health clinics 	<ul style="list-style-type: none"> • Perceived stress negatively related to all smoking outcomes • Pregnancy favorably influenced all smoking outcomes except for confidence. • Exposure to intervention only affected motivation. • Health concerns positively related to all smoking outcomes • Pregnancy increased a woman's Health concerns and decreased perceived stress. These two variables mediated the effect of pregnancy on smoking outcomes.

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Dornelas et al., 2006	Comparison of smoking outcomes between usual care group and group receiving intervention of counseling plus telephone follow-up	<ul style="list-style-type: none"> • RCT • $N = 105$ low-income predominantly Hispanic smokers at urban prenatal clinic 	<ul style="list-style-type: none"> • Majority of subjects were multiparous and unmarried • CPD at baseline ≤ 10, down from pre-pregnancy smoking rate of 20.8 • Majority smoked within 30 min. of waking • Majority started smoking before age 16 years
Eiden et al., 2013	Examination of differences on demographics, psychopathology and smoking outcomes among low income pregnant women with different smoking trajectories	<ul style="list-style-type: none"> • Descriptive comparative design • $N = 215$ urban pregnant smokers 	<p>Persistent smokers had:</p> <ul style="list-style-type: none"> • Highest demographic and mental health risks • Higher cravings • More likely to endorse smoking to reduce negative affect
Flick et al., 2006	Examine association between prenatal tobacco use and psychiatric disorders	<ul style="list-style-type: none"> • Descriptive correlational study • $N = 744$ African American and White low-income women living in urban and rural areas recruited from WIC programs 	<ul style="list-style-type: none"> • Majority of smokers were never married, multiparous, and White. • Persistent smokers showed increased likelihood of having anxiety disorder, affective disorder, behavior disorder, or use of alcohol or illicit drugs. • Prenatal smokers were 2 to 2.5 times more likely to have a psychiatric disorder compared to non-smokers.

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Higgins et al., 2009	Examine influence of education status on prenatal smoking cessation, prenatal smoking abstinence, and postpartum smoking abstinence	<ul style="list-style-type: none"> • Secondary analysis of RCT • $N = 316$ • WIC recipients • 35% spontaneous quitters and 65% current smokers 	<p>Predictors of spontaneous cessation:</p> <ul style="list-style-type: none"> • Education level • Pre-pregnancy CPD • Withdrawal score • SHS in home • Stress level <p>Predictors of third trimester abstinence:</p> <ul style="list-style-type: none"> • Pre-pregnancy CPD • Intervention • Pre-pregnancy quit attempts • Withdrawal score
Holtrop et al., 2010	Examine factors associated with continued smoking and quitting among pregnant women	<ul style="list-style-type: none"> • Descriptive survey design • $N = 2,203$ Medicaid-eligible women • 57% non-smokers, 17% quitters, and 26% smokers 	<p>Factors strongly related to persistent smoking:</p> <ul style="list-style-type: none"> • Mental health history • Stress • Demographics (unmarried, not African American) • Current alcohol abuse • Past drug use
Homish et al., 2012	Examine the impact of pre-conception social-environment influences on smoking cessation during first trimester pregnancy	<ul style="list-style-type: none"> • Longitudinal descriptive survey • $N = 316$ low-income smokers in a prenatal clinic at large urban hospital 	<p>Controlling for pre-conception heaviness of smoking, factors that increase likelihood of prenatal smoking:</p> <ul style="list-style-type: none"> • Partner smoking status • Friends smoking status • Frequency of exposure to environmental smoke

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Jesse et al., 2006	Determine the associations between sociodemographic, psychosocial, and spiritual factors to health risk behaviors during pregnancy	<ul style="list-style-type: none"> • Descriptive study • $N = 130$ ethnically diverse low-income women from an urban prenatal clinic • 39% smokers • 28% substance abusers 	<ul style="list-style-type: none"> • Black prenatal smokers: less social support, higher stress levels and more frequent substance use • White prenatal smokers: more likely to use illicit substances • Significant predictors of smoking in the aggregate were: White race, less than high school education, abuse, and religiosity.
Morasco et al., 2006	Comparison of characteristics of spontaneous prenatal smokers from current smokers	<ul style="list-style-type: none"> • RCT • $N = 141$ low-income, predominantly Hispanic women • 23% spontaneous quitters 	Spontaneous quitters: <ul style="list-style-type: none"> • Higher self-confidence • Fewer CPD • Younger age
Nichter et al., 2007	Document smoking trajectories and factors contributing to, or undermining harm reduction and quit attempts	<ul style="list-style-type: none"> • Ethnographic analysis • $N = 53$ low-income, WIC eligible, pregnant smokers from a large metropolitan area • 30% quitters; 43% reducers; 26% persistent smokers 	<ul style="list-style-type: none"> • Majority White, single, multiparous • Quitter characteristics: stable living arrangements; support to quit smoking; moral identity as mother • Persistent smoker characteristics: frequent shifts in residence; lack of social and financial support; high rates of depression

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Ockene et al., 2002	Describe the prevalence of spontaneous cessation and alcohol use alone and in combination and associated factors	<ul style="list-style-type: none"> • Secondary analysis of RCT • $N = 601$ low-income smokers pregnant participating in WIC 	Characteristics of spontaneous quitters: <ul style="list-style-type: none"> • Primiparous; Non-Black • Non-smoking partner • Not native to US • Greater than high school education • Lower nicotine dependence • Reported higher perceived risk to fetus • Did not report “too many other problems in life to stop” (p. 150)
Parker et al., 2007	Evaluate the feasibility and cost-effectiveness of a telephone-based motivational smoking cessation intervention for underserved pregnant smokers	<ul style="list-style-type: none"> • RCT • $N = 358$ pregnant smokers 	<ul style="list-style-type: none"> • Overall sample was predominantly White • Predictors of prenatal smoking cessation: <ul style="list-style-type: none"> ○ Exposure to SHS from family and friends; ○ At least one 7-day quit attempt ○ Receipt of full intervention
Patterson et al., 2012	Examine effects of self-reported neighborhood violence and perceived safety on tobacco use	<ul style="list-style-type: none"> • Descriptive cross-sectional design • $N = 1,521$ low income, minority pregnant women being treated at urban emergency room • 22% smokers 	Smoker characteristics: <ul style="list-style-type: none"> • Majority partnered; working for pay • Mild to moderate depressive symptoms • PSS-10 score 6.8 (compared to 6.0 in nonsmokers) • Majority do not have routine prenatal visits • Majority report lifetime use of marijuana • Majority report violence every day or some days • Self-reported neighborhood violence independent predictor of prenatal smoking

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Pbert et al., 2004	Evaluate the effect of provider/clinic intervention on prenatal smoking rates at delivery and postpartum	<ul style="list-style-type: none"> • RCT • $N = 601$ • Low-income current smokers or spontaneous quitters receiving WIC services and prenatal care at community health center • 27.7 – 29.8% were spontaneous quitters. 	<p>Sample characteristics:</p> <ul style="list-style-type: none"> • White, unmarried, primiparous • Mean CPD was 14.89 – 18.43 • Majority had a TTF < 30 minutes.
Petersen et al., 2005	Describe characteristics associated with reporting discussion of smoking with providers among pregnant smokers receiving Medicaid	<ul style="list-style-type: none"> • Descriptive comparative design • PRAMS data for 20,287 women across 15 states between 1998 – 2000 	<ul style="list-style-type: none"> • Smoker characteristics: primarily White, unmarried, multiparous, adequate prenatal care, reported discussion about smoking with their provider. • Discussions had a negative impact on quitting and no impact on abstinence
Petersen et al., 2006	Evaluate association between levels of Medicaid coverage for prenatal smoking cessation interventions on prenatal quitting and postpartum abstinence	<ul style="list-style-type: none"> • Descriptive population based survey design • PRAMS data for 7,513 women from 15 states during 1998 – 2000 • Three levels of coverage for prenatal smoking cessation: Extensive, some, or none 	<ul style="list-style-type: none"> • Medicaid insured smokers primarily White, unmarried, and employed • Higher levels of coverage was associated with higher quit rates

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Pickett et al., 2002	Examine whether local-area characteristics increase risk of prenatal smoking	<ul style="list-style-type: none"> • Descriptive design using chart review and geocoding • <i>N</i> = 878 pregnant women in California • 18% smokers at first prenatal visit 	Predictors of prenatal smoking: <ul style="list-style-type: none"> • Neighborhood working class status • Working class family • Unemployment • Less than high school education • Unmarried • Publicly insured
Pletsch, 2002	Evaluate effectiveness of a moderately intensive community-based smoking cessation program for pregnant women	<ul style="list-style-type: none"> • Two-group longitudinal, RCT • <i>N</i> = 74 Black smokers residing in metropolitan Milwaukee, WI 	<ul style="list-style-type: none"> • Mean CPD of sample was 8.3 • Age of smoking onset = 16 years. • Majority of smokers less than high school education with an annual income of < \$15,000, and an average of 2 other smokers in the household
Pletsch et al., 2003	Describe context and beliefs surrounding smoking cessation	<ul style="list-style-type: none"> • Descriptive naturalistic qualitative design • <i>N</i> = 15 low-income Black pregnant smokers 	<ul style="list-style-type: none"> • Sources of stress included parenting challenges, disruptive home environments, violent neighborhoods, low social support, personal health problems. • Smoking was a source of stress management. • Participants identified personal will as major factor for cessation. • “Living the stressful life” and “personal accountability for smoking cessation” identified as two main themes

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Roberts-Clarke et al., 2002	Identify variables associated with smoking status in low-income pregnant Latina and White women	<ul style="list-style-type: none"> • Descriptive comparative design • <i>N</i> = 198 low-income pregnant smokers from six urban obstetrics clinics • 71.8% White and 28.2% Latinas 	<ul style="list-style-type: none"> • Aggregate characteristics: unemployed, had parents who smoke and had partners who smoke • White women: higher CPDs; more likely to have smoking partners compared to Latinas
Ruger et al., 2008	Examine the cost-effectiveness of motivational interviewing in low-income current smokers and recent quitters	<ul style="list-style-type: none"> • RCT • <i>N</i> = 302 current smokers or recent quitters 	<p>Sample characteristics:</p> <ul style="list-style-type: none"> • White, unmarried, completed high school • Primarily state health insurance • Age of smoking onset was between 14 and 17 for most women
Ruggiero et al., 2000	Comparison of the constructs of the Transtheoretical Model between low-income pregnant and nonpregnant smokers	<ul style="list-style-type: none"> • Descriptive comparative design with matched groups • <i>N</i> = 206 equally divided between pregnant and nonpregnant low-income smokers from five community health clinics in New England metropolitan area 	<p>Pregnant smoker characteristics:</p> <ul style="list-style-type: none"> • Primarily White, single • Lower CPD compared to non-pregnant smokers (10.7 to 15.4) • Less negative attitude toward smoking • More tempted in habit-related situations • Made less use of experiential processes of change compared to non-pregnant women

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Scheibmeir et al., 2005	Identify factors associated with ex-smokers' use of smoking cessation strategies	<ul style="list-style-type: none"> • Descriptive cross-sectional design • $N = 58$ primarily low-income spontaneous quitters 	Motivation to quit smoking is the only significant factor explaining use of smoking cessation strategies
Solomon & Flynn, 2005	Description of a statewide telephone peer-support system to help low-income pregnant women quit smoking	<ul style="list-style-type: none"> • Univariate descriptive design • $N = 948$ low-income pregnant smokers referred from WIC in Vermont from October 1994 to December 2000 	<ul style="list-style-type: none"> • CPD pre-pregnancy was 24 • At prenatal WIC visit, CPD was 10.7
Song & Fish, 2006	Investigate demographic and psychosocial characteristics of prenatal smokers and nonsmokers in low-socioeconomic status, rural Appalachian 2-parent families	<ul style="list-style-type: none"> • Descriptive cross-sectional survey design • $N = 92$ women recruited from community health care center in Lincoln County, WV 	Prenatal smokers characteristics: <ul style="list-style-type: none"> • Less likely to have completed high school • Less extroverted • Lower self-esteem • Less intimate support • More negative marital relationship
Stotts et al., 2004	Assess the impact of a motivational intervention on TTM based mechanisms of change	<ul style="list-style-type: none"> • RCT • $N = 54$ • Low-income pregnant smokers attending a public clinic 	<ul style="list-style-type: none"> • Majority of women were in contemplation or preparation stage of change • Low to moderate mean self-efficacy • Mild to moderate depression • Increased confidence, decreased temptation, and decreased depression

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Wakschlag et al., 2003	Examine whether persistent pregnancy smoking is associated with a pattern of psychosocial risk and health-compromising behaviors	<ul style="list-style-type: none"> • Descriptive comparative design • $N = 96$ predominantly Caucasian, working-class pregnant women • 37% nonsmokers • 17% pregnancy quitters • 46% persistent smokers 	<ul style="list-style-type: none"> • Persistent smokers (compared to nonsmokers and quitters): <ul style="list-style-type: none"> ○ Younger at onset of smoking ○ Higher CPD ○ Lower income ○ More children ○ More likely to have problematic relationships, poorer adaptive functioning, and problematic health behaviors • Both quitters and smokers more likely to be single compared to non-smokers.
Ward et al., 2006	Examine race-specific differences in correlates of cessation in low income pregnant women	<ul style="list-style-type: none"> • Descriptive comparative design • $N = 248$ low income Black and White pregnant women who smoked regularly prior to pregnancy • Recruited from area WIC clinics and obstetric services of an inner-city public hospital 	<ul style="list-style-type: none"> • Predictors of prenatal cessation were the same for both racial groups: <ul style="list-style-type: none"> ○ Higher income ○ Fewer previous pregnancies ○ Older age of smoking onset ○ Lower nicotine dependence level ○ Greater success at previous quit attempts ○ Less exposure to in-home SHS ○ Reported greater motivation to quit because smoking was a hassle • Differences between racial groups in income, education level, marital status, nicotine dependence, and smoking history

Authors, Year	Purpose	Design/Sample	Factors/Predictors Characteristics Associated with Low SES Prenatal Smokers
Webb et al., 2011	Determine prevalence and associated characteristics of first lifetime use of cigarettes during pregnancy or postpartum	<ul style="list-style-type: none"> • Secondary analysis of longitudinal study • Descriptive comparative design • $N = 1,676$ low-income urban women 	<p>First time smokers:</p> <ul style="list-style-type: none"> • More likely to have lower income, be unmarried, and be less educated than non-smoker group • 10.2% of women initiated smoking in pregnancy or postpartum • Other associated characteristics include high stress level and depressive symptomatology
Wen et al., 2012	Examine barriers associated with non-adherence to smoking cessation counseling	<ul style="list-style-type: none"> • RCT • $N = 277$ low income minority inner city smokers 	<ul style="list-style-type: none"> • Participants primarily single, multiparous, mean CPD of 9.2 with an average of 6.6 quit attempts in the past year • Overall low self-efficacy level and low mood disturbance • Prenatal non-adherence predicted by increased CPD
Woodby et al., 1999	Determine predictors of smoking cessation	<ul style="list-style-type: none"> • Secondary analysis of a randomized control trial of a smoking cessation intervention. • Current study uses a descriptive design • $N = 435$ pregnant Medicaid recipients 	<p>Predictors of smoking cessation at third trimester:</p> <ul style="list-style-type: none"> • Baseline cotinine values • Duration of smoking habit • Self-efficacy • SHS exposure • Patient education methods

CHAPTER III
CRITICAL REVIEW OF MEASURES OF NICOTINE DEPENDENCE IN
PERINATAL WOMEN

Introduction

The purpose of this paper is to present a critical review and psychometric analysis of measures of nicotine dependence in women during the perinatal period. Tobacco use remains the leading cause of preventable disease, disability and death in the United States (CDC, 2011). Perinatal populations are not spared the morbidity impact of tobacco use. Although smoking rates among pregnant women in the U.S. have seen an overall decline in the last two decades – from 18.4% to 10.2% (Adams et al., 2008) – this rate still far exceeds the desired goal set by the World Health Organization’s Healthy People 2020 of 1.4% (United States Department of Health and Human Services [USDHHS], Healthy People 2020, 2012). Furthermore, we know that the decline in pregnancy smoking rates varies by region. Louisville’s Office of Policy Planning and Evaluation (2007) reported that 29% of women in the city smoke during pregnancy.

The negative consequences of tobacco use during pregnancy are widely known (Oncken et al., 2010) and efforts to provide prenatal smoking cessation interventions are well-documented (Lumley et al., 2009). Some concerted efforts are aimed at addressing

smoking behavior in the postpartum period with an emphasis on smoking relapse prevention (French, Groner, Wewers, & Ahijevych, 2007; Gaffney, Baghi, Zakar, & Sheehan, 2006). Postpartum interventions address the maternal morbidities and neonatal concerns related to secondhand smoke exposure associated with the continued smoking of the mother in the postpartum period. Secondhand smoke (SHS) exposure for newborns increases their risk for Sudden Infant Death Syndrome, respiratory infections, ear infections and asthma – in addition to increasing their risk for the long-term consequences of heart disease and lung cancer (CDC, 2011).

Despite current efforts to address perinatal smoking behavior, there is not a clear conceptual understanding of nicotine dependence, the role it plays in smoking persistence, and how it should be measured in pregnant and postpartum women. This paper will explore conceptual definitions of nicotine dependence and provide an overview of the state of the measurement of this concept. The three most commonly used measures of nicotine dependence in perinatal smoking studies will be described and their psychometric properties will be evaluated. Finally, recommendations will be given for new directions in the measurement of nicotine dependence among women in the perinatal period.

Conceptual Definition of Nicotine Dependence

Establishing a clear conceptual definition of nicotine dependence is not easily achieved. The literature indicates some ambiguity and controversy about the definition of nicotine dependence, and its role in smoking behavior. This section will begin by exploring theoretical frameworks for nicotine dependence and then delineate a conceptual definition of this construct for the purpose of this paper.

Theoretical Framework: Exposure vs. Sensitivity

Two theoretical frameworks are useful in understanding the mechanism of nicotine dependence. Both explain dependence in terms of sensitivity and exposure. The traditional framework is the “exposure model” (Pomerleau, Collins, Shiffman, & Pomerleau, 1993). In this model, continued exposure to nicotine is dependent on the initial sensitivity response. A highly sensitive response results in an adverse reaction (nausea, cough, and dizziness). This, in turn, leads to smoking avoidance and results in lower exposure and less opportunity to develop tolerance. An initially decreased sensitive response, in the presence of social and environmental facilitators of smoking, would lead to increased exposure, increased tolerance, and eventual progression to some level of nicotine dependence (Pomerleau et al., 1993). Continued exposure according to the model depends on the level of an individual’s sensitivity. Increased exposure leads to increased tolerance, which ultimately leads to nicotine dependence.

Challenging the exposure model is the “sensitivity” model, which suggests that individual sensitivity rather than exposure drives nicotine dependence. In this model, a highly sensitive individual experiences a combination of adverse and rewarding effects from initial exposure. With increased exposure to nicotine in the environment, tolerance increases and the individual becomes highly dependent on nicotine; however, an individual with low sensitivity experiences minimal effects from nicotine. Regardless of exposure this individual will experience little change in reaction resulting in either non-smoking or at most mild dependence (Pomerleau et al., 1993). Thus, individual sensitivity directly drives dependence regardless of exposure.

Whether sensitivity or exposure drives nicotine dependence, individual sensitivity to nicotine varies and diminishes with increased exposure (Pomerleau et al., 1993). Reduction in sensitivity due to exposure or tolerance also varies among individuals (Pomerleau et al.). Both models acknowledge the importance of a “facilitating environment” suggesting that nicotine dependence is a result of both biological and behavioral adaptations.

The Concept of Dependence

The terms “dependence” and “addiction” refer to the compulsory intake of tobacco (USDHHS, 2010); however definitions of both terms are unclear. Atrens (2001) describes the difficulty of conceptually defining addiction and related terms. Addiction has broad and varied use in the scientific and popular literature. People are described as being “addicted” to a variety of substances from pharmacological agents to food, and even love (Atrens). Two key sources, including the US Surgeon General’s Report on nicotine addiction (USDHHS, 1988) and the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) (USDHHS, 2010) provide guidance in understanding the concept of addiction as it relates to nicotine.

Guiding criteria in common to both of these sources include: compulsive use; psychoactive effects; tolerance and/or drug-reinforced behavior; patterns of use despite known harmful effects; relapse following abstinence and unsuccessful efforts to quit; recurrent cravings; and physical dependence.

Nicotine Dependence

The discussion regarding nicotine dependence must start with evaluating the impact of “nicotine.” Evidence suggests that nicotine may not have the primacy it was

originally thought to have in understanding smoking behavior. Studies such as the one by Rose, Behm, Westman, and Johnson (2000) showed that denicotinized cigarettes are similar to those containing nicotine in terms of the resulting satisfaction, psychological reward, and reduction of cravings. In a review of literature on the self-administration of pure nicotine, Dar and Frenk (2004) strongly proposed that both smokers and non-smokers failed to show a preference for nicotine over placebo. Finally, despite the availability of nicotine replacement therapy (NRT) for the past two decades, the impact on smoking cessation has been marginal (Rose, 2006). This suggests to some researchers (Atrens, 2001; Dar & Frenk, 2004; Rose, 2006) that there are other factors beyond nicotine dependence that play an important role in tobacco addiction.

Despite this growing body of evidence, most researchers still maintain that nicotine is a powerful, reinforcing factor essential to understanding smoking behavior (Benowitz, 2010; Dar & Frenk, 2004; Rose, 2006). Authorities such as the US Surgeon General have even declared nicotine to be as addictive as heroin or cocaine (Dar & Frenk, 2004; USDHHS, 1998). The brief review below describes the construct of nicotine dependence as a critical, but not necessarily primary determinant of smoking persistence.

In addition to cigarettes, a variety of emerging products offer a vehicle of delivery for the ingestion or absorption of nicotine. These include: Snus, other dissolvable tobacco products, e-cigarettes, and hookah (McMillen, Maduka, & Winickoff, 2012). This paper focuses only on the use of traditional cigarettes in the measurement of nicotine dependence.

Nicotine dependence is a hypothetical and multidimensional construct that includes outcomes of heavy smoking, inability to quit, and other issues associated with

tobacco dependence (World Health Organization [WHO], 2008). Despite the challenges of defining this construct, it is believed that the degree of dependence on nicotine varies among smokers and that it can be measured. The measurement of this construct has potentially important implications for treatment and success of smoking cessation (Breslau & Johnson; Seidner & Burling, 2003). A reliable and valid measure of nicotine dependence is critical to the field.

Overview of the Measurement of Nicotine Dependence

There are various approaches to the measurement of nicotine dependence which can be divided into three categories: diagnostic, self-report, and biomarker.

Diagnostic Approach

Formal diagnostic systems guide clinicians in classification, treatment, and prognosis. The most commonly used are the *Diagnostic and Statistical Manual of Mental Disorders 4th edition (DSM-IV)* and the *International Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)*. Both require the manifestation of a certain number of symptoms which encompass physiological, psychological, and behavioral features of dependence including: unsuccessful quit attempts, time spent using and/or procuring cigarettes, neglect of important social activities, use in spite of negative consequences, and presence of withdrawal symptoms (Colby, Tiffany, Shiffman, & Niaura, 2000). In addition, there are diagnostic structured interview instruments such as the tobacco portion of the National Institute on Mental Health-Diagnostic Interview Schedule (NIMH-DIS). These structured surveys are designed to aid with clinical diagnosis and research methods (Colby et al., 2000). Diagnostic classification systems pose several challenges including the popular connotation of

diagnosis as established medical fact; the need for changing measures when diagnostic criteria change; heterogeneity among individuals within a diagnostic class; and arbitrary cut-offs defining dependence as a particular number of defined features (Colby et al.). Because of these limitations, diagnostic systems may not be useful for measurement in research (Colby et al.).

Self-report instruments are most commonly used to measure nicotine dependence. The most widely used self-report measure of nicotine dependence is the Fagerström Tolerance Questionnaire (FTQ) along with its variants (Fagerström, 1978; Heatherton, Kozlowski, Frecker, & Fagerström, 1991; Heatherton, Kozlowski, Frecker, Rickert & Robinson, 1989). Other nicotine dependence instruments include: the Cigarette Dependence Scale (CDS; Etter, Le Houezec, Perneger, 2003), the Nicotine Dependence Syndrome Scale (NDSS; Shiffman and Balbanis, 1995), the Wisconsin Inventory of Smoking Dependence Motives (WISDM; Piper, McCarthy, & Baker, 2006), and the Hooked on Nicotine Checklist (HONC) (DiFranza et al., 2002). Self-report approaches offer inexpensive, non-invasive, confidential, and potentially reliable and valid measures to evaluate the construct of nicotine dependence (Seidner & Burling, 2003). In addition, they may be able to capture various facets of smoking behavior thereby reflecting the multidimensional qualities of the construct of nicotine dependence.

Disadvantages of self-report methods include potential over- or underestimation of smoking habits, and socially conditioned responses due to environmental or social pressure (Sharma, 2008). For example, biomarker validation studies demonstrated that pregnant women may conceal their smoking behavior (Ford, Tappin, Schluter & Wild, 1997; Klebanoff, Levine, Clemens, DerSimonian, & Wilkins, 1998; Webb, 2003).

Cnattingius (2004) suggests this may be due to negative public attitudes toward prenatal smoking.

Single-item measures of nicotine dependence are commonly used in large survey studies to assess two dimensions of dependence: consumption of cigarettes (cigarettes smoked per day or CPD) or the time to first cigarette upon waking (TTF). The advantages of single item measures are primarily pragmatic when sample sizes are large and measurement of a wide range of behaviors in a short period of time is the goal. Disadvantages of this approach include a lack of consensus on the choice of the best single item and the inability to capture the complexity of a multidimensional construct such as nicotine dependence (Colby et al., 2000).

Some research uses biomarkers in body fluids as an “objective index of dependence” (West, 2004, p. 338). Biomarkers provide an accurate measure of nicotine or tobacco consumption. Cotinine assays are most frequently used in perinatal populations to validate smoking status or SHS exposure. Cotinine tested in saliva (Montalto & Wells, 2007), plasma (Kvalvik et al., 2012), neonatal hair (Sørensen, Bisgaard, Stage, & Loft, 2007), and maternal hair (Ashford & Westneat, 2012) are strongly associated with prenatal tobacco use and SHS exposure. Meconium may also be a useful biological matrix for measuring prenatal tobacco use and SHS exposure (Braun et al., 2010).

Biological measures, while helpful in capturing use and exposure, are not an adequate measure of the complex construct of nicotine dependence. Although CO measurement is an easy, useful, and inexpensive method for obtaining objective data from smokers, it measures smoke intake over preceding hours not nicotine breakdown in

the body. Kapusta and colleagues (2010) found that exhaled CO levels served as a satisfactory means of discriminating between smokers and non-smokers, but they did not distinguish adequately among different levels of nicotine dependence.

Biological measures do have advantages as validators of nicotine dependence. First, they are continuous measures that can be quantified. Second, they can be reliably and validly measured. Third, as indicators of exposure, they play an important role in the framework of nicotine dependence since dependence cannot develop in the absence of exposure (Colby et al., 2000). For these reasons, biological measures of nicotine in body fluids serve to validate measures of dependence and are frequently used for that purpose (Pomerleau, Pomerleau, Majchrzak, Kloska, and Malakuti, 1990). Biochemical validation may be especially useful in intervention studies to validate self-report with low-income women (Webb et al., 2003), student populations, and when using self-administered rather than interviewer-administered questionnaires (Patrick et al., 1994).

Disadvantages include the obtrusiveness in obtaining a physical specimen and the cost of the analysis. Despite their reported objectivity, there are threats to their reliability and validity. For example, CO can be elevated in non-smokers exposed to secondhand smoke (Kumar et al., 2011) and to certain poorly functioning domestic heating systems (Cox & Whichelow, 1985). Biomarkers such as cotinine are also susceptible to variability in individual metabolism (Benowitz, 2010).

Existing Measures of Nicotine Dependence Used in Studies of Perinatal Women

Nicotine dependence is not widely measured in studies of smoking behavior in perinatal populations. The primary focus is on measurement of smoking exposure and abstinence. Studies that did examine nicotine dependence in perinatal populations

predominantly used versions of the Fagerström Tolerance Questionnaire (FTQ), the Fagerström Test for Nicotine Dependence (FTND), and the Heaviness of Smoking Index (HSI).

Fagerström Tolerance Questionnaire (FTQ)

The FTQ is an 8-item paper and pencil questionnaire developed to measure a person's dependency on nicotine as an aid in treatment decisions (Fagerström, 1978; Fagerström & Schneider, 1989). The items were developed from theoretical notions of reliance on nicotine. Items focus on: consumption of cigarettes (CPD) (higher number is indicative of greater dependence); brand of cigarettes (higher nicotine content is indicative of greater dependence); and depth of inhalation (deeper inhalation assumes higher availability of nicotine which points to higher dependence). Two of the items are related to difficulty dealing with smoking restrictions such as refraining from smoking in forbidden places and smoking when ill (i.e., frequent urges when these external restrictions are applied indicates higher dependence). The remaining three items are dichotomous and relate to the number of cigarettes smoked early in the day, including time to first cigarette (TTF) (≥ 30 min. [0] or ≤ 30 min. [1]), which cigarette the subject would most hate to give up (Any other [0] or First of day [1]), and whether or not the subject smokes more frequently during the morning compared to the rest of the day (No [0] or Yes [1]). Scores are summed and range from 0-11. Higher scores indicate a greater degree of dependence (Radzius, Moolchan, Henningfield, Heishman & Gallo, 2001; Seidner & Burling, 2003; Sharma, 2008).

The FTQ has consistently shown good predictive validity compared with other measures of nicotine dependence. For example, FTQ scores predicted successful

cessation in the absence of NRT (Fagerström & Schneider, 1989). In the general population of smokers, higher FTQ scores were associated with greater levels of biochemical markers of nicotine dependence including CO, cotinine, and nicotine levels (Fagerström & Schneider, 1989). Correlations between FTQ scores and cotinine biomarker in a sample of healthy subjects was significant ($n = 136$, $r = .35$, $p < .001$).

In spite of the instrument's predictive validity and associations with biomarker levels, the internal consistency of the FTQ is low across samples. Pomerleau et al. (1994) found acceptable test-test reliability but low internal reliability coefficients in two samples. Cronbach's alpha for healthy American smokers was .47 ($n = 237$). The alpha coefficient was .61 in French smokers with depression ($n = 36$).

Seidner and Burling (2003) tested the FTQ among male drug/alcohol dependent smokers and found an alpha coefficient of .49. Factor analysis yielded a two-factor solution consisting of "morning smoking" and "smoking pattern" dimensions (p. 631) which accounted for 52% of the item variance. Thus, the low alphas may be attributable to the measurement of more than one underlying dimension by the FTQ.

Among studies using FTQ in perinatal populations, only one out of the five reported psychometric properties (see Table 2). Albrecht et al. (1999) measured nicotine dependence in pregnant adolescents. Cronbach's alpha was .61 and the FTQ was significantly associated with salivary cotinine levels ($r = .49$, $p < .01$). Due to the lack of psychometric reporting on the FTQ in the perinatal studies reviewed, it is difficult to come to conclusions about its reliability and validity in perinatal research. However, the psychometric properties reported by Albrecht et al. suggest that the internal consistency and validity of the FTQ mirror those reported by the general population (Cronbach's

alphas range: .47-.61) (Pomerleau et al., 1994; Seidner & Burling, 2003). In summary, the FTQ appears to have mediocre reliability yet displays evidence of validity as a self-report measure of nicotine dependence.

Fagerström Test for Nicotine Dependence (FTND)

In 1991, the FTQ was revised in order to address some of the psychometric issues described previously (Seidner & Burling, 2003, p. 1124). The items of nicotine rating and inhalation did not load on either of the previously identified factors. As a result, the two non-loading items were eliminated. Factor analysis of the remaining 6-item scale (the FTND) supported the homogeneity of the items (Heatherton, 1991). In addition, the scoring was revised for two items. Responses for the TTF are now given on a 4-point scale ranging from > 60 minutes (0) to ≤ 5 minutes (3). CPD responses are also given on a 4-point scale ranging from ≤ 10 cigarettes (0) to ≥ 31 cigarettes (1) (Heatherton et al., 1991). Scores are summed for a total range of 0-10. Higher scores indicate greater dependence. The Flesch-Kincaid Reading Grade Level of the FTND is 4.4 (WHO, 2008). The measure is available in several languages and is used internationally (WHO, 2008).

The revisions made by Heatherton et al. (1991) yielded greater predictive ability of the FTND than the original FTQ. In a non-clinical sample of smokers, Heatherton et al. (1991) reported that the FTND corrected some of the psychometric and conceptual problems of the FTQ including better internal consistency with a coefficient alpha of .61. This is a considerable improvement on the alpha of .48 for the FTQ in the same sample. The FTND had marginally improved psychometric properties in other studies. Pomerleau et al. (1994) found slightly better reliability of the FTND compared to the

FTQ (.64 vs. .58) in a subset of their sample of healthy American smokers. Likewise, Seidner and Burling (2003) found improved reliability coefficients when comparing the FTND with the FTQ (.59 vs. .49) in their sample of male drug/alcohol dependent smokers. Although a Cronbach's alpha of .59 is low, considering the FTND only has six questions (compared to eight for the FTQ), the difference may be considered more substantial. The reliability coefficients for the FTND are still below traditionally accepted standards for clinical use or research.

In terms of factor structure, Seidner and Burling (2003) found that the FTND had a similar two-factor structure to the FTQ. The factor solution for the FTND accounted for a greater percentage of the item variance than for the FTQ (i.e., 62% vs. 52%).

The FTND predicted both behavioral and biochemical indices (CO and cotinine) of smoking in various countries (Kozlowski, Porter, Orleans, Pope, & Heatherton, 1994). Seidner and Burling (2003) reported the FTND was more strongly correlated with CO markers than the original FTQ. The FTND also predicted cessation outcomes and heightened risk for psychiatric comorbidities in a large sample in Germany (WHO, 2008).

Despite the fact that the majority of studies in perinatal populations used the FTND, no reports of their psychometric properties were found (See Table 3).

Heaviness of Smoking Index (HSI)

The HSI is another derivative of the original FTQ. The HSI was developed prior to the FTND (Heatherton et al., 1989). The HSI retained only two of the original eight questions asking subjects about CPD and TTF (Heatherton et al., 1989). The theoretical explanation for the importance of TTF to measuring nicotine dependence stems from the

relatively short plasma half-life of nicotine. Typically, smokers' blood nicotine levels deplete by the time they wake up in the morning (Kozlowski, Director & Harford, 1981). Heavy smokers are likely to face withdrawal symptoms until they smoke their first cigarette of the day (Heatherton et al., 1989).

Prior to the development of the HSI, there was no consistency in how researchers scored or applied cut-offs to CPD and TTF questions. For example, FTQ categorized CPD as 1-15, 16-30, 31-45. Other researchers using CPD, however, could arbitrarily use sets of 10 or 20 for categorization. Heatherton et al. (1989) suggest that the original FTQ score for CPD may be inappropriate since it cannot differentiate those who purchase packages of 20 cigarettes from those who purchase packages of 25 cigarettes. The HSI now measures CPD in increments of 10 allowing for that discrimination. The HSI has a Flesch-Kincaid Reading level of 4.2. It has been translated into many languages and has been used internationally (WHO, 2008).

Since the HSI is comprised of only two items, internal consistency estimates are not relevant (WHO, 2008). Intercorrelations between the two items of the measure indicate low to moderate levels of association (e.g., $r = .27 - .36$) (Baker et al., 2007). HSI scores were strongly correlated over a 3-year period ($r = .70$) (Borland, Yong, O'Connor, Hyland, & Thompson, 2010). In terms of validity, the HSI (like the FTND and FTQ) predicted both behavioral and biomarker indices of smoking in international research studies (Heatherton et al., 1989; Kozlowski et al., 1994; WHO, 2008). In addition, the two items that make up the HSI account for much of the predictive validity of the FTND (Heatherton et al., 1989). Heatherton and colleagues (1989) found that both items were excellent predictors of biochemical measures of tobacco use in three

independent samples of smoking adults from Canada. For example, the TTF explained 33.6% (adjusted R^2) of the variance in plasma cotinine levels and the CPD explained 45.7% of CO levels. Seidner and Burling (2003) also found that the HSI had a stronger correlation with carbon monoxide than did either the FTQ or the FTND.

Heatherton and colleagues (1989) reported that the two items have differential sensitivity in their predictive ability. TTF was a better predictor of cotinine, whereas CPD was consistently a better predictor of CO and nicotine levels. This may reflect the ability of TTF to detect enduring cotinine levels while CPD may be a better measure of recent levels.

Assumptions behind the questions on the HSI pose a potential threat to validity since they both assume that the subject is a daily smoker. This must be considered in the interpretation of surveys conducted with non-daily smokers (WHO, 2008).

Studies using HSI in perinatal populations (see Table 4) did not include psychometric data. Further, the measurement of nicotine was secondary and sometimes not even included in the results. Still, other research examining the HSI suggests that it offers a practical, non-invasive, and powerful index of nicotine dependence.

Biomarker Approach

Perinatal smoking research is replete with biomarker measurements; however, they are largely used to validate exposure and/or abstinence. In the studies reviewed, salivary cotinine was primarily used with one instance of urinary cotinine identified. No precision or accuracy of measurements were addressed.

Although nicotine measurement is highly specific for tobacco use or exposure (in the absence of NRT), it has a very short half-life of only two hours making it an

impractical biomarker measure. Cotinine, however, is a highly specific and sensitive marker for tobacco use (in the absence of NRT) and has a half-life of 16 hours (Benowitz Hukkanen, & Jacob, 2009). Benowitz and colleagues suggest that in the absence of NRT, cotinine is the best biomarker for measurement in smoking studies and found strong correlations among cotinine concentrations measured in plasma, saliva, and urine. They reported that any one of these fluids can be used as a marker of nicotine intake.

Biomarker measurements are open to error and variability. For instance, the relationship between cotinine levels and intake of nicotine varies due to the variability in the rate of nicotine to cotinine conversion (Benowitz, 1996). Cotinine levels are affected by factors such as race, sex, age, and the presence of liver or kidney disease (Benowitz et al., 2009). Although its half-life is longer than that of nicotine, cotinine levels reflect short-term exposure to tobacco of about three to four days.

Comparison of the Strengths and Weaknesses of the Measures

The instruments and approaches reviewed have several strengths and weaknesses. As described previously, the three paper and pencil measures highlighted all showed poor reliability. Because the HSI only has two items, calculation of internal consistency is not appropriate. The FTQ and the FTND both have mediocre internal consistency reliabilities, at best. Of the two, however, the range of FTND's alpha coefficients is more acceptable.

In terms of construct validity, the FTQ and its variants have a stable factor structure. The FTQ and FTND have a two-factor structure consisting of smoking pattern and morning smoking dimension (Seidner & Burling, 2003). These two factors are reflected in the two questions of the HSI. Between the FTQ and FTND, the FTND's

factor structure accounted for a greater percentage of item variance (Seidner & Burling, 2003).

The strength of all three self-report measures is their predictive validity. The FTQ has consistently shown good predictive validity for both behavioral and biochemical indices – displaying strong associations with biomarkers of nicotine dependence and predicting successful cessation in the absence of NRT (Fagerström & Schneider, 1989). Some research suggests that the FTND has stronger correlations with CO markers than the FTQ (Seidner & Burling, 2003). Like the FTQ, the FTND predicted cessation outcomes in smoking cessation studies (WHO, 2008). In spite of its brevity, the HSI also shows strong predictive validity for behavioral and biomarker indices (Heatherton et al., 1989; Kozlowski et al., 1994; WHO, 2008). In fact, the two items on the HSI account for much of the predictive ability of the FTND (Heatherton et al., 1989).

In terms of practical application, the three paper and pencil instruments are all relatively brief, easy, and cost-effective to administer. Of the three, the HSI is the briefest measure and provides utility in studies where a short measure is needed. Cotinine measurements by saliva or urine are relatively non-invasive. Although costly to analyze, they provide a helpful way to validate self-reports.

Recommendations

The FTQ, FTND, and HSI have moderate reliability and good evidence to support validity for measuring nicotine in a variety of populations. To date, these measures have not been extensively used in the perinatal population. Nicotine dependence is an important construct to understand in the study of smoking behavior and may be helpful in the design of appropriate smoking cessation interventions for pregnant and postpartum

women. Further psychometric evaluation of these measures as they are used in perinatal populations is warranted.

The following recommendations are suggested for future studies in which the FTQ, FTND, HSI, and biomarker measures are used:

1. Thorough psychometric reporting when using these instruments in studies with women in the perinatal period.
2. The use of cotinine measurements to validate self-report of smoking and to address validity issues surrounding the response bias that may occur with perinatal populations.
3. The inclusion of precision and accuracy reporting whenever biomarker measurements are used.
4. The use of all eight of the original FTQ questions to allow all three measures (FTQ, FTND, and HSI) to be scored and compared so that the psychometric properties of all three can be compared in one study (Seidner & Burling, 2003).

Conclusions

Despite the widespread use of the FTQ and its derivatives in many populations, the psychometric properties of the measures in perinatal populations should be evaluated. Of the three Fagerström measures examined in this review, the HSI is the most efficient and valid index of nicotine dependence, accurately predicting both behavioral and biomarker indices of smoking. The use of biomarkers, when feasible, to accompany these self-report measures enhances reliability. All eight of the original FTQ questions should be used when possible to evaluate its usefulness and that of its derivative

measures, and to allow for comparisons. This is essential to determine the most reliable and valid method for measuring nicotine dependence in pregnant and postpartum women.

Table 2

Summary of Nicotine Dependence (ND) Research using FTQ in Perinatal Women

Author/Date	Purpose	Sample	Conceptual Definition	ND Instrument with Cronbach α (if reported)	Findings Related to ND
Albrecht et al., 1999	Measure ND to enhance efficacy of smoking-cessation programs in school or prenatal clinics	94 pregnant adolescents	<ul style="list-style-type: none"> • Exposure Model • APA qualifiers 	Modified FTQ (FTQ – item about nicotine rating) with salivary cotinine validation Cronbach α = .61	Significant correlation between FTQ and salivary cotinine Overall FTQ significantly correlated with CPD item 15% of sample had FTQ score > 6 indicating ND
Fischer et al., 2000	To assess the maternal and fetal acceptability of buprenorphine and neonatal abstinence syndrome (NAS) in children born to buprenorphine-maintained mother	Fifteen opioid-dependent pregnant women	Not defined	FTQ	Decreased ND from FTQ score 5 to 3 (admission to delivery)

Author/Date	Purpose	Sample	Conceptual Definition	ND Instrument with Cronbach α (if reported)	Findings Related to ND
Haug, Svikis, & Diclemente, 2004	To compare the effectiveness of Motivational therapy tailored to stage of change, with standard-care advice on reducing tobacco	63 pregnant opioid-dependent women \leq 26 weeks gestation, receiving methadone and currently smoking $>$ 5 CPD	Not defined	FTQ	Used to compare two groups at baseline. No difference in ND between two groups
Varescon, Leignel, Poulain, & Gerard, 2011	To assess the perceived stress and coping strategies used by pregnant smokers when they seek help to quit smoking	80 pregnant women – 40 smokers with stated intentions to quit; 40 non-smokers	Not defined	FTQ with CO validation	<p>FTQ score correlated with CO level and with “self-blame” a coping item on the COPE scale.</p> <p>Mean FTQ score = 3.4 indicating low ND</p> <p>Mean CO level = 11.89 ppm (cut-off of 5 ppm)</p> <p>Women with low ND, but high CO levels sought help with quitting smoking.</p>

Table 3

Summary of Nicotine Dependence (ND) Research using FTND in Perinatal Women

Author/Date	Purpose	Sample	Conceptual Definition	ND Instrument with Cronbach α (if reported)	Findings Related to ND
Bullock et al., 2009	Test effect of nurse delivered telephone support intervention and a booklet intervention separately and in combination	345 rural pregnant smokers	Not defined	FTND	Decreased ND from pre-pregnancy to after pregnancy recognition for entire sample
Chan, Einarson, & Koren, 2005	To examine the effectiveness of bupropion as a smoking cessation aid during pregnancy	44 pregnant women who smoked and had been exposed to bupropion during first trimester	Not defined	FTND	Results not reported

Author/Date	Purpose	Sample	Conceptual Definition	ND Instrument with Cronbach α (if reported)	Findings Related to ND
H ndel et al., 2009	To compare smoking status, urge to smoke and intention to change smoking behavior of primigravidae and multigravidae	642 women postpartum who smoked before	Defined as “urge to smoke”	FTND	<p>Mean FTND score after pregnancy was 1.9 among primigravidae and 2.1 among multigravidae.</p> <p>ND differed significantly between the two groups before and after pregnancy</p> <p>Primigravida women showed less ND than multigravida women.</p>
Levine et al., 2006	To assess motivation for postpartum abstinence in pregnant women who had quit smoking and examine relationship of weight concerns and mood to abstinence motivation	119 pregnant smokers	Not defined	FTND	Prepregnancy ND did not predict woman’s motivation to remain abstinent postpartum.

Author/Date	Purpose	Sample	Conceptual Definition	ND Instrument with Cronbach α (if reported)	Findings Related to ND
Panaretto et al., 2009	To examine patterns of ND, the FTND and its correlation with self-reported tobacco use and urinary cotinine concentrations.	201 Aboriginal women who smoke at their first antenatal visit	Not defined	FTND with urine cotinine validation	<p>Mean FTND score = 4</p> <p>Two items (TTF and CPD) correlated with the FTND score.</p> <p>CPD explained 30.3% of the variation of the FTND score.</p> <p>Significant positive correlation with urine cotinine levels</p>
Riske et al., 2006	To examine the intention to resume smoking in the post-partum period and its predictive value for smoking within 12 months post-partum	301 women recruited from obstetric wards who reported having stopped smoking during pregnancy	Not defined	FTND	FTND score did not differ significantly between women who had the intent to resume smoking and women who did not.

Author/Date	Purpose	Sample	Conceptual Definition	ND Instrument with Cronbach α (if reported)	Findings Related to ND
Wisborg et al., 2000	To assess effect of nicotine patches on cotinine-validated smoking cessation in pregnant women and effect of nicotine on birth weight and preterm delivery	250 pregnant women who smoked > 10 cigarettes after the first trimester	“Nicotine is the substance on which smokers depend physically and which causes withdrawal symptoms in those who stop smoking” (p. 967).	FTND With salivary cotinine validation	FTND results not reported except to state that level of nicotine dependence was distributed equally between placebo and intervention groups

Table 4

Summary of Nicotine Dependence (ND) Research using HSI in Perinatal Women

Author/Date	Purpose	Sample	Conceptual Definition	ND Instrument with Cronbach α (if reported)	Findings Related to ND
Agrawal et al., 2008	Explore associations between smoking during pregnancy (CSDP) sociodemographic and psychiatric correlates and between CSDP and patterns of smoking. Examine role of heritable and environmental influences on CSDP and investigate whether these latent risk factors are shared with a predisposition to ND	1,134 adult Australian female monozygotic and dizygotic twin pairs,	Not defined	HSI	Women who smoked during even part of their pregnancy had higher HSI scores than those who did not smoke.

Author/Date	Purpose	Sample	Conceptual Definition	ND Instrument with Cronbach α (if reported)	Findings Related to ND
Agrawal et al., 2010	Evaluate the possible association between maternal smoking during pregnancy and offspring outcomes of birth weight, pre-term birth, remediation, low scholastic achievement, regular smoking, attention deficit hyperactivity disorder and conduct problems while controlling for similar behaviors in parents	1,342 unique pregnancies in 1,122 mothers	Not defined	HSI (maternal)	Maternal ND correlated positively with Paternal ND (measured via DSM criteria).
Coleman et al., 2012).	Investigate the efficacy and safety of nicotine patches during pregnancy	981 pregnant smokers	Not defined	HSI with salivary cotinine	Not included
Ludman et al., 2000	Examine perceived stress and depressive symptoms as correlates and predictors of smoking cessation during pregnancy	819 pregnant smokers	Not defined	HSI	HSI items were strongly associated with smoking status.

CHAPTER IV
THE ROLE OF PSYCHOSOCIAL FACTORS AS MEDIATORS OR MODERATORS
OF THE RELATIONSHIP BETWEEN SOCIOECONOMIC STATUS AND
PRENATAL SMOKING BEHAVIOR

Introduction

The purpose of this study was to examine the role of three psychosocial variables – chronic stressors, the quality of the primary intimate relationship, and depressive symptoms – in explaining the relationship between socioeconomic status (SES) and prenatal smoking. Tobacco use is the leading cause of preventable disease, disability, and death in the United States (CDC, 2011). Prenatal women are not spared the impact of tobacco use. Decades of research highlight the negative effect of smoking on pregnancy outcomes (Cnattingius, 2004; Vardavas et al., 2010). With rates ranging from 4.5% in Vermont to 30.5% in West Virginia, prenatal smoking is a significant national health problem (Tong et al., 2013).

Current prenatal smoking cessation interventions show limited effectiveness, particularly for women from low socioeconomic status (SES) backgrounds who are most at risk for this behavior (Lumley et al., 2009). Although several SES indicators and psychosocial factors have been identified as correlates and predictors of prenatal smoking, little is known about the influence of psychosocial factors on the relationship between SES and prenatal smoking behavior.

Background

In addition to nonsmokers and persistent prenatal smokers, there are women who quit smoking prior to or as soon as they realize they are pregnant. These women are referred to as “spontaneous quitters” (Solomon & Quinn, 2004). Spontaneous quit rates vary from 29% to 43% (Chattingius, Lindmark, & Meirik, 1992; Colman & Joyce, 2003; Severson, Andrews, Lichtenstein, Wall, & Zoref, 1995). Several factors have been identified as predictors or correlates of prenatal smoking status.

Socioeconomic Status (SES)

Research has consistently linked three indicators of low SES with increased prenatal smoking behavior: income, education, and employment. Low income women are more likely to engage in prenatal smoking than those with higher income levels (Adams et al., 2008; Tong et al., 2009). Lower levels of education are strongly associated with and even predict prenatal smoking status (Goodwin et al., 2007; Higgins et al., 2009). For example, in 2000 only 2% of college graduates in the U.S. reported smoking during pregnancy compared to 25% of prenatal smokers who did not complete college (Martin, Ventura, Park, Menacker, & Hamilton, 2002). Employment status also is associated with prenatal smoking. Pregnant women are more likely to be smokers and to persistently smoke throughout pregnancy if they have unskilled jobs or are unemployed (Hakansson, Lendahls, & Peterson, 1999; Penn & Owen, 2002).

Stress

The relationship between stress and smoking is well documented in the prenatal literature. Women who continue to smoke during pregnancy perceived more stress in their lives than those who quit (Haslam, Draper, & Goyder, 1997). Job strain (Dejin-

Karlsson et al., 1996), financial stress (Bullock et al., 2001), parenting challenges, living in disruptive home environments, and lack of social support (Pletsch et al., 2003) are sources of stress that affect prenatal smoking status. Furthermore, factors known to be stressful, such as low education level (Higgins et al., 2009), abuse (Jesse et al., 2006), low social support (Bullock et al., 2009), and neighborhood violence (Patterson et al., 2012), were all associated with prenatal smoking and low SES suggesting a relationship between SES and stress.

Social Support

Several indicators of social support are associated with prenatal smoking status. A common indicator of social support used in the prenatal literature is marital/cohabitation status. Prenatal smoking and being unmarried/single were associated in several studies (Goodwin et al., 2007; Haslam et al., 1997; Penn & Owen, 2002). Little is known about the effect that the quality of social relationships has on prenatal smoking status. A few studies suggest that a lower level of partner support is associated with persistent prenatal smoking (Bullock et al., 2001; DeJin-Karlsson et al., 1996). Morales, Marks, and Kumar (1997) found that prenatal smokers more frequently reported problems and conflict in their marital relationships compared to non-smokers including lack of trust in their partners as confidants and difficulty sharing interests and activities with them. To date, no prenatal smoking studies have examined the quality of a woman's primary intimate relationship as a measure of available social support in the prenatal period.

Depressive Symptoms

The link between depressive symptoms and prenatal smoking is strong. Prenatal smokers have a higher rate of depressive symptoms than nonsmokers (Pritchard, 1994). Depressive symptoms also predict prenatal smoking status (Linares et al., 2009; Maxson, Edwards, Ingram, & Miranda, 2011; Zhu & Valbo, 2002). The research on major depressive disorder is inconclusive. Goodwin et al. (2007) found that 12.4% of pregnant women who used cigarettes had a major depressive disorder (MDD) according to DSM-IV diagnostic criteria, whereas the association between MDD and persistent prenatal smoking was not supported in another study (Flick et al., 2006).

Second Hand Smoke (SHS) Exposure

SHS exposure affects prenatal smoking behavior. Having a husband/partner who smokes increases the likelihood of persistent prenatal smoking (Schneider et al., 2010) and having a nonsmoking husband/partner is strongly associated with cessation success (Bullock et al., 2009; Grange et al., 2006; Hakansson et al., 1999; Ockene et al., 2002; Penn & Owen, 2002; Zhu & Valbo, 2002).

SHS exposure from other family and friends is also associated with prenatal smoking. Haslam and colleagues (1997) found that pregnant smokers have a higher proportion of family members and friends who smoked compared with pregnant women who have never smoked. Persistent smokers described family and friends who smoke as strong influences on their own smoking behavior and smoking as a shared social activity among family and friends (Edwards & Sims-Jones, 1998).

Nicotine Dependence

The degree of nicotine dependence also plays a role in persistent prenatal smoking. Nicotine dependence is measured in a variety of ways. One commonly used measure of dependence is the Fagerström Tolerance Questionnaire. Other proxies for nicotine dependence include heaviness of smoking, number of cigarettes smoked per day, years of smoking, and smoking soon after waking. Each of these indicators of dependence is associated with prenatal smoking (Colman & Joyce, 2003; Crittenden et al., 2007). Increased nicotine dependence is associated with a greater likelihood of persistent smoking (Colman & Joyce, 2003; Crittenden et al., 2007; Ockene et al., 2002).

Interrelationships among Prenatal Smoking Factors

All of the psychosocial variables described above are associated with prenatal smoking status and interrelationships among them are reported in the literature. For example, research on stress and prenatal smoking indicate that sources of stress are related to low SES and low social support (Bullock et al., 2001). Dejin-Karlsson et al. (1996) suggest that prenatal smoking may be viewed as a maladaptive reaction to stress due to a woman's lack of resources to meet stressful demands. Exactly how these variables affect the relationship between SES and prenatal smoking behavior is unclear. A more in-depth understanding of the complex interrelationships among variables that link SES with prenatal smoking behavior is needed.

Conceptual Framework

Gallo and Matthews (2003) proposed a framework to explain how psychosocial factors serve as pathways connecting low SES to poor health outcomes (see Figure 1). The model describes the associations among low SES, stressful experiences, psychosocial

resources, emotion and cognition, and biological and behavioral pathways predicting morbidity and mortality over time. Gallo and Matthews suggest that low SES environments are associated with increased exposure to stressful situations or decreased exposure to rewarding or beneficial situations. This exposure has a direct negative effect on an individual's emotions and cognitions. Individuals with a low SES have a smaller set of resources to draw from in order to deal with stressful events. This "bank of resources" is labeled "reserve capacity" (Matthews, Gallo, & Taylor, 2010, p. 147) and may be diminished due to exposure to resource draining situations or the inability to develop or replenish resources. An individual's reserve capacity moderates the effect of exposure to stressful or beneficial situations on emotion and cognition. In this model, emotion and cognition have direct relationships to health behaviors.

This theoretical model incorporates several psychosocial variables implicated in prenatal smoking behavior. It also provides testable relationships that may enrich our understanding of the mechanisms linking SES to prenatal smoking. The first specific aim of this study was to test potential mediators and moderators of the relationship between SES and prenatal smoking status based on the Reserve Capacity Model. Figure 2 displays the hypothesized relationships based on this model and tested in this study.

H₁: Chronic stressors mediate the relationship between SES and depressive symptoms.

H₂: The quality of the primary intimate relationship mediates the effect of SES on depressive symptoms.

H₃: The quality of the primary intimate relationship moderates the effect of chronic stressors on depressive symptoms.

H₄: Depressive symptoms mediate the relationship between chronic stressors and prenatal smoking status.

H₅: Depressive symptoms mediate the effect of the quality of the primary intimate relationship on prenatal smoking status.

The second specific aim was to evaluate the ability of chronic stressors, the quality of the primary intimate relationship, and depressive symptoms to independently predict prenatal smoking status controlling for other known predictors of prenatal smoking status

Methods

Design

Secondary analysis of data from a 5-year, prospective non-experimental multicenter study of pregnant women was conducted (Ashford, O'Brien, McCubbin, Westneat, & Barnett, 2013). The purposes of the original study were to: (a) explore the hypothesis that preterm birth and low birthweight are associated with higher levels of prenatal inflammatory markers in saliva, serum, and cervico-vaginal fluid; and (b) determine if psychosocial and biobehavioral variables in combination with these inflammatory markers pose a significant risk for adverse birth outcomes. Questionnaire data and biomarker samples were collected once during each trimester of pregnancy and postpartum. The current study is a cross-sectional prevalence study and longitudinal panel study of predictors of prenatal smoking status at the third trimester of pregnancy. Data on the independent variables were collected during the first trimester (5-13 weeks gestation). Smoking status was determined from urine cotinine and self-report obtained in all three trimesters.

Sample and Setting

In the parent study, pregnant women were recruited according to their history of preterm birth. Inclusion criteria were: pregnant; at least 18 years of age; single gestation; and no history of diabetes, heart disease, sexually transmitted disease, multifetal pregnancy, or second trimester bacterial vaginosis. Women with a current history of illegal or prescription drug abuse and those with a previous normal pregnancy who delivered a preterm/low birthweight baby during the current pregnancy were excluded. Participants were recruited from three different prenatal clinics located at: the University of Kentucky, a regional medical center in Hopkins County, Kentucky, and the University of Virginia. The sample size for the present study was 371 women.

Measures

Smoking status. The women were divided into three groups: Non-Smoker (NS), Spontaneous Quitter (SQ), and Persistent Prenatal Smoker (PPS). NS status was determined based on urine cotinine levels using the NicAlert cotinine assay (Nymox, 2013) and self-report questions. According to NicAlert standards, non-users of tobacco products are defined as those with urine cotinine ≤ 99 ng/ml. Therefore, those women who deny smoking/tobacco use at the baseline assessment, but who have urine cotinine levels of greater than or equal to 100 ng/ml are considered tobacco users.

Women were placed in the NS group if they were never users, or if they quit smoking prior to pregnancy or had not smoked in the past 12 months and stated that they were not influenced by their pregnancy to quit. After urine cotinine confirmation of current nonsmoking status, women were placed in the SQ group if they quit smoking during the first trimester or if they quit smoking before pregnancy and were influenced by

their pregnancy to do so. Also included in this group were women who smoked during the first trimester, but whose urine cotinine level subsequently indicated that they quit smoking. PPS were identified by urine cotinine levels indicative of smoking at all three prenatal data collection points (5-13 weeks; 14-26 weeks; 27-36 weeks gestation) or urine cotinine indicative of relapse at the third trimester. Urine cotinine and self-report were strongly correlated in the first trimester ($\rho = .68, p < .001$).

Socioeconomic status (SES). SES is a multidimensional construct commonly used in social science research to capture information about a person's access to a variety of resources and opportunities. There is no commonly accepted definition of SES; measurement of this construct varies across studies (Oakes & Rossi, 2003). In health-related research, SES is measured almost entirely based on occupational position, education, and/or income (Oakes & Rossi, 2003). This is reflected in prenatal research.

To best represent SES from available data, researchers have combined indicators to create an overall SES variable. Romero, Martinez, and Carvajal (2007) equally weighted three significantly correlated indicators of SES--parental education, perceived SES, and home characteristics--to create a composite SES variable for their study on bicultural stress and adolescent risk behaviors in Latino and Non-Latino populations. Janicki-Deverts et al. (2007) also created a composite SES variable by summing standardized scores of income, education, and employment status. Ickovics and Viscoli (1997) defined social class groups from a composite score they created from education (years of school completed) and occupation.

In the present study, a composite variable was created to capture the multidimensional nature of SES by summing scores of three variables: income,

education, and employment status. Annual household income was a trichotomous variable ($0 \leq \$20,000$; $1 = \$20 - \$39,999$; and $2 \geq \$40,000$); both education ($0 \leq$ high school; $1 >$ high school) and employment status ($0 =$ Unemployed; $1 =$ Employed) were dichotomized. In a principal components analysis of the three indicators of SES, all loaded strongly on a single component. Scores on the composite SES variable ranged from 0-4; higher scores reflected a higher level of SES. Correlations between each component variable and the composite score were strong (range of $\rho = .62 - .89$, $p < .001$).

Chronic stressors. The Everyday Stressors Index (ESI) was developed to measure low-income mothers' perceptions of chronic stressors they face on a daily basis (Hall, 1983). The 20-item ESI assesses five common problem areas: role overload, financial concerns, parenting worries, employment problems, and interpersonal conflict. Respondents rate how much each problem worries, upsets, or bothers them using a 4-point scale of not at all bothered (0) to bothered a great deal (3). Scores are summed and range from 0-60 (Hall, 1983). Higher scores indicate a higher level of chronic stressors. In samples of mothers of young children, the ESI demonstrated strong internal consistency with alphas ranging from .81 to .86 (Hall & Farel, 1988; Hall, Kotch, Browne, & Rayens, 1996; Hall, Williams, & Greenberg, 1985; Peden, Rayens, Hall, & Grant, 2004). Content and construct validity of the ESI were also supported in a number of studies (Hall, 1983; Hall & Farel, 1988; Hall et al., 1996; Pollock et al., 2005). Cronbach's alpha in the current sample was .87.

Quality of the primary intimate relationship. The Autonomy and Relatedness Inventory (ARI) is a 32-item instrument that assesses the quality of a woman's primary

intimate relationship in the following eight areas: autonomy, relatedness, acceptance, support, listening, control, detachment/rejection, and hostile control (Schaefer & Edgerton, 1982). Women respond to items in reference to the person they identify as most important in their life. Responses are given on a 5-point Likert scale ranging from not at all like (1) to very much like (5) the intimate. Negative items are reverse scored and all item responses are summed; 32 is subtracted from the total to form a cumulative score ranging from 0 to 120. Higher scores indicate a more positive relationship (Hall & Kiernan, 1992). The ARI demonstrated good reliability and validity in studies conducted with mothers and married couples. Cronbach's alphas ranged from .70 to .90; subscale alphas ranged from .53 to .76 (Carson, Carson, Gil, & Baucom, 2004; Goodman, 1999; Hall et al., 1985; Hall & Kiernan, 1992; Rankin-Esquer, Burnett, Baucom, & Epstein, 1997). The measure also demonstrated good content, convergent, and factorial validity (Hall & Kiernan, 1992). Cronbach's alpha in the current sample was .94.

Depressive symptoms. The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Savosky, 1987) is a 10-item self-rated scale which has shown high sensitivity (Eberhard-Gran, Eskild, Tambs, Opjordsmoen, & Samuelsen, 2001) as a screening tool for postpartum depression. Items are scored on a 3-point scale from 0 to 3. Responses are summed to form a cumulative score that ranges from 0 to 30. The suggested threshold for follow up in a routine primary care setting is a score of 9-10; higher scores may indicate depressive illness (Cox et al., 1987). Cronbach's alphas in samples of pregnant women ranged from .82 - .84; test-retest reliability across all three trimesters ranged from .55 - .63 (Bergink et al., 2011; Bunevicius, Kusminskas, Pop, Pedersen, & Bunevicius, 2009). Construct validity was supported by substantial correlations between

the EPDS and the anxiety and somatization subscales of the Symptom Checklist-90 (Bergink et al., 2011). Cronbach's alpha in the current sample was .86.

Smoking related variables. SHS exposure in the home was dichotomized to reflect exposure vs. non-exposure based on the item: "How many hours in a day are you exposed to other people's tobacco smoke indoors at home?" Nicotine dependence was measured with a single item asking the number of cigarettes smoked daily during the three months prior to pregnancy.

Demographic characteristics. Age, race (Caucasian vs. Non-Caucasian), parity, and marital status (Married/Partnered vs. Single/Divorced/Separated) were collected via self-report at first trimester data collection.

Procedure

Medical Institutional Review Board approval for the parent study was obtained from the University of Kentucky; an exemption certification was received for the current study from the University of Louisville Institutional Review Board. Research nurses conducted eligibility screening from prenatal records and consented eligible participants in person. The women were free to withdraw from the study at any time. There were three prenatal collection periods: 5-13 weeks; 14-26 weeks; and 27-36 weeks gestation. Questionnaire data and urine were obtained at each point. A minimum of four weeks was allotted between collection points. Questionnaires were administered via a web-based survey; paper copies were offered to participants according to their preference. All written material was available in English and Spanish at the 6th grade level. Participants received a \$20 gift card after each collection point as an incentive.

Data Analysis

All analyses were performed using SPSS software, version 22.0 (IBM Corp., 2013). Descriptive statistics were used to examine participant characteristics.

Differences among the smoking status groups were assessed using chi-square tests for categorical variables. One-way Analyses of Variance (ANOVA) was used to examine differences in means across groups of continuous variables.

Potential psychosocial mediators according to the hypothesized relationships based on the Gallo and Matthews model were evaluated using Baron and Kenny's (1986) formal steps to test for mediation plus an SPSS script (PROCESS) developed by Hayes (2013). This macro uses bootstrapping methods to generate confidence intervals for estimates of the product coefficients for the indirect or mediated effects. Bootstrapping is preferred to the more traditional Sobel's test because it does not assume normality of the distribution of the indirect effects and thereby protects against Type II error (Hayes, 2013). Covariates included in all of the mediation and moderation models were: parity, age, race, marital status, and SHS exposure.

The first two hypotheses were analyzed as a multiple mediator model; both chronic stressors and the quality of the primary intimate relationship were tested as parallel mediators of the effect of low SES on depressive symptoms. The PROCESS macro allowed both indirect pathways to be assessed simultaneously. In addition to testing the significance of the indirect effects, the macro tests for significance in the difference between the parallel indirect effects (Hayes, 2013).

The outcome variable for the final two hypotheses was smoking status groups (a categorical variable with three levels). Traditional mediation analysis methods or the

PROCESS macro do not support a multilevel categorical outcome. Because the SQ and PPS groups did not differ on any of the three psychosocial variables examined in this mediation analysis, the two groups were combined into an overall smoking group for the purpose of these two mediation analyses. PROCESS supports dichotomous outcomes by estimating coefficients using logistic regression modelling of the probability of being a smoker versus a nonsmoker.

The moderation model was tested using hierarchical multiple regression analysis. In order to reduce multicollinearity from the creation of interaction terms, chronic stressors and the quality of the primary intimate relationship were centered before computation of the interaction term.

Finally, multinomial logistic regression was used to evaluate the ability of chronic stressors, the quality of the primary intimate relationship, and depressive symptoms to independently predict the probability of being a nonsmoker or a spontaneous quitter versus a persistent smoker. These variables were modelled with other predictors of prenatal smoking status determined from tests of single variables and treated as covariates in the analyses. Using backward elimination, variables were removed one at a time according to the least significant p -value until all remaining variables were significant at $p \leq .05$. The choice for the final model also considered model fit statistics and parsimony.

Results

Participant Characteristics

The mean age of the participants was 25.9 ± 5.2 years. Other sociodemographic and personal characteristics of the sample are summarized in Table 5. The majority of

the sample was evenly split between the lowest and the highest income levels. The majority of the women were White, married/partnered, primiparous, with some post-high school education, and employed either full or part-time. Of the women, 202 (54.4%) were nonsmokers, 84 (22.6%) were spontaneous quitters, and 85 (22.9%) were persistent prenatal smokers.

Mean scores for the psychosocial variables are given in Table 6. Overall, the women had a low level of depressive symptoms, a moderate level of chronic stressors, and a high quality of the primary intimate relationship. Most participants identified a husband, boyfriend, or partner as their primary intimate ($n = 237$; 64%). Almost 22% ($n = 80$) listed their mother as the intimate and others indicated another family member or friend ($n = 44$; 12%). Data were missing for 10 women (2.7%).

Variables Associated with Smoking Status

The mean age differed across the three smoking status groups, $F(2, 365) = 7.8, p < .001$. Post-hoc comparisons using the Tukey HSD test indicated that the mean age of the persistent smokers ($M = 24.62, SD = 5.08$) was significantly lower than the nonsmokers ($M = 26.86, SD = 5.16$). Spontaneous quitters ($M = 24.86, SD = 5.15$) also were younger than nonsmokers but did not differ in age compared to persistent smokers. All of the categorical sociodemographic and personal characteristics were significantly associated with prenatal smoking status (see Table 7). Compared to nonsmokers, persistent smokers were significantly more likely to: have a lower annual household income; have a high school education or less; and be unemployed, single/divorced/separated, and multiparous. Persistent smokers also were more likely to be exposed to indoor SHS compared to both spontaneous quitters and nonsmokers.

Similarly, they were more likely to have smoked over 20 cigarettes per day prior to pregnancy compared to the other two groups.

Mean baseline scores on the ARI, the ESI, and the EPDS differed significantly by prenatal smoking status (see Table 8). Post-hoc comparisons indicated that persistent smokers and spontaneous quitters had lower mean ARI scores and higher mean ESI and EPDS scores compared to nonsmokers. The means of spontaneous quitters and persistent smokers did not differ on any of the three variables.

Testing the Gallo and Matthews Model

Mediation analyses. The potential parallel mediation by the quality of the primary intimate relationship and chronic stressors of the relationship between SES and depressive symptoms (controlling for parity, age, race, marital status, and SHS exposure) was tested in a multiple mediation analysis. The relationship between SES and depressive symptoms was *fully* mediated by chronic stressors and the quality of the primary intimate relationship. As Figure 3 illustrates, all indirect pathways through the mediators were significant. The total effect of SES on depressive symptoms was significant, but the direct effect, independent of the two mediators, was not. The unstandardized indirect effects through both mediators were tested using bootstrapping procedures (5,000 samples). The 95% CI indicated that both indirect effects were significant. There was no significant difference in the strength of the two indirect effects (see Table 9).

The remaining two mediation hypotheses were tested using simple mediation models with the outcome variable dichotomized as nonsmoker vs. smoker. The same covariates were included in these models. The effect of chronic stressors on prenatal

smoking status was *partially* mediated by depressive symptoms. Table 10 and Figure 4 illustrate that all pathways are significant. Since the bootstrap CI for the indirect effect was above zero ($ab = .01$, CI: .003 to .02), there was evidence of a significant indirect effect.

The direct effect of the quality of the primary intimate relationship (controlling for depressive symptoms) was not significant. Although the total effect of the quality of the primary intimate relationship on group status is very small, the analysis indicates that this small effect is *fully* mediated by the indirect effect through depressive symptoms. The indirect effect was significant as indicated by the bootstrap CI (see Table 10 and Figure 5).

Moderation analyses. A multiple regression model was tested to investigate the potential moderating effect of the women's primary intimate relationships on the relationship between chronic stressors and depressive symptoms (see Table 11). For women with any type of intimate, the main effects of chronic stressors and the quality of the primary intimate relationship were significant. The level of chronic stressors was positively related to depressive symptoms ($\beta = .42, p < .001$), and the quality of the women's primary intimate relationship was inversely related to depressive symptoms ($\beta = -.25, p < .001$). Chronic stressors' unique contribution to the model ($sr^2 = .357, p < .001$) was almost twice that of the quality of the primary intimate relationship ($sr^2 = .195, p < .001$). The interaction between chronic stressors and the quality of the primary intimate relationship was not significant. No interaction was evident even when controlling for the type of primary intimate (husband/partner/boyfriend vs. other). Type of primary intimate was not significantly related to depressive symptoms.

Predictors of Prenatal Smoking Status

A multinomial logistic regression analysis was conducted to assess the ability of a number of variables to predict the likelihood of being a nonsmoker versus a persistent smoker or a spontaneous quitter versus a persistent smoker. The full model contained nine variables: the SES composite score, age, race, marital status, parity, SHS exposure, and the three psychosocial variables. Each variable was included in the model because of its significant association with prenatal smoking status in earlier chi-square and ANOVA analyses. “Cigarettes per day” (CPD) led to a quasi-complete separation of the data where one level of the CPD variable was associated almost completely with one level of the outcome variable. The resulting parameter estimates would have been unreliable. Therefore, CPD was not included in the model. SES was the strongest predictor of smoking status in the full model. Those with the lowest SES composite score had .046 times the odds of being a nonsmoker versus a persistent smoker (see Table 13).

As shown in Table 12, only five of the nine independent variables in the full model were significant predictors of prenatal smoking status, although the model as a whole was significant [$\chi^2 = 214.641, (24, N = 342), p < .001$]. Using backward elimination, variables were removed one at a time according to the least significant p -value in the following order: marital status, age, and the quality of the primary intimate relationship. The progression of model fitting is outlined in Table 12. In the final model, SES, chronic stressors, race, SHS exposure, parity, and depressive symptoms were independent predictors of prenatal smoking. Model fit was assessed using the likelihood ratio test, and the AIC and BIC fit statistics. The difference in the log likelihoods of the two models was not significant [$\chi^2 (6, N = 342) = 1.987, p > .05$]; however, both the AIC

and BIC indicated better fit of the final model (see Table 12). Based on these results, the more parsimonious final model was chosen as the preferred best predictive model.

The parameter estimates in the final model (see Table 14) indicated that SHS exposure and SES were the strongest predictors of nonsmoking versus persistent smoking status. Women who were not exposed to SHS had almost 21 times the odds of being a nonsmoker compared to a persistent smoker. Women in the lowest SES level had .065 times the odds of being a nonsmoker versus a persistent smoker. Parity, depressive symptoms, and chronic stressors also predicted nonsmoking versus persistent smoking status. Race did not influence the odds of being a nonsmoker versus a persistent smoker.

The strongest predictor of spontaneous quitter versus persistent smoker status was race followed by parity and SHS exposure. None of the other variables had significant parameter estimates. Non-White women had almost five times the odds of being a spontaneous quitter versus a persistent smoker. Both primiparas and women who were not exposed to SHS had increased odds of being a spontaneous quitter. Primiparas had four times the odds, and women not exposed to SHS had three times the odds of being a spontaneous quitter.

Discussion

The prevalence of smoking in this group of pregnant women is comparable to recent statistics reported for Kentucky. Twenty-three percent of participants in this sample smoked compared to 25.1% in Kentucky (Osterman, Martin, Mathews, & Hamilton, 2011).

Sociodemographic and personal characteristics clearly differentiated nonsmokers from persistent smokers. This supports what has already been shown in the literature,

namely that pregnant smokers, compared to nonsmokers, are more likely to have a lower income (Tong et al., 2009), educational level (Higgins et al., 2009; Kahn, Certain, & Whitaker, 2002; Tong et al., 2009), and employment status (Penn & Owen, 2002), and be unmarried (Adams et al., 2008), multiparous (Colman & Joyce, 2002; Kahn et al., 2002), and younger (Goodwin et al., 2007; Tong et al., 2009).

Psychosocial variables also differentiated these two groups. Persistent smokers had higher levels of chronic stressors and depressive symptoms and lower quality of the primary intimate relationship compared to nonsmokers. Differences in stress (Bullock et al., 2001) and depressive symptoms (Zhu & Valbo, 2002) between these two groups were previously reported. The quality of the primary intimate relationship had not previously been tested as a potential predictor of prenatal smoking status.

Two smoking related variables differentiated among all three smoking status groups. Indoor SHS exposure and nicotine dependence increased from group to group in this order: nonsmoker, spontaneous quitter, and persistent smoker. This is consistent with prior research. Higher levels of nicotine dependence were positively associated with persistent smoking (Colman & Joyce, 2003; Ockene et al., 2002) and negatively associated with spontaneous cessation (Crittenden et al., 2007). SHS exposure from a partner or from other smokers in the household was independently associated with a lower likelihood of quitting smoking during pregnancy (Kahn et al., 2002; Ockene et al., 2002).

The proportion of non-Whites and primiparous spontaneous quitters was greater than that of persistent smokers confirming what has been found in previous research (Cluss et al., 2011; Colman & Joyce, 2003). That these two groups only differed on race

and parity is notable since studies have shown that spontaneous quitters are more likely to have a higher income and education (Curry, McBride, Grothaus, Lando, & Pirie, 2001), be married (Curry et al., 2001), and have higher levels of stress (Ockene et al., 2002). Lack of power may be one reason that this study could not detect differences between spontaneous quitters and persistent smokers. Categorical comparisons between these two groups for all sociodemographic and personal variables (aside from race) were underpowered, as were the ANOVA comparisons. Another possible reason may be that differences between spontaneous quitters and persistent smokers were more subtle and difficult to detect since studies have shown that for some women, prenatal smoking cessation may only be temporary (Stotts, DiClemente, Carbonari, & Mullen, 1996). Pregnant smokers differ markedly from non-pregnant smokers in the processes they use to quit smoking. Spontaneous quitters have a high level of self-efficacy and a low usage of internal processes of change suggesting that they are externally motivated by their pregnancy to quit (Ruggiero et al., 2000; Stotts, DiClemente, Carbonari, & Mullen, 2000; Stotts et al., 1996). High rates of postpartum relapse (Colman & Joyce, 2003) lend support to the notion that spontaneous quitters are smokers who merely suspend their behavior.

Testing of the Gallo and Matthews Model

Mediation in the model. This study tested a conceptual model of cognitive and emotional pathways that link SES to prenatal smoking status. The model was broken down into five hypotheses that tested four mediators and one moderator of the relationship between low SES and prenatal smoking status.

The first two hypotheses were supported. Controlling for parity, age, race, marital status, and SHS exposure, the effect of SES on depressive symptoms was mediated by chronic stressors and the quality of the primary intimate relationship. Significant indirect effects indicated that as SES level increased, chronic stressors decreased. Chronic stressors was directly related to depressive symptoms. Controlling for SES, as the level of chronic stressors increased, so did depressive symptoms. SES also was positively related to the quality of a woman's primary intimate relationship. As SES increased, so did the quality of the relationship. As the quality of the relationship increased (controlling for SES), depressive symptoms declined.

These findings were consistent with prior research that reported similar associations among low SES, stress, depressive symptoms and social support. Individuals with low SES are more likely to encounter or live in stress inducing environments (Baum, Garofalo, & Yali, 1999; Mathews et al., 2010) and low SES has an inverse relationship with depression (Gallo & Matthews, 2003). In previous prenatal research, low SES women had higher levels of stress and negative affect (Businelle et al., 2013; Crittenden et al., 2007) and lower levels of social support (Bullock et al., 2009; Nichter et al., 2007) compared to those with high SES. High levels of chronic stressors were associated with high levels of depressive symptoms in low-income mothers (Hall et al., 1985). Low levels of the quality of a woman's relationship with her husband were associated with a slight increase in depressive symptoms in low-income mothers (Hall et al., 1985).

Level of depressive symptoms partially mediated the relationship between chronic stressors and smoking status. The positive coefficient of the total effect of chronic

stressors on smoking status indicated that as chronic stress levels increased, the likelihood of being a persistent prenatal smoker also increased by 2%. This small increase in odds is partially explained by a significant indirect effect through depressive symptoms.

In the final mediation hypothesis, depressive symptoms fully mediated the small effect of the quality of the primary intimate relationship on smoking status. The quality of a woman's relationship with her primary intimate was directly related to depressive symptoms, and as depressive symptoms increased by one unit, the likelihood of being a persistent smoker versus a nonsmoker increased by 4%. These two pathways fully explain the relationship between the quality of the primary intimate relationship and smoking status.

This mediation analysis suggests that the three psychosocial variables of chronic stressors, depressive symptoms, and the quality of the primary intimate relationship have key roles in the pathways that lead from SES to prenatal smoking status. By recognizing these mediational pathways, prevention and intervention strategies can be designed to target these variables and ultimately improve prenatal smoking outcomes.

Moderation in the model. The moderator hypothesis was tested to see if the strength of the association between chronic stressors and depressive symptoms differed based on the level of the quality of the primary intimate relationship. There was no evidence of moderation, even when controlling for type of intimate; however, as shown in the indirect paths of the mediation analysis, the main effects of chronic stressors and quality of the primary intimate relationship on depressive symptoms were significant.

Chronic stressors was positively related to depressive symptoms whereas the quality of the primary intimate relationship was negatively related to depressive symptoms.

Previous studies support the hypothesis that social support buffers the impact of stress on depressive symptoms. For example, social support and good quality of the partner relationship moderated the effect of various stressors on adverse psychological outcomes (Divney et al., 2012; Rosand, Slinning, Eberhard-Gran, Roysamb, 2012). Other studies, including the current one, did not find that the quality of support acted as a moderator (Aneshensel & Stone, 1982). The significant main effect of the quality of the primary intimate relationship on depressive symptoms was demonstrated in previous research (Hall et al., 1985). This is an important finding for understanding the pathways that lead to prenatal smoking in low SES women.

These analyses provided evidence to support the use of the Gallo and Matthews Reserve Capacity Model as a framework for understanding the relationship between SES and prenatal smoking. Evidence for the moderating role of the quality of the primary intimate relationship was absent; however, all three psychosocial variables were instrumental as mediators of the relationship between SES and prenatal smoking status. Chronic stressors, depressive symptoms, and the quality of the primary intimate relationship all contributed to the explanation of the relationship between SES and prenatal smoking behavior

Predictors of Prenatal Smoking Status

Consistent with previous research (Colman & Joyce, 2003; Ockene et al., 2002; Penn & Owen, 2002; Ward, Vander Weg, Sell, Scarinci, Cocke Read, 2006; Zhu & Valbo, 2002), the final model contained five significant predictors of prenatal smoking

status: SES, chronic stressors, race, SHS exposure, parity, and depressive symptoms. In the final model, SHS exposure was the strongest predictor of the probability of nonsmoking versus persistent smoking. Women who were not exposed to indoor SHS smoke had almost 21 times the odds of being a nonsmoker versus a persistent smoker. This mirrors the findings of Penn and Owen (2002) who found that partner smoking status and SHS exposure were the two strongest predictors of current smoking status. SES was the second strongest predictor of nonsmoking status. Women in the lowest SES level had .065 times the odds of being a nonsmoker versus a persistent smoker when compared to women in the highest SES level. Taking the inverse of these odds, women in the lowest SES level had 15 times the odds of being a persistent smoker versus a nonsmoker compared to women in the highest SES level. This comes as no surprise given the strong association between SES and prenatal smoking demonstrated in the research and clinical literature (Colman & Joyce, 2003; Fiore et al., 2008; Lumley et al., 2009; Ockene et al., 2002; Penn & Owen, 2002).

Predictors of spontaneous cessation differed from predictors of nonsmoking status. The strongest predictor of being a spontaneous quitter versus a persistent smoker was race, followed by parity, then SHS exposure. Being a non-white woman increased the odds of being a spontaneous quitter versus a persistent smoker by 4.7. The literature on race and spontaneous cessation in pregnancy is inconclusive. Some studies found a higher proportion of White women quit, whereas other studies reported Black and Hispanic women were more likely to quit (Solomon & Quinn, 2004).

Primiparas were almost four times more likely to be a spontaneous quitter than a persistent smoker. Other researchers found a similar association between parity and

spontaneous cessation (Curry et al., 2001; Ockene et al., 2002). SHS exposure was the third strongest predictor of the likelihood of being a spontaneous quitter. Women who were not exposed to indoor SHS had three times the odds of being a spontaneous quitter versus a persistent smoker. Other studies have also found that lower levels of SHS exposure were significantly associated with spontaneous cessation (Dejin-Karlsson et al., 1996; Ockene et al., 2002).

Unlike other studies (Colman & Joyce, 2003; Holtrop et al., 2010; Penn & Owen, 2002), age and marital status did not predict prenatal smoking status in the current study. There are three possible reasons age was not a predictor of smoking status in the final model. First, age did not differentiate spontaneous quitters from persistent smokers in our sample. Second, the difference in mean age between nonsmokers and the other two groups was only two years. Third, the literature is inconsistent on age differences between spontaneous quitters and persistent smokers (Solomon & Quinn, 2004).

Marital status did not predict prenatal smoking status, unlike other studies that showed a strong association between the two (Colman & Joyce, 2003; Holtrop et al., 2010; Penn & Owen, 2002; Solomon & Quinn, 2004). In contrast with other studies (e.g., Curry et al., 2001), SES was not an independent predictor of spontaneous cessation in this study. Variables not included in this study were associated with spontaneous cessation in prior research including: having a planned pregnancy (Curry et al., 2001; Dejin-Karlsson et al., 1996); intention to breastfeed (O'Campo, Faden, Brown, & Gielen, 1992); morning sickness (Curry et al.); and lower levels of nicotine dependence (Cluss et al., 2011; Ockene et al., 2002). Previous studies of the relationships between

psychosocial characteristics and spontaneous cessation are not conclusive (Solomon & Quinn, 2004). The present study sheds light on these relationships.

The quality of the primary intimate relationship has not been previously studied as a predictor of prenatal smoking. Although our final model suggested that the quality of the primary intimate relationship was not an independent predictor of prenatal smoking status, the mediation analyses in this study showed that it played an important role as a mediator of the relationship between SES and depressive symptoms, which in turn predicted smoking status.

This study examined psychosocial predictors of prenatal smoking in two ways. These two approaches are not inconsistent from one another. Two of the three psychosocial mediators tested in the Gallo and Matthews model were significant predictors in our final multinomial regression model. Although the quality of the primary intimate relationship was not included as an independent predictor, mediation analyses suggest that its primary role in the prenatal smoking pathway may be as a mediator.

Limitations

The method of smoking status assignment in this study may not have allowed for precise discrimination of the women's smoking status. The NS group, for example, included women who were never smokers and women whose survey answers indicated that they had quit smoking over one year ago. The grouping method also may not have captured occasional smokers or those who reduced the number of cigarettes smoked per day. Jhun et al. (2010) suggest that low levels of urine cotinine may not necessarily reflect quit status since pregnant women metabolize nicotine very rapidly.

Statistical analysis restrictions were present in this study. Nicotine dependence is a known predictor of prenatal smoking status, but it could not be included as an independent variable in the multinomial logistic regression analysis because the nature of the question/response caused instability in the model. The trichotomous outcome of smoking status also limited the statistical analysis and required the collapsing of smoking status groups for testing two of the hypotheses.

Recommendations for Future Research

Future studies must go beyond the longstanding variables examined in previous literature as potential predictors of smoking in the prenatal period. New variables must be studied in order to better understand the context of prenatal smoking. Qualitative studies with spontaneous quitters and persistent prenatal smokers may uncover perceptions, motivation, and barriers related to smoking cessation in pregnancy that warrant closer examination in hypothesis testing studies. Development of new tools to measure these variables and consistency in measurement of known variables will enhance the science and the translation of research into interventions. In order to provide a framework for these new variables, theoretical models must also be expanded to incorporate a multifactorial approach to prenatal smoking research. Finally, studies designed to capture this complexity are needed. Analysis strategies that can accommodate latent variables like SES, stressors, and motivation as well as multiple mediators and moderators will be able to more comprehensively assess the pathways and mechanisms that contribute to prenatal smoking in this population.

Table 5

*Sociodemographic and Personal Characteristics of the Sample of Pregnant Women
(N = 371)*

Characteristic	Frequency	%
Annual Household Income (<i>n</i> = 360)		
< \$20,000	143	38.5
\$20,000 – 39,999	75	20.2
> \$40,000	142	38.3
Missing	11	3.0
Education (<i>n</i> = 368)		
≤ High School	129	34.8
> High School	239	64.4
Missing	3	0.8
Employment Status (<i>n</i> = 369)		
Not Employed	134	36.1
Employed Part/Full-time	235	63.3
Missing	2	0.5
Race (<i>n</i> = 367)		
White	245	66.0
African American	54	14.6
Hispanic or Latina	53	14.3
Asian	8	2.2
Other	7	1.9
Missing	4	1.1
Marital Status (<i>n</i> = 369)		
Single/Divorced/Separated	105	28.3
Living with Partner/Married	264	71.2
Missing	2	0.5
Term Deliveries (<i>n</i> = 305)		
0	209	56.3
≥ 1	96	25.9
Missing	66	17.8
Indoor SHS Exposure (<i>n</i> = 367)		
Not Exposed	266	71.7
Exposed	101	27.2
Missing	4	1.1
CPD 3 months pre-pregnancy (<i>n</i> = 365)		
None	251	67.7
Up to 10	55	14.8
11-20	37	10.0
> 20	22	5.9
Missing	6	1.6

Table 6

Descriptive Statistics and Cronbach's Alphas for the Psychosocial Variables^a

Variable	Mean (SD)	Actual Range	Potential Range	Cronbach's Alpha
Edinburgh Postnatal Depression Scale	5.71 (4.99)	0 – 27	0 – 30	.87
Everyday Stressors Index	30.61 (8.51)	20 – 66	0 – 60	.86
Autonomy and Relatedness Inventory	110.10 (15.97)	29 – 128	0 – 120	.94

^aSample size varies from 357 to 369 due to missing data.

Table 7

<i>Association of Sociodemographic and Personal Characteristics with Smoking Status^a</i>					
Variable	Smoking Status Group ^b			χ^2	Cramer's V
	NS (n = 197)	SQ (n = 89)	PPS (n = 85)		
Annual Household Income ^x					
< \$20,000	22.2%	63.7%	58.5%	88.32***	.35
\$20,000 – 39,999	17.2%	21.3%	29.3%		
≥ \$40,000	60.6%	15.0%	12.2%		
Education ^x					
≤ High School	17.0%	59.5%	53.6%	63.38***	.42
> High School	83.0%	40.5%	46.4%		
Employment Status ^x					
Unemployed	26.9%	41.7%	53.6%	19.62***	.23
Employed	73.1%	58.3%	46.4%		
Race ^y					
Non-Caucasian	23.5%	60.2%	29.8%	36.28***	.31
Caucasian	76.5%	39.8%	70.2%		
Marital Status ^x					
Single/Divorced/Separated	18.4%	44.0%	36.9%	22.94***	.25
Married/Partner	81.6%	56.0%	63.1%		
Parity ^y					
No live birth	72.7%	72.7%	55.7%	7.8*	.16
≥ 1 live birth	27.3%	27.3%	44.3%		
Exposure to SHS ^z					
Not Exposed	93.0%	59.3%	36.5%	104.93***	.54
Exposed	7.0%	40.7%	63.5%		
Cigarettes per Day 3 months Prior to Pregnancy ^z					
None	98.0%	54.2%	10.0%	232.58**	.56
Up to 10	2.0%	27.7%	35.0%		
11-20	0.0%	14.5%	31.3%		
> 20	0.0%	3.6%	23.8%		

^aSample size varies from 306 to 369 due to missing data.

^bNS = Non-Smoker; SQ = Spontaneous Quitter; PPS = Persistent Prenatal Smoker

^xSignificant difference between NS and PPS.

^ySignificant difference between SQ and PPS

^zSignificant difference between all three groups

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 8

Comparison of Means of Psychosocial Variables by Smoking Status^a

Variable	Smoking Status Group ^b			<i>F</i>	df	<i>p</i>
	NS	SQ	PPS			
Autonomy and ^x Relatedness Inventory	113.96 (12.43)	102.67 (18.96)	108.07 (17.53)	16.49	2	<.001
Everyday Stressors Index ^x	27.82 (6.43)	33.48 (9.47)	34.41 (9.50)	27.29	2	<.001
Edinburgh Postnatal Depression Scale ^x	4.09 (4.03)	7.10 (5.02)	8.22 (5.61)	28.03	2	<.001

^aSample size varies from 357 to 369 due to missing data.

^bNS = Non-Smoker; SQ = Spontaneous Quitter; PPS = Persistent Prenatal Smoker

^xSignificant difference between NS and PPS.

Note. Standard deviations appear in parentheses below the means. Means with significant differences are significantly different at the .05 level based on Tukey's HSD post hoc paired comparisons.

Table 9

Effects of Parallel Multiple Mediators (Chronic Stressors and Quality of the Primary Intimate Relationship) on the Relationship between SES and Depressive Symptoms (N = 346)

Paths	B	β	LL ^a 95%	UL ^a 95%
Total Effect (c) of SES → Depressive symptoms	-1.10 ^{***}	-.33 ^{***}	--	--
Direct Effect (c') of SES → Depressive symptoms (Controlling for both mediators)	-.31	-.09	--	--
Indirect Effect through Chronic Stressors (a1*b1)	-.50	-.15	-.76	-.30
Indirect Effect through the Quality of the Primary Intimate Relationship (a2*b2)	-.29	-.09	-.51	-.14
Comparison of Difference between Indirect Effects (a1b1 – a2b2)	-.21	-.06	-.52	.08

^aConfidence Intervals are for unstandardized coefficients

** $p < .01$; *** $p < .001$

Note. Analyses controlled for parity, age, race, marital status, and SHS exposure

Table 10

Analysis of Mediation Relationships Based on the Gallo and Matthews Reserve Capacity Model^a

Mediation Hypotheses	Total Effect ^b		Direct Effect ^b		Indirect Effect				Mediator Paths			
	(c)		(c')						a		b ^b	
	B	OR	B	OR	B	OR	LL ^c 95%	UL ^c 95%	B	OR	B	OR
Chronic stressors → Smoking Status (^d Depressive symptoms)	.02 ^{***}	1.02	.01 [*]	1.01	.01 ^{**}	1.01	.003	.02	.30 ^{***}	1.35	.03 ^{**}	1.03
Quality of the primary intimate relationship → Smoking Status (^d Depressive symptoms)	-.007 ^{**}	.99	-.002	.998	-.005 ^{***}	.995	-.008	-.002	-.13 ^{***}	.88	.04 ^{***}	1.04

^aSample size varies from 349 to 360 due to missing data.

^bMediation analysis performed using logistic regression modelling the probability of being a smoker versus a nonsmoker.

^cConfidence Intervals are for unstandardized coefficients.

^dMediated by depressive symptoms.

Note. Analyses controlled for parity, age, race, marital status, and SHS exposure.

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 11

Multiple Regression Analyses of the Effect of the Quality of the Primary Intimate Relationship (QPIR) as a Potential Moderator of the Association between Chronic Stressors and Depressive Symptoms (N = 347)

Step/Variables in the Model	B	β	R ²	ΔR^2	F Change
All Primary Intimates					
Step 1: Chronic Stressors	.25 ^{***}	.42 ^{***}	.437	--	--
QPIR	-.08 ^{***}	-.25 ^{***}			
Step 2: Chronic Stressors	.25 ^{***}	.42 ^{***}	.437	.000	.004
QPIR	-.08 ^{***}	-.25 ^{***}			
Chronic Stressors X QPIR	.000	.001			
Husband/Partner/Boyfriend					
Step 1: Chronic Stressors	.25 ^{***}	.42 ^{***}	.443	--	--
QPIR	-.08 ^{***}	-.25 ^{***}			
Intimate Type	-1.03	-.10			
Step 2: Chronic Stressors	.25 ^{***}	.42 ^{***}	.443	.000	.007
QPIR	-.08 ^{***}	-.25 ^{***}			
Intimate Type	-1.03	-.10			
Chronic Stressors X QPIR	.00	-.004			

Note. Analyses controlled for parity, age, race, marital status, and SHS exposure.

** $p < .01$; *** $p < .001$

Table 12

Summary of Multinomial Logistic Modeling for Predictors of Prenatal Smoking Status (Nonsmoker, Spontaneous Quitter, or Persistent Smoker)^{a,b}

Modeling Steps	Model Fit	Likelihood Ratio Test χ^2								
		SES	Chronic Stressors	Race	SHS Exposure	Parity	Depressive Symptoms	QPIR	Age	Marital Status
Full Model										
AIC ^b	519.771	25.157**	5.717	11.825**	56.238***	9.163*	7.918*	2.832	.472	.061
BIC	619.476									
Step 1										
AIC	515.832	25.450**	5.757	14.274**	56.340***	9.369**	7.859*	2.775	.490	
BIC	607.868									
Step 2										
AIC	510.935	27.114**	6.439*	14.316**	55.914***	10.160**	8.015*	2.767		
BIC	595.301									
Step 3										
AIC	505.784	29.634***	6.841*	15.824***	60.869***	13.530**	7.034*			
BIC	583.057									

^aPersistent prenatal smoker is the reference group.

^bSample size varies from 342 to 352 due to missing data.

^cAIC = Akaike Information Criterion; BIC = Bayesian Information Criterion. Both are fit statistics that allow for the comparison of nested and non-nested models.

Note. QPIR = Quality of Primary Intimate Relationship

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 13

Multinomial Logistic Regression of Predictors of the Likelihood of Being a Nonsmoker or a Spontaneous Quitter versus a Persistent Prenatal Smoker – Full Model (N = 342)

Variables	NS vs. PPS			SQ vs. PPS		
	B	df	OR	B	df	OR
SES Level (vs. Level 4)						
0	-3.085 ^{***}	1	.046	-.632	1	.532
1	-1.909 ^{**}	1	.148	-.245	1	.783
2	-.595	1	.551	.156	1	1.269
3	-1.256 [*]	1	.285	-.428	1	.652
Chronic Stressors	-.055 [*]	1	.946	-.001	1	.998
Race (Non-White vs. White)	.740	1	2.096	1.468 ^{**}	1	4.339
SHS (Not exposed vs. Exposed)	2.982 ^{***}	1	19.730	1.033 ^{**}	1	2.811
Parity (Primiparous vs. Multiparous)	.862 [*]	1	2.369	1.189 ^{**}	1	3.283
Depressive Symptoms	-.114 [*]	1	.892	-.100 [*]	1	.905
Quality of the Primary Intimate Relationship	-.008	1	.992	-.020	1	.980
Marital Status (Single vs. Married/Partnered)	.085	1	1.088	.104	1	1.109
Age	-.025	1	.975	-.005	1	.995

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 14

Multinomial Logistic Regression of Predictors of the Likelihood of Persistent Prenatal Smoking – Final Model (N = 352)

Variable	NS vs. PPS			SQ vs. PPS		
	B	df	Exp (B)	B	df	Exp (B)
SES Level (vs. Level 4)						
0	-2.726 ^{***}	1	.065	-.315	1	.730
1	-1.747 [*]	1	.174	-.124	1	.883
2	-.435	1	.647	.287	1	1.332
3	-1.220 [*]	1	.295	-.422	1	.656
Chronic Stressors	-.057 [*]	1	.945	-.002	1	.998
Race (Non-White vs. White)	.793	1	2.211	1.544 ^{***}	1	4.682
SHS (Not exposed vs. Exposed)	3.035 ^{***}	1	20.801	1.100 ^{**}	1	3.004
Parity (primiparous vs. multiparous)	1.005 ^{**}	1	2.732	1.354 ^{**}	1	3.874
Depressive Symptoms	-.110 [*]	1	.895	-.072	1	.931

* $p < .05$; ** $p < .01$; *** $p < .001$

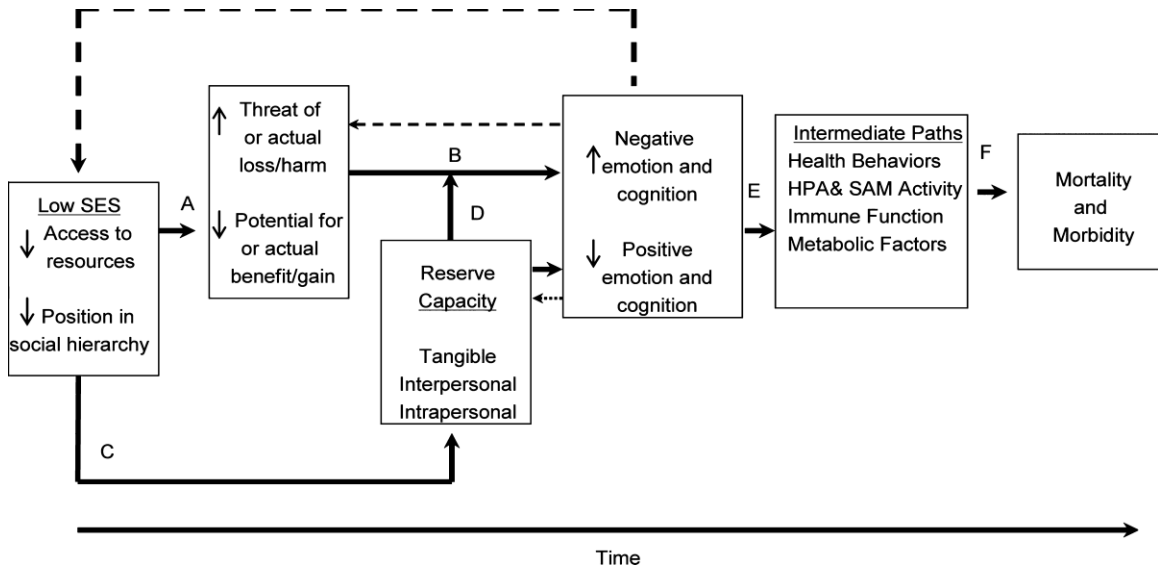


Figure 1. The Gallo and Matthews Reserve Capacity Model (Gallo & Matthews, 2003, p. 34). Permission not required for use of one figure per *Psychological Bulletin* website. <http://www.apa.org/about/contact/copyright/index.aspx#not-required>)

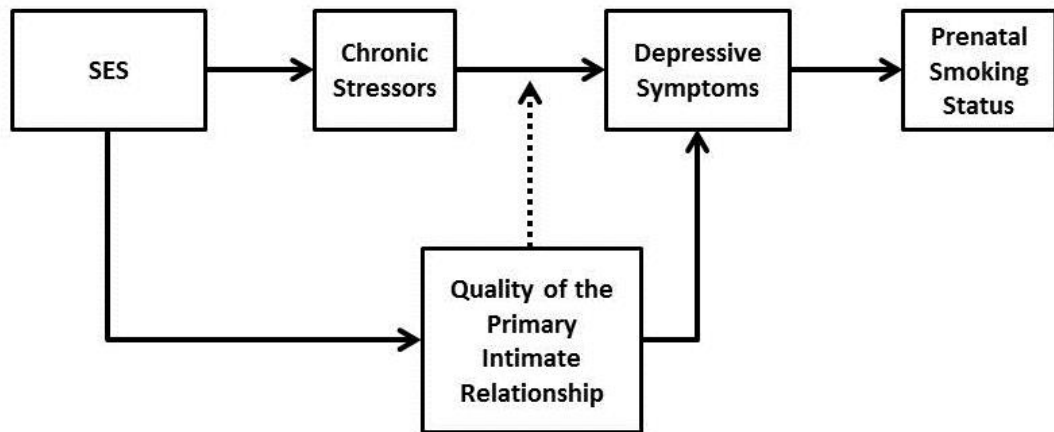


Figure 2. Proposed relationships among SES, chronic stressors, quality of the primary intimate relationship, depressive symptoms and prenatal smoking status.

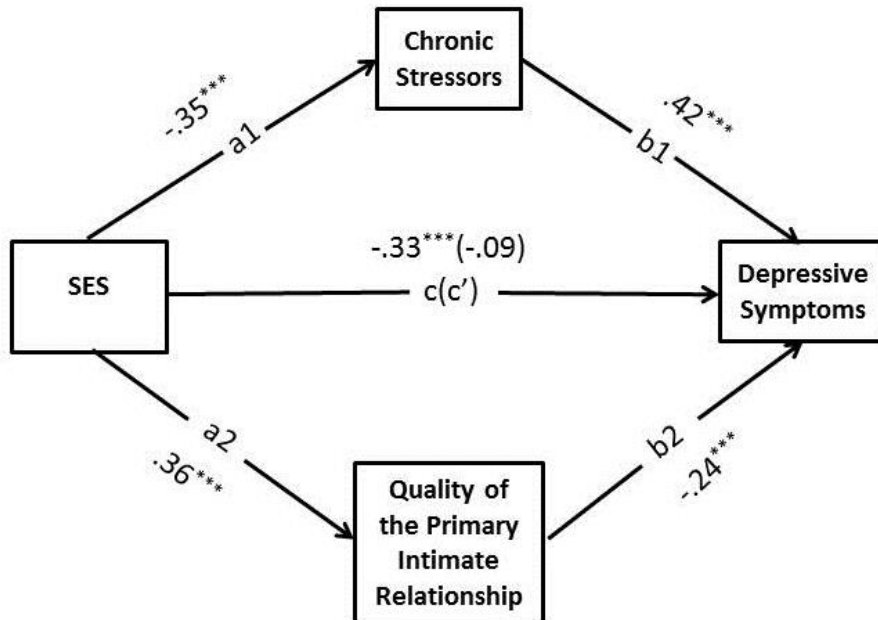


Figure 3. Model of two parallel mediators of the relationship between low SES and depressive symptoms. All values represent standardized coefficients. *** $p < .001$

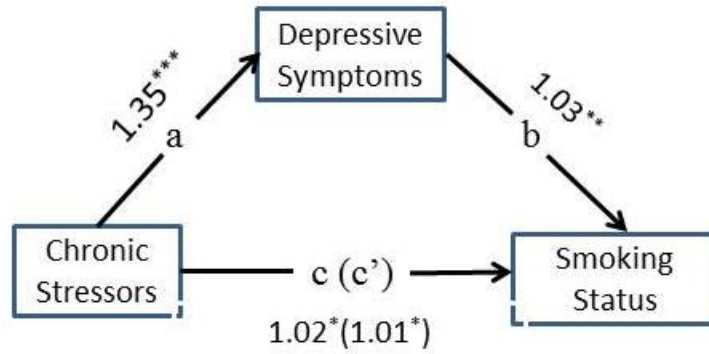


Figure 4. The effect of chronic stress on prenatal smoking status mediated by depressive symptoms. All values represent odds ratios. * $p < .05$; ** $p < .01$; *** $p < .001$

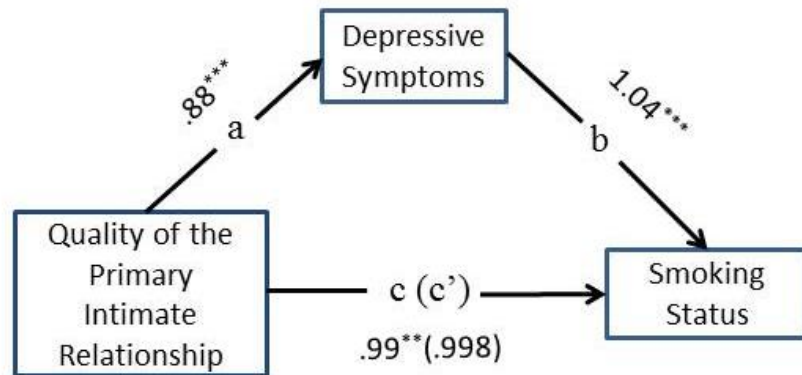


Figure 5. The effect of the quality of the primary intimate relationship on prenatal smoking status mediated by depressive symptoms. All values represent odds ratios.

* $p < .05$; ** $p < .01$; *** $p < .001$

CHAPTER V

DISCUSSION AND CONCLUSIONS

The purposes of this dissertation were to: (1) critically review the literature on prenatal smoking in low socioeconomic status (SES) women to identify characteristics unique to this population; (2) review and evaluate the psychometric properties of nicotine dependence measures used in perinatal smoking research; and (3) evaluate three psychosocial variables as potential mediators or moderators of the relationship between SES and prenatal smoking status.

Synthesis of Findings and Implications

In Chapter Two, the review of prenatal smoking literature revealed that many of the factors associated with prenatal smoking in low SES women mirror those of the broader population of pregnant smokers. As reflected in the general prenatal smoking research, low SES pregnant smokers are: White (Kahn et al., 2002), unmarried (Bullock et al., 2001; Kahn et al., 2002), and multiparous (Colman & Joyce, 2003). They have: high rates of unintended pregnancy (Zhu & Valbo, 2002); higher levels of nicotine dependence (Hakansson et al., 1999), secondhand smoke (SHS) exposure (Kahn et al., 2002), stress (Bullock et al., 2001), depressive symptoms (Zhu & Valbo, 2002); and lower levels of social support (Bullock et al., 2001). Multivariate analyses from Chapter Four supported these findings. The final predictive model of prenatal smoking status

contained six significant predictors: SES, chronic stressors, race, SHS exposure, parity, and depressive symptoms.

It is important to note, however, that many of these studies, including Chapter Four, though not specifically focused on low SES women, report that the majority of the smokers have low SES indicators (Colman & Joyce, 2003; Kahn et al., 2002; Zhu & Valbo, 2002). This suggests that many of the factors associated with prenatal smoking may in fact be factors unique to a low SES population.

Rethinking Traditional Variables and Uncovering New Variables Linked to Prenatal Smoking in Low SES Women

Prenatal smoking research has uncovered several factors that comprise the profile of a prenatal smoker. Chapter Two revealed that many of these characteristics apply to low SES pregnant smokers. Future research needs to focus on a clearer, more detailed profile of the low SES pregnant smoker. This is required in order to develop effective prevention strategies and cessation interventions for this population.

Chapter Two contributed to this effort by uncovering a clearer picture of several traditional variables associated with prenatal smoking. Although the overwhelming majority of women in the studies reviewed were unmarried, marital status in low SES women may be a “fluid and transient category” (Nichter et al, 2007, p. 751). Therefore, marital status may not provide a good point of comparison for smokers and nonsmokers. Rather, the quality of the marital relationship may be more meaningful to assess.

Few studies have explored the relationship of the quality of social support to prenatal smoking (Morales et al., 1997). Chapter Four examined the association of the quality of a woman’s primary intimate relationship with prenatal smoking. The majority

of the women in the study (64%) identified a husband/boyfriend/partner as their primary intimate. Although the quality of the primary intimate relationship was not a direct predictor of prenatal smoking status, it played a very important role as a mediator of the pathway between SES and prenatal smoking status.

Related to the quality of relationships is the issue of abuse that was highlighted in Chapter Two. Low SES smokers were more likely to report physical abuse before and during their pregnancy (Adams et al., 2008; Bullock et al., 2001); rates of abuse range from 16% -22% (Jesse et al., 2006; Nichter et al., 2007). Although none of the studies reported the specific source of abuse, Nichter et al. indicated that most of the women described themselves as being in “high-stress relationships” (p. 751) and Bullock et al. described the abuse as being within the family. The results of Chapters Two and Four suggest that assessing the quality of a woman’s primary intimate relationship is important for low SES pregnant smokers.

Linking Psychosocial Variables

In order to further the field of prenatal science research, studies must move beyond a focus on independent predictors of prenatal smoking to uncover the complex interrelationships and pathways among the variables that influence prenatal smoking. Using the Gallo and Matthews (2003) Reserve Capacity Model as a framework in Chapter Four, psychosocial variables that linked SES to prenatal smoking were identified. First, SES was inversely related to chronic stressors. Low SES women were vulnerable to higher levels of chronic stressors. This, in turn, increased their vulnerability to depressive symptoms. The quality of the primary intimate relationship was also affected by SES. Women with lower levels of SES had a lower quality of

primary intimate relationships which was associated with increased levels of depressive symptoms. Depressive symptoms directly increased the odds of being a prenatal smoker. In addition to the direct relationships, chronic stressors, the quality of the primary intimate relationship, and depressive symptoms mediated the pathway from SES to prenatal smoking status.

These findings have both practice and research implications. Smoking cessation interventions must address the psychosocial variables identified as important factors in predicting prenatal smoking. In the Gallo and Matthews model, stress is the first variable in the pathway that leads to adverse health behaviors. Interventions that focus on stress management are known to be important for smoking cessation (Fiore et al., 2008). Stress management for low SES women, however, needs to be tailored to relevant sources of stress. For example, two of the stressors identified by low SES women were parenting challenges and personal health concerns (Pletsch et al., 2003). Offering parenting support groups or taking advantage of the prenatal window for health intervention to address other personal health issue may mitigate the pathway from low SES to increased levels of chronic stressors.

Prenatal care may need to incorporate the assessment of other psychosocial variables and factors unique to low SES women including: screening for depressive symptoms, mental illness, drug and/or alcohol abuse, family dynamics, and social support network. Each of these has been implicated as a factor in prenatal smoking among low SES women. The challenge for researchers and practitioners is to find in depth, relevant, and practical assessment tools.

Addressing some issues commonly faced by low SES women may require a more upstream approach. Stress that results from violent neighborhoods or a woman's perception that she is not safe necessitates involvement on an urban planning and policy level. Approaches must also be collaborative and interdisciplinary if they are to be effective. Going beyond the prenatal healthcare provider to collaborate with social workers, psychologists, community activists, law enforcement, and urban planners broadens the possibilities for prenatal smoking prevention and intervention.

In order to accommodate the multifaceted nature of prenatal smoking, future research studies must be designed to capture complexity. Theoretical models should be expanded to incorporate a multifactorial approach to prenatal smoking. Analyses strategies should be able to accommodate latent variables like SES, stressors, and motivation as well as multiple mediators and moderators to more comprehensively assess the pathways and mechanisms that contribute to prenatal smoking.

Measurement of Variables

SES. Oakes and Rossi (2013) state that the gap between SES measurement and SES health studies is large. This is evident in prenatal research. One method of measuring SES is to create a composite variable of indicators as was done in Chapter Three. Other studies have done the same (Ickovics & Viscoli; Janicki-Deverts et al., 2007; Romero et al., 2007). There are established SES measures available (Oakes & Rossi), but these are not commonly used in perinatal research and have not been tested in this population. Most often, studies use single items like income, education, or employment status, to measure SES. Although these indicators are important aspects of the construct, Oakes and Rossi suggest that health researchers need measures that can

capture a more contextual understanding of SES, if they are to gain insight into the social context, networks, and environment that affect health behavior.

Furthermore, even the individual indices may need some reevaluation to accurately assess the context of low SES prenatal smokers. Several studies reviewed in Chapter Two reported that low SES pregnant smokers are employed. Rates of employed women ranged from 54% (Song & Fish, 2006) to 81% (Petersen et al., 2005). Future studies may need to investigate the relationship of employment type to prenatal smoking status rather than unemployment versus employment. Similarly, a high school diploma may not provide an appropriate cut-off for classifying study participants as low SES. Fifteen out of 27 of the studies reviewed indicated that pregnant smokers had a minimum of a high school degree. Percentages of prenatal smokers with greater than a high school degree ranged from 54.9% (Woodby et al., 1999) to 74% (Higgins et al., 2009).

Stress. Measurement of psychosocial variables presents another challenge to prenatal smoking research in low SES populations. For example, stress was identified as a significant contributing factor to prenatal smoking in both Chapters Two and Four. In Chapter Two, the majority of the studies that measured stress used the 4- or 10-item Perceived Stress Scale (PSS). Reports on the results of the scale, however, were inconsistent. One study reported mean scores not appropriate to the range of the scale (Bullock et al., 2009). Another combined the PSS-4 with items from different scales to create a composite score for emotional wellbeing (Ockene et al., 2002), and another used an unidentified scale to measure increased levels of stress in the week prior to the study (Higgins et al., 2009). Considering the important role that stress plays in prenatal smoking in this population, consistency of measurement is critical.

Sources of stress reported in the studies reviewed in Chapter Two have implications for the kinds of stress measure chosen. Sources of stress in low SES women reported in the literature included: physical altercations, illicit drug use (Adams et al., 2008); parenting challenges, living in disruptive home environments, violent neighborhoods, lack of social support, and personal health problems (Pletsch et al., 2003); and perceived safety and neighborhood violence (Patterson et al., 2012).

Understanding the source of stress is critical for researchers to select effective measures for use in studies and for practitioners to provide appropriate assessment. The study presented in Chapter Four used the Everyday Stressors Index (ESI). The ESI was developed for the purpose of measuring maternal perceptions of daily chronic stressors in low-income women (Hall, 1983). Items on the ESI address all of the common stress sources identified by low SES women in Chapter Two. With a history of excellent reliability in low-income mothers, the ESI also had a strong alpha in this study (.87). The ESI may be a useful and relevant measure for assessing chronic stressors in low SES women.

Nicotine Dependence. Both Chapters Two and Four showed that nicotine dependence is an important factor in prenatal smoking. Measurement of nicotine dependence, however, is challenging because of a lack of clarity in the conceptual definition of the construct. This lack of clarity is reflected in the measurement of the construct across studies. The majority of the reviewed studies in Chapter Two measured consumption as the number of cigarettes per day (CPD) smoked. Some studies also examined the time it took for a woman to smoke her first cigarette of the day (TTF). These two items comprise the Heaviness of Smoking Index (HSI), a derivative of the

Fagerström Test for Nicotine Dependence (FTND). However, none of the studies that used the two items reported an HSI score.

Perinatal smoking studies reviewed in Chapter Three predominantly used the Fagerström Tolerance Questionnaire (FTQ) (Fagerstrom, 1978) or one of its derivatives (Heatherton et al., 1991; Heatherton et al., 1989). However, very few studies reported psychometric properties of these measures. Chapter Three stressed the importance of thorough psychometric reporting of nicotine dependence instruments. Intentional testing and reporting of these measures will allow researchers to evaluate the usefulness of these instruments for low SES women.

The measurement of nicotine dependence exemplifies the challenge of measuring latent constructs critical to prenatal smoking research. Reliable and valid measures for these constructs are necessary to derive accurate and meaningful results. This calls for further development in the conceptual understanding of latent constructs like stress, nicotine dependence, and SES as well as testing of current and future instruments in the low SES prenatal population.

New Variables. Chapter Two highlighted unique issues associated with prenatal smoking. Further investigation is required to identify measurable variables and relevant instruments. Unique issues for prenatal smoking in low SES women include: living in a working class neighborhood (Pickett et al., 2002), alcohol consumption and substance abuse (Adams et al., 2008; Jesse et al., 2006; Patterson et al., 2012), access/use of healthcare issues (Patterson et al.), psychiatric diagnoses (Flick et al., 2006), and adaptive or interpersonal problem behaviors (Wakschlag et al., 2003). Qualitative research with

pregnant smokers may uncover perceptions related to these issues that warrant closer examination in hypothesis testing studies.

Summary

The findings of this dissertation support the widely held belief that prenatal smoking is a complex phenomenon. In particular, this work highlights psychosocial factors as mediators of the relationship of SES with prenatal smoking behavior. Healthcare providers and policy makers cannot ignore the influence of psychosocial factors on prenatal smoking. Truly effective prevention and intervention approaches must address these psychosocial factors and other relevant issues using collaborative prevention and intervention approaches if we are to see an improvement in prenatal smoking cessation rates.

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CURRICULUM VITAE

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I. EDUCATION

Date	Degree/Course	Institution
May 2010 – Present	PhD/Nursing Focus: Prenatal Smoking Behavior	University of Louisville Louisville, KY
May 2010 – August 2013	MSN/Nursing Education	University of Louisville Louisville, KY
Sept. 1994 – May 1996	BS in Nursing	Rutgers University Camden, NJ
Sept. 1989 – May 1992	Diploma in Nursing	Humber College Etobicoke, Canada

II. ACADEMIC APPOINTMENT

Date	Title	Institution
Aug. 2012 – Dec. 2013	Graduate Teaching Assistant Maternal Child Health Baccalaureate Program	University of Louisville Louisville, KY

III. PROFESSIONAL EXPERIENCE

Date	Degree/Course	Institution
Jan. 2009 – Present	Staff Nurse Couplet Care Unit & Newborn Nursery	Norton Healthcare Systems Louisville, KY
Nov. 2004 – July 2008	Staff Nurse Mother/Baby Unit	Mountainside Hospital Montclair, NJ
Nov. 2001 – Oct. 2004	Staff Nurse LDRP Unit	Princeton Healthcare Systems Princeton, NJ
Nov. 1999 – Nov. 2001	Staff Nurse Pediatric/Eating Disorders Unit	Princeton Healthcare Systems Princeton, NJ

IV. CERTIFICATION & RN LICENSURE(S)

Date	Licensure or Certification	License/Certification #
Oct. 2010 – Present	National Certification Maternal Newborn Nursing	YAN104355278
Mar. 2009 – Present	Kentucky Board of Nursing Registered Nurse License	1119535
Aug. 1994 – May 2009	New Jersey State Board of Nursing Registered Professional Nurse License	26NO10916200

V. TEACHING

Aug. 2012 – Dec. 2013	NUR 461 Childbearing Family - Graduate Teaching Assistant Roles: Clinical Instructor for Labor & Delivery (Student Group Size: 4-5) Clinical Instructor for Postpartum & Newborn Nursery (Student Group Size: 6-7) Implementation of Postpartum Hemorrhage Simulator using simMan (Student Group Size: 5-6)	
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May 2013 – NUR 364 Therapeutic Nursing Interventions – Graduate Teaching
July 2013 Assistant
Roles: Clinical Instructor for Clinical Learning Lab & LTC
Facility (Student Group Size: 10)

Aug. 2012 – NUR 364 Therapeutic Nursing Interventions – Graduate Teaching
May 2013 Assistant
Roles: Supervision of Open Lab (Student Group Size:
Variable)

VI. AWARDS

Date	Award	Institution
Jan. 2014 – Present	Dissertation Completion Award	University of Louisville

VII. RESEARCH PRODUCTIVITY

Research Funding

A Comparison of the Characteristics of Current and Former Postpartum Inpatient Smokers, Graduate Student Council Research Award, University of Louisville, \$222, April 2013.

Manuscript in Press

Yang, I. & Hall, L. (2014). Characteristics of current and former postpartum inpatient smokers. *MCN: The American Journal of Maternal Child Nursing*.

Poster Presentations

Yang, I. & Hall, L. (2014, February). *Characteristics of Current and Former Postpartum Inpatient Smokers*. Southern Nursing Research Society, San Antonio, TX.

Yang, I. & Hall, L. (2013, September). *Characteristics of Current and Former Postpartum Inpatient Smokers*. Research! Louisville, Louisville, KY.

VIII. PROFESSIONAL MEMBERSHIPS & ACTIVITIES

Memberships

2010 – Present: American Nurses Association

2008 – Present: Association of Women's Health, Obstetric and Neonatal Nurses

2011 – Present: Kentucky Nurses Association

1996 – 2011: Sigma Theta Tau International Honor Society of Nursing, Eta Mu Chapter

2011 – 2013: STTI Honor Society of Nursing, Iota Zeta Chapter

2009 – Present: Southern Nursing Research Society

IX. COMMITTEES AND SERVICE

Date	Position	Institution
2012 – Present	Graduate Student Representative – Research and Evidence Based Practice Committee	University of Louisville School of Nursing
2012 Various Dates	Volunteer - Vaccination Program	Kentucky Refugee Ministries/UofL SON
2009 Various Dates	Volunteer – Building Program	Habitat for Humanity