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The Influence of Exposure to Others Smoking among Black and White Low Income Pregnant Smokers

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The Influence of Exposure to Others' Smoking Among

Black and White Low Income Pregnant Smokers

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THE INFLUENCE OF EXPOSURE TO OTHERS' SMOKING ON CESSATION AMONG LOW INCOME PREGNANT SMOKERS

by

Archana Chitta

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ABSTRACT

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This study examined the relationship between exposure to other people's smoke and quitting smoking among 248 low income Black and White pregnant women. Indices of exposure included smoking restrictions in the home, number of regular smokers in the home, exposure to other's smoke in the home, partner's smoking behavior, and proportion of friends who smoke regularly. Covariates examined included age, income, education, nicotine dependence, and gestational age. Being exposed to smoking in the home (adjusted OR = 360; CI = .182 – .173), and the number of smokers in the home (adjusted OR = .594; CI = .377 – .934) were both related to decreased likelihood of cessation. There were no racial differences between any exposure/cessation associations. Results suggest that exposure to others' smoking is a significant determinant of quitting smoking among low income black and white women and should be considered as a target for smoking cessation interventions in this population.

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CHAPTER 1

Introduction

The health and economic costs of tobacco use in the U.S. are staggering. It is the number one cause of preventable morbidity and mortality in the United States (USDHHS, 2008). More than 440,000 Americans die of tobacco-related disease annually, accounting for one of every five (CDC, 2009a). Cigarette smoking affects numerous organs and organ systems and causes numerous cancers (e.g., lung, bladder, head and neck, colon, kidney, pancreas), as well as cardiovascular, pulmonary, and reproductive diseases, and other conditions including cataracts, osteoporosis, periodontitis, and gastric ulcers (CDC, 2009g; Hudmon, Kilfoy, & Prokhorov, 2006). Tobacco use also has a huge economic burden, costing $96 billion in direct medical care expenditures and $97 billion in lost productivity every year in the U.S. (CDC, 2009d).

Approximately 21% of U.S. adults smoked in 2008; smoking is less common among women (18.3%) than in men (23.1%) (CDC, 2009c), but the smoking rates in the last 40 years have declined only half as much among women as in men (25% vs. 50%, respectively; Giovino, 2002). One particularly vulnerable sub-population affected by cigarette smoking is pregnant women. An estimated 18% of 15-44 year old pregnant women in the U.S. smoke cigarettes (CDC, 2009b) and those with lower incomes are more likely to smoke during pregnancy than women with higher income levels (Penn & Owen, 2002). Cigarette smoking during pregnancy is a major health concern for both the mother and the fetus (CDC, 2009b). Maternal smoking and exposure to ETS (Environmental Tobacco Smoke, which originates from exhalations of smokers) during pregnancy has been linked with stillbirth, congenital anomalies, placental ruptures,

neonatal death (Ferrell, 2009), spontaneous abortion, childhood blood pressure, gestational diabetes, and low birth weight in infants (Rogers, 2008). The health effects of smoking are often extended from infants to children of smokers, who are also subject to numerous health effects (e.g., asthma, middle ear infections, bronchitis) when they are exposed to ETS (EPA, 2008). However, these health risks can be reduced or avoided if women stop smoking.

Cigarette smoking is the most important modifiable risk factor for pregnancy-related complications (Andres & Day, 2000). Yet, only an estimated 18-25% of smokers quit once they are pregnant (CDC, 2004a). Considerable work has been devoted to developing cessation treatments for this population. However, these interventions have had limited success in increasing quit rates and preventing relapse among pregnant women, thus emphasizing the need for examining individual and interpersonal determinants to identify factors that can be modified to aid cessation, or to better tailor interventions to patient characteristics (Lancaster, Hajek, Stead, West, & Jarvis, 2006).

Several determinants such as sociodemographic, nicotine dependence, and psychological factors, as well as exposure to other people's smoking, have been found to be associated with quitting status among pregnant women (Ebert, Riet, & Fahy, 2009). While earlier research failed to show race differences in quitting during pregnancy (Woodby, Windsor, Snyder, Kohler, & Diclemente, 1999), recent research, using larger, more representative samples suggests that race may be an important determinant in influencing smoking cessation (Avery & Stallings, 2003). For instance, an analysis of the 1997-2001 Pregnancy Risk Assessment Monitoring System (PRAMS) data in a random sample of pregnant women (n = 2101) in North Carolina by Avery and Stallings (2003)

showed that minorities were more likely to quit during pregnancy than white non-Hispanic women. Also, many studies have shown that younger (18-24 years), unmarried, women with low education (less than 12 years), and below the poverty level are less likely to attempt quitting smoking (Avery & Stallings, 2003; Fingerhut, Kleinman, & Kendrick 1990; Gilman et al., 2008; Lu, Tong, & Oldenburg, 2001; Yu, Park, & Schwalberg, 2002). Thus, sociodemographic factors are important determinants of smoking cessation among women.

Another important determinant is nicotine dependence. An estimated 20.6% of all adults in the United States are currently smokers (of which 18.1% are women), and approximately 50% are categorized as nicotine dependent, with the likelihood of being dependent increasing over time in the U.S. for women (CDC, 2009c). Nicotine dependence, thus, is an important barrier to smoking cessation, especially among low-income, unmarried, and unemployed pregnant women (Gilman, Breslau, Subramanian, Hitsman, & Koenen, 2008). Women were shown to be more likely to stop smoking during pregnancy if they smoked less (than 10 cigarettes per day) during the pre-pregnancy period than women who smoke more and who continue to smoke throughout pregnancy (Giglia, Binns, & Alfonso, 2006). Therefore, being less nicotine dependent improves the chances of cessation for pregnant women.

Psychosocial factors such as negative affect, including perceived psychosocial stress, boredom, tension, and depression also predict failure to quit smoking and to relapse post-partum (Kennison, 2009; Ripley-Moffitt et al., 2008; Schnoll et al., 2007; Quinn et al., 2006). Smoking-related attitudes such as concern about weight gain (Berg, Park, Chang, & Rigotti, 2008), and low levels of motivation and confidence also can

reduce pregnant women's intention to stay quit (Schnoll et al., 2007). Social influences such as pressure from peers (Kennison, 2009), high job strain (Dejin-Karlsson et al., 1996), lack of support from partners who smoke (Haslam, Draper, & Goyder, 1997), and influence of friends and family (Ingall & Cropley, 2009), are other key determinants to smoking cessation among pregnant women. On the other hand, positive effects including self-efficacy about quitting (Giovino, 2002), motivation to adopt behavioral and experiential strategies (Scheibmeir, O'Connell, Aaronson, & Gajweski, 2005), social support in the form of receiving good care during pregnancy from people around them, high social participation, and high instrumental support (Dejin-Karlsson et al., 1996) encourage cessation.

Social support further fits into a general framework of positive vs. negative behaviors from partners, family members and friends that influence the likelihood of a cessation attempt (Dejin-Karlsson et al., 1996), especially when exposed to their smoking. This is further supported by the concept of *cue reactivity*, according to which individuals are likely to relapse due to developing urges and cravings when exposed to certain physical cues (such as others' smoking) around them (Niaura et al., 1988). This type of response has been demonstrated in many studies. For instance, some studies demonstrate that pregnant women are more likely to stop smoking if they have partners who do not smoke, or stop smoking (Levitt, Shaw, Wong, & Kaczorowski, 2007; McBride, Curry et al., 1998), or if they do not live with current smokers. This issue, however, has received relatively little attention. Further, despite evidence that African American smokers tend to be more nicotine dependent than white smokers, and to have a harder time quitting (CDC, 1998), no studies have examined racial/ethnic differences in

exposure to other people's smoking among pregnant women, and how this is related to the likelihood of quitting.

Statement of the Problem

Cigarette smoking is the leading cause of preventable morbidity and mortality in the United States (USDHHS, 2008). Approximately 21% of U.S. adults smoked in 2008 (CDC, 2009c). Approximately 18.3% of adult smokers in the United States are women (CDC, 2009c). An important sub-population exposed to cigarette smoking is pregnant women and cigarette smoking causes many health-related complications during and after pregnancy. Thus, it is an important modifiable risk factor for pregnancy-related complications (Andres & Day, 2000). However, not many interventions have been successful at increasing cessation rates among women (Lancaster et al., 2006). It is vital, therefore, that we increase our understanding of modifiable risk factors (psychosocial factors and social support) of smoking cessation during pregnancy.

As described above, there is evidence that exposure to other people's cigarette smoke is an important and modifiable determinant of the likelihood of quitting smoking during pregnancy. Within a cue reactivity framework, exposure to other people's smoke can create cue reactions causing urges and cravings to use a substance, leading to relapse (Niaura et al., 1988). Several studies have examined various aspects of exposure to other's smoking, but this important risk factor has not been studied systematically, using a variety of indices of exposure, nor have exposure/quitting associations been compared in black and white low income smokers. Low income smokers are at particularly high risk of smoking, and differences in nicotine dependence and likelihood of quitting have

been reported for blacks and whites. Thus, examining these issues in a bi-racial sample is especially important.

Purpose of the Study

The purpose of this study is to examine the relationships between several indices of exposure to other people's smoke on the likelihood of quitting among low income pregnant women, and to determine whether these associations differ between blacks and whites.

Research Questions

(1) Does exposure to other people's cigarette smoke decrease the likelihood of quitting smoking among low income pregnant women?

(2) Which indices of exposure to other people's smoke are most strongly associated with quitting smoking?

(3) Are there any racial differences in these associations?

Significance of the Study

The findings from this study will add new insight into potentially modifiable determinants of smoking cessation among low income pregnant women. The study will advance previous research by investigating whether these associations are similar or different among two at-risk groups for failure to quit smoking during pregnancy: whites and African Americans. The study also will advance previous research by examining several distinct and potentially important indices of exposure to other people's smoke, including partner's smoking, friends' smoking, and extent of exposure to other people's smoke within the home.

CHAPTER 2

Review of Literature

Tobacco use is the number one cause of preventable morbidity and mortality in the United States (USDHHS, 2008). Cigarette smoking has been the most common form of tobacco use in the United States for several decades (Hudmon et al., 2006). Each day, about 1000 persons below 18 years of age, and more than 1500 adults above 18 years start to smoke cigarettes on a daily basis (CDC, 2009d). Currently, 23.7% of adults aged 25-44 years, 32.4% of American Indians/Alaskan natives, 41.3% adults with low education or only a GED diploma, and 31.5% adults who live below the poverty line smoke cigarettes (CDC, 2009c).

Tobacco use has a profound effect on mortality worldwide and in the United States. Worldwide, an estimated 5 million people die annually from tobacco-related causes, which is equivalent to one in 10 deaths among adults (WHO, 2010). Tobacco is also predicted to cause more than 8 million deaths annually in the world by the year 2030 (CDC, 2009d). More than 440,000 Americans die of tobacco-related disease annually accounting for one of every five deaths in the United States (CDC, 2009a). Tobacco use, in the form of smoking cigarettes (along with deaths from secondhand smoke), has caused about 14 million premature deaths in the United States since 1964 (Giovino, 2002). For every one person who dies from a smoking related disease, it has been estimated that 20 other persons suffer from at least one serious illness due to smoking (CDC, 2009d), and adult smokers are likely to die 14 years earlier than nonsmokers (CDC, 2009g).

Premature mortality in smokers occurs due to tobacco smoking's effect on numerous organs and systems. Cigarette smoking causes many diseases such as a) cancer

of the lung, bladder, larynx, kidney, esophagus, mouth, pancreas, as well as gastric cancer, and acute myeloid leukemia b) cardiovascular diseases such as ischemic heart disease, atherosclerosis, cerebrovascular disease, and other arterial diseases c) pulmonary diseases such as pneumonia, bronchitis, emphysema, influenza, chronic airway obstruction d) reproductive effects such as and low birth weight, and e) other effects such as sudden infant death syndrome cataract, osteoporosis, periodontitis, and ulcers (CDC, 2009g; Hudmon et al., 2006).

Tobacco use not only affects human health, but is also a huge economic burden. Every year in the United States, $96 billion in direct medical care expenditures and $97 billion in lost productivity are related to smoking, (CDC, 2009d) at an estimated $10.47 per pack of cigarettes sold in the United States (CDC, 2009e). It is estimated that an individual smoker spends nearly a quarter of a million dollars when he/she smokes two packs of cigarettes a day for about 50 years, with each pack costing $4.12 on an average, plus, an additional 1.5% interest rate if the money was banked monthly (Hudmon, Kilfoy, & Prokhorov (2006). Thus, tobacco use presents both economic and deleterious health effects among smokers.

Smoking Among Women

Smoking among U.S. adults remains less common among women (18.3%) than men (23.1%) (CDC, 2009c), but declines in smoking rates in the last 40 years have dropped among women only half as much as among men (25% vs. 50%, respectively; Giovino, 2002). This difference may partially be because men stopped smoking earlier, during the early twentieth century, than women (CDC, 2000) or barriers to quitting that are more problematic for women, such as psychosocial stress (Schnoll et al., 2007), over

the years. Smoking rates among women are especially high for American Indians or Alaskan Natives (26.8%), those between the ages of 25 and 44 years (21.4%), who did not attend college (38.8%), and living below the poverty level (26.9%) (CDC, 2009b).

The health effects of tobacco use by women are enormous. Annually, an estimated 178,000 women in the United States die due to cigarette smoking (CDC, 2009b). Lung cancer has surpassed breast cancer as the most common cancer among women, and 90% of all lung cancer deaths in women are a result of smoking. Women who smoke also are at substantially higher risk than non-smokers of cervical cancer. They are also highly susceptible to developing cardiovascular disease and are likely to die from pulmonary obstructive disease (CDC, 2009b).

Smoking During Pregnancy

One particularly vulnerable sub-population affected by cigarette smoking is pregnant women. An estimated 18% of 15-44 year old pregnant women in the U.S. smoke cigarettes (CDC, 2009b) and those with lower incomes are more likely to smoke during pregnancy than women with higher income levels (Penn & Owen, 2002). In particular, maternal smoking during pregnancy has become concentrated among young women with lower levels of education and income, and those who have a smoking spouse (Chaaya, Awwad, Campbell, Sibai, & Kaddour, 2003; Gilman et al., 2008).

Cigarette smoking during pregnancy is a major health concern for both the mother and the fetus (CDC, 2009b) and has been linked with stillbirth, congenital anomalies, placental ruptures, and neonatal death (Ferrell, 2009). Further, smoking can have effects on the respiratory health of women as well (Maziak, Ward, Rastam, Mzayek, & Eissenberg, 2005). Other pregnancy-related health problems include ectopic pregnancy,

spontaneous abortion, preterm birth, low birth weight, neurobehavioral effects, transplacental carcinogenesis, childhood blood pressure, and gestational diabetes (Rogers, 2008). According to the Surgeon General's report on *Women and Smoking*, smoking during pregnancy causes more than 950 infant deaths annually (CDC, 2004b).

Not only does smoking throughout pregnancy have effects on the fetus, but ETS from maternal (and parental) smoking can also cause sudden infant death syndrome in infants, and wheeze, cough, phlegm, breathlessness, asthma, middle ear infections, bronchitis and pneumonia (Cook & Strachan, 1999; EPA, 2008) and also is associated with increased risk of obesity, type II diabetes, and elevated blood pressure in children (Rogers, 2008). However, these risks can be prevented if women stop smoking during and post pregnancy.

Cigarette smoking is the most important modifiable risk factor for pregnancy-related complications (Andres & Day, 2000). It is estimated that there would be a 10 % decrease in the perinatal deaths, a 35% decrease in low-birth weight infants, and a 15% decrease in preterm births, if women are not exposed to tobacco during pregnancy (Ferrell, 2009). It is also estimated that the delivery of 1300 low birth infants could be prevented with a 1% annual drop in the prevalence of smoking among pregnant women (Jauniuax & Greenough, 2007).

Women are more likely to quit during pregnancy than at any other time in their lives (Ebert et al., 2009) but unfortunately, only an estimated 18-25% of smokers quit once they are pregnant (CDC, 2004a), and about 60% of women who quit resume smoking within 12 months (Hannöver et al., 2008). As such, considerable work has been

devoted to developing and implementing smoking cessation interventions for nicotine dependence amongst this population.

Smoking cessation interventions among pregnant women. According to the Surgeon General's report on *Tobacco Use among U.S. Racial/Ethnic Minority Groups*, a chief reason that quitting is so difficult for most smokers, including pregnant women, is dependence, or nicotine addiction (CDC, 1998). Nicotine is found in tobacco smoke along with an estimated 4000 other chemicals, of which more than 60 have been identified as carcinogens (Ferrell, 2009). The effects of nicotine addiction have been compared with that of many psychoactive drugs. While smoking has positive effects such as mood enhancement, relaxation, and improved concentration, cessation produces several withdrawal symptoms including anger/irritability, depression, difficulty concentrating, and urges to smoke (CDC, 1998).

Given the difficulty that pregnant women have with quitting due to nicotine dependence, assisting them to quit is a major public health priority and numerous intervention strategies for cessation have been developed to help women quit, and to lower the health risks to both the mother and the fetus. Self-help materials which have been tested in the general population of smokers have not been widely tested for pregnant smokers. One cluster randomized trial that evaluated self-help (n=1527) concluded that providing pregnant women with self-help materials tailored to their needs improved cessation (Moore et al., 2002). Generally, the interventions that have been widely tested on this population are relapse prevention, and those delivered by healthcare providers (behavioral or pharmacological).

Two identical reviews on more than 50 randomized and quasi-randomized trials assessed behavioral intervention methods which included relapse prevention methods to see if there was a reduction in the number of quitters who relapsed. Studies (about 36) where abstainers were randomized were compared to those studies where participants were randomized prior to their quit date. This review found no significant effect in studies which incorporated behavioral interventions on randomized abstainers including smokers in military training, those who were hospitalized, and also in pregnant women. A meta-analysis tested the effect of several behavioral interventions which comprised face-to-face counseling sessions along with written materials for self-help, relapse prevention counseling sessions and written pamphlets, telephone counseling, psychotherapy sessions, use of motivational interviewing, and counseling from providers plus office system interventions, for pregnant women. They found no significant effect for any of these interventions implemented either during pregnancy (8 trials) (n = 1523; RR = 1.04; CI = 0.98 to 1.11), or when followed postpartum (12 trials) (n = 3273; RR = 1.07; CI = 0.98-1.18) between women who received the interventions with those who did not (Hajek, Stead, West, Jarvis, & Lancaster, 2009).

Likewise, another meta-analysis compared the effect of different behavioral interventions (6 trials) at the end of pregnancy for pregnant abstainers. These interventions included providing self-help materials and focused booklets, counseling both during pregnancy and postpartum, counseling along with social support materials with routine clinic visits, structured interventions including counseling from nurse along with prenatal clinic visits, tailored self-help materials along telephone counseling pre- and postpartum, and advice from midwives and found no significant effect (n = 1183; OR

= 1.17; CI = 0.90-1.53) compared to those who received only usual care. Further, they did not find any significant effect of these behavioral interventions among pregnant abstainers even during the postpartum period (seven trials) (n = 2695; OR = 1.08; CI = 0.92-1.27) (Lancaster et al., 2006) compared to those who received only usual care. Thus, overall there is no evidence that relapse prevention interventions are effective for pregnant women.

Counseling, as a form of relapse prevention has also been tested for pregnant women. While postpartum women are likely to find both individual and group counseling very helpful (Levine, 2008), group therapies in which patients can support each other are thought to be more beneficial than self-help (Rore et al., 2008). Likewise, a review of more than 40 randomized trials on intervention via telephone counseling through quit lines indicated a potential benefit (n > 18,000; OR = 1.41; CI = 1.27 to 1.57) of increasing motivation to quit among smokers when they received numerous sessions of "call-back counseling" when compared to both the behavioral and pharmacological interventions (Stead, Perera, & Lancaster, 2006).

Given the limited success of behavioral interventions, it has been suggested that the safety and efficacy of pharmacological interventions be comprehensively evaluated for pregnant smokers (Crawford, Tolosa, & Goldenberg, 2008; Schnoll et al., 2007; Westmass & Brandon, 2004). Several agents have been widely evaluated among non-pregnant smokers and shown to be effective, including various nicotine replacement products (gum, patch, lozenge, nasal spray, and inhaler). These agents approximately double the likelihood of long-term abstinence (Stead, Perera, Bullen, Mant, & Lancaster, 2008). Newer non-nicotine agents such as Bupropion and Varenicline also have been

shown to be effective for cessation among non-pregnant smokers (Hajek et al., 2009). However, potential risks of neuropsychiatric symptoms such as suicidal thoughts, depression, hostility, and agility have been mentioned with using the non-nicotine drugs (FDA, 2009).

As such, little work has been done to evaluate these agents in pregnant smokers. One concern, for NRT products, is that nicotine can cause risks to the mother (such as high maternal heart rate and blood pressure) and to the fetus (such as risk for SIDS), and requires individualized care (Rore et al., 2008; Schnoll et al., 2007). Likewise, the teratogenic effects of Bupropion and Varenicline have not been adequately evaluated to date (Rore et al., 2008). Given this limited knowledge, stopping smoking before or early as possible during pregnancy (preferably before 16 weeks into the pregnancy), with behavioral treatment when needed, remains the standard of treatment (CDC, 2009h; Fiore, Bailey & Cohen, 2000).

Determinants of smoking cessation among pregnant women. Given the limitation of currently available interventions, examining individual and interpersonal determinants or barriers of cessation among pregnant women may be useful to identify factors that can be modified to aid cessation, or to better tailor interventions to patient characteristics. Smoking during pregnancy can be maintained by a combination of a woman's inadequate knowledge of the associated risks of smoking on her health and that of her fetus, physiological processes such as nicotine dependence, psychological issues (such as depression), and socioeconomic factors (such as the stress associated with financial insecurity) (Ebert et al., 2009). As such, numerous studies have examined determinants of cessation among pregnant women. Determinants can be broadly

classified as sociodemographic, smoking-related, psychosocial, and exposure to other people's smoke.

Sociodemographic factors. Several sociodemographic characteristics have been found to be associated with smoking cessation. A few common ones include race, age, education, income, employment, and marital status (Avery & Stallings, 2003).

Ethnicity is related to the likelihood of smoking cessation. While earlier research shows that race is not a significant determinant to a woman's quitting smoking during pregnancy (Woodby et al., 1999), recent research suggests that race may be an important determinant in influencing smoking cessation (Avery & Stallings, 2003). Sociodemographic correlates of smoking cessation were analyzed in a nationally representative sample of pregnant women (n = 5288) from the 1998 National Health Interview Survey (NHIS) supplement on Pregnancy and Smoking. This analysis included smoking behavior among nonsmokers, persistent smokers, successful quitters, and unsuccessful quitters. Analysis of this survey based on their smoking status showed that Hispanic women were three times less likely to continue smoking (persistent smokers) during pregnancy than non-Hispanic whites (OR = 3.09, 95% CI = 1.68, 5.67). Hispanic women were also shown to be more likely to quit (OR = 3.09) smoking as soon as they become pregnant than other ethnic groups (Yu, Park, & Schwalberg, 2002). An analysis of the 1997-2001 Pregnancy Risk Assessment Monitoring System (PRAMS) data in a random sample of pregnant women in North Carolina by Avery & Stallings (2003) showed that minorities were more likely to quit during pregnancy than white non-Hispanic women (n = 2101; OR = 1.1; CI = 0.7-1.6).

Ockene and colleagues (2002) assessed spontaneous smoking cessation among an ethnically diverse sample (African American, white, Hispanic & other races) of low-income pregnant women attending WIC clinics, and who were enrolled for receiving an intervention in a randomized clinical trial, *Quit Together*. Several internal and environmental factors were hypothesized as variables that are likely to influence the use of cigarettes or alcohol among low-income pregnant women. These variables were assessed in the baseline interview and included behaviors of substance use before and during pregnancy, attitudes and perceptions (e.g., risks of smoking on the health of the fetus), environmental factors (e.g., partner or husband's smoking status), and current smoking status. The results of their assessment showed that smoking cessation was less common among African American women than in other ethnic groups (n = 601; OR = 0.30; CI = 0.12-0.72). Race was also shown to be a significant predictor of smoking (n = 130) in a descriptive study assessing psychosocial factors associated with smoking and substance use in low-income African American and white women. The results showed that African American women were less likely to smoke to during pregnancy (28%) than white women and (55%) (Jesse, Graham, & Swanson, 2006), and were also likely to be abstinent at delivery (Ma, Goins, Pbert, & Ockene, 2005).

Many studies have shown that younger (18-24 years), unmarried, women with low education (less than 12 years), and below the poverty level are less likely to attempt quitting smoking (Avery & Stallings, 2003; Fingerhut et al., 1990; Gilman et al., 2008; Lu, Tong, & Oldenburg, 2001; Yu et al., 2002).

A secondary analysis of the New South Wales (NSW) Midwives Data Collection (MDC) 1999–2003 surveillance system covering all births in NSW public and private

hospitals as well as home births examined the associations between sociodemographic characteristics of pregnant women and their smoking behaviors (pregnant women who were likely to smoke during pregnancy vs. pregnant women who were likely to quit during pregnancy). The results showed that smoking was highly prevalent among women from lower SES compared to women belonging to middle and higher SES (n = 426, 344; OR = 1.84; CI = 1.72-1.96; $p < 0.05$). Smoking was also higher among teenage mothers (42.9%) compared to women who were older than 35 years (11.2%) (OR = 1.18; CI = 1.10-1.27) (Mohsin & Bauman, 2005). Yet, women below the age of 20 years have been shown to significantly quit smoking during pregnancy than women above 35 years (n = 2101; OR = 3.3; CI = 1.8-6.2) (Avery & Stallings, 2003) and also be abstinent at delivery as shown in a data obtained from a randomized clinical trial of smoking cessation among (n = 327) low-income pregnant women (Ma et al., 2005).

A study using data from Michigan birth certificates (n = 14, 731) examining determinants of smoking behavior during second pregnancy (among pregnant women who smoked during first pregnancy) found that women were more likely to smoke if they had less education, were white, and had no father's name on the birth certificate of the first child. Smoking was likely among mothers from the low-income category (less than $35, 000 per year) than mothers from the middle income category ($35, 000 - $50, 000) (OR=1.19; CI=1.09–1.30) (Abrevaya, 2008). A study on a cohort of first time pregnant women in Sweden (n = 872) attending antenatal clinics showed a high risk of smoking among unmarried compared to married women (n = 257; RR = 2.7; CI = 1.5, 4.8) (Dejin-Karlsson et al., 1996). Women were less likely to quit if they were living with partners than if they were married (n = 5288; OR = 0*:*64; CI = 0*:*41–0.99), and those with low

socioeconomic status were half as likely to attempt to quit than women who were below or at the poverty level (OR = 0.57; CI = 0.38-0.87) (Yu et al., 2002). A greater number of years of education/graduating from a university was a significant predictor (n = 4660; OR = 2.03; CI = 0.99-4.15) of successful quitting of smoking among pregnant women in a hospital based survey in Lebanon (Yunis et al., 2007). In a randomized clinical trial assessing spontaneous cessation among low-income pregnant women attending WIC clinics, results show that smoking cessation was less common among women with a less than high school education (n = 601; OR = 1.73; CI = 1.09–2.74) compared to those who had more than a high school education (Ockene et al., 2002). A cohort study on pregnant women smokers (n = 316) showed educational achievement to be a robust predictor of smoking status upon entering prenatal care, abstinence ante partum, and of smoking-status at 6-month postpartum. Women with more than 12 years education than those with less than 12 years of education were 27 times more likely to be abstinent upon entering prenatal care, had 6-fold greater odds of showing abstinence at 24-weeks postpartum, and had 9-fold greater odds of being abstinent, than women with less than 12 years of education (Higgins et al., 2009). Women with more than a high school education were more likely to quit smoking during pregnancy than those who were not (n = 2101; RR = 1.9; CI = 1.1-2.3) (Avery & Stallings, 2003).

There are numerous pathways by which socioeconomic deprivation may influence the likelihood of smoking cessation (Ward, Klesges, & Halpern, 1997), including limiting access to prenatal care and the cessation assistance that typically is available through ob/gyn providers. Limited access to guidance about the deleterious effects of smoking can hinder a woman's efforts to improving her health during and post-pregnancy (Quinn

et al., 2006). Women with less prenatal care (Palma et al., 2007) have been shown to be less successful at quitting than those with adequate prenatal care (n = 4660; RR= 1.72; CI = 1.02-2.91) (Yunis et al., 2007).

In conclusion, pregnant women from lower socioeconomic backgrounds are more likely to smoke, and less likely to quit during pregnancy. Smoking rates are especially high among white women, but African American women may have more difficulty quitting smoking than white women.

Nicotine dependence. Nicotine dependence is an important determinant of cigarette smoking. An estimated 22.8% of Americans are currently smokers, and approximately 50% are categorized as nicotine dependent, with the likelihood of being dependent increasing over time in the U.S. for women (Goodwin, Keyes, & Hasin, 2009). About 46% of Americans can be categorized as nicotine dependent at some point in their lifetime (Goodwin et al., 2009). Nicotine, which is a psychoactive drug, is the component of cigarette smoke that produces dependence (CDC, 2009f). After a puff or a cigarette, nicotine is delivered to the Central Nervous System via arterial circulation within 10 to 20 seconds after a person inhales the tobacco smoke. This tends to produce a positive feeling in the smokers (Ebert et al., 2009) forcing them to smoke on a regular basis and making it difficult to quit irrespective of several attempts. As a result, smokers develop tolerance (need for increased amount of nicotine) with increase in use of cigarettes (CDC, 1998). Smokers also relapse due to withdrawal symptoms such as anxiety, stress, irritability, difficulty in concentrating, and increased appetite (CDC, 2009f) when the concentration of nicotine in the body is not sufficient to keep up stimulation (CDC, 1998). As such, nicotine dependence was found to be the most

important barrier to smoking cessation among low-income (< 150% of the US poverty level), unmarried, and unemployed pregnant women compared to women who had median income (≥$40,000), were married, and employed (Gilman et al., 2008). Chronicity of smoking and nicotine dependence, thus influence the likelihood of quitting.

Many population-based studies explored the association of nicotine dependence to quitting smoking among pregnant women. Intensity of smoking or number of cigarettes smoked prior to pregnancy has been repeatedly shown to be a significant predictor of continued smoking among pregnant women, even in different ethnicities including a majority of non-Hispanic white women and other minority ethnic groups (Avery & Stallings, 2003; Palma et al., 2007; Yunis et al., 2007). For instance, more number of cigarettes smoked per day before pregnancy (n = 601, RR = 0.94; CI = 0.91–0.96), and the need to smoke a cigarette within 30 minutes after waking (RR =2.18; CI= 1.36–3.50) were shown to be factors associated with less likelihood of quitting smoking among low-income pregnant women (Ockene et al., 2002).

Women who smoked 20 or more cigarettes a day prior to pregnancy were less likely to quit smoking during pregnancy (n = 2102; RR = 4.2; CI = 2.9-6.2) than women who smoked 10 or fewer a day prior to pregnancy (Avery & Stallings, 2003). In other words, less intensity (less than 5 cigarettes per day) of smoking (OR = 2.35, 95 % CI: 1.36–4.09) prior to pregnancy (n = 4660) was an important determinant to successful smoking cessation compared to those who smoked heavily (more than 10 cigarettes a day) (Yunis et al., 2007). Smoking duration was also significantly associated with successful quitting (n = 5288), with women aged between 35-49 and who smoked for more than 20 years being less likely to quit when compared with women aged between

18-24 and who smoked for less than 10 years (OR = 2.75; CI = 1:50-5.04), suggesting that nicotine addiction developed over many years could be a strong determinant of success in quitting (Yu et al., 2002).

In sum, nicotine dependence is an important determinant of quitting smoking among pregnant women.

Psychosocial factors. Pregnancy often helps many women change their smoking behavior to prevent or reduce health risks to their unborn child (Bottorff, Johnson, Irwin, & Ratner, 2000; Hannöver et al., 2008). This period (both current and previous pregnancies) serves as a strong reason for women to start thinking about quitting smoking (Kennison, 2009; Ockene et al., 2002). Psychosocial factors are important barriers that influence cessation among smokers and can be broadly classified as: negative affect, smoking-related attitudes, and social support.

Numerous studies have evaluated the association of various indices of negative affect on smoking cessation attempts by pregnant women. Negative affect, including perceived pre- and post- psychosocial stress (Schnoll et al., 2007), boredom, tension, and depression, predict failure to quit smoking and to relapse post-partum (Kennison, 2009; Ripley-Moffitt et al., 2008; Schnoll et al., 2007; Quinn et al., 2006). Recently, an analysis of the 2004 Pregnancy Risk Assessment Monitoring System (PRAMS) data from women (n = 2566) in 16 states by Allen and his colleagues (2009) showed that women who experienced postpartum depressive symptoms were 1.86 times as likely to relapse than those who did not experience such symptoms (CI = 1.31-1.65). Goedhart, van der Wal, Cuijpers, & Bonsel (2009) assessed the association of psychosocial problems with continued smoking during pregnancy in a population-based cohort study (n = 8266)

among pregnant women who smoked prior to pregnancy (n = 1947) in Amsterdam. They assessed the psychosocial variables among quitters and non-quitters and found that non-quitters showed significant associations of depressive symptoms, and normal & "high and low levels of pregnancy-related anxiety (linear term OR = 0.75; $p < 0.001$; quadratic term OR = 1.01, $p < 0.001$), with exposure to physical/sexual violence (OR = 3.13, $p = 0.021$), and with high job strain (OR = 1.66, $p = 0.047$)", than quitters.

The effects of depression on smoking cessation have been observed in clinical trials. In a randomized controlled trial, pregnant smokers (n = 77) who were depressed were less likely than non-depressed smokers (n = 50) to achieve abstinence (OR = 2.39; CI = 1.22–4.70, p =.01) (Linares Scott, Heil, Higgins, Badger, & Bernstein, 2009). A prospective observational study conducted in Boston examined the association between depression, stress, and anxiety to relapse among women (n = 65) postpartum. This study found that increases in depression and stress due to a previous pregnancy, unhappiness in current pregnancy, undergoing counseling for anxiety and depression, and having ever struggled with depression, significantly ($p < 0.05$) increased relapse among women after 12 weeks postpartum (Park et al., 2009). Women who find planning life postpartum to be foreboding are likely to relapse (Stotts, DiClemente, Carbonari, & Mullen, 2000). Also, stressors like infants' crying lead to immediate relapse (Gaffney & Henry, 2007). A qualitative study by Ripley-Mofitt and colleagues (2008) among pregnant women (n = 94) who attended prenatal clinics in Central North Carolina compared women who remained smoke free and those who relapsed. Smoking to manage stress was found to be a significant factor to relapse.

Smoking-related attitudes such as concern for weight gain (Berg et al., 2008), and low levels of motivation and confidence can reduce pregnant women's intention to stay quit (Schnoll et al., 2007). Often, unplanned pregnancies (Dejin-Karlsson et al., 1996), perceptions such as viewing smoking as "fun" instead of an addiction prior to pregnancy, and expecting quitting smoking to be an easier task hinder smoking cessation (Bottorff et al., 2000). On the other hand, positive effects including self-efficacy about quitting (Giovino, 2002), and motivation to adopt behavioral and experiential strategies (Scheibmeir et al., 2005) are related to quitting smoking among pregnant women. Smoking-specific health concerns also appear to motivate a pregnant woman's desire to quit smoking. In a qualitative study of 94 pregnant women, "concern for fetal health" was found to be a motivation to remain smoke-free, whereas "feelings of regret, shame or, low self-esteem" were found to contribute to relapse (Ripley-Mofitt et al., 2008).

Concern for post cessation weight gain was identified as a significant barrier to quitting smoking in a review of six studies by Bock, Lewis, Jennings, Marcus-Blank, and Marcus (2009). For instance, women (n = 412) attending obstetric clinics for smoking intervention trials were studied to assess their attitudes towards weight gain and smoking. Less concern towards gaining post-cessation weight was associated with being abstinent at the "end-of- pregnancy" (OR = 1.77; CI = 1.01-3.09) and also postpartum (OR = 2.09; CI = 1.05-4.14) (Berg et al., 2008).

Social influences such as pressure from peers, stigma of being called a smoker during pregnancy (as referenced by Kennison, 2009), high job strain (Dejin-Karlsson et al., 1996), and social support in the form of receiving good care during pregnancy from people around them, high social participation (actively taking part in social activities such

as attending church, involving in family gatherings, etc.), and high instrumental support (able to access certain resources like advice, information, etc.) (Dejin-Karlsson et al., 1996) influence the likelihood of quitting smoking among this vulnerable population. A population-based study in Sweden among first-time pregnant women (n = 872) found that psychosocial resources such as low social participation (such as attending church, family gatherings, etc.), less access to services, advice and resources, and those with little support from the infant's father, could be significant contributors to continued smoking among pregnant women (Dejin-Karlsson et al., 1996). Thus, understanding psychosocial variables, especially those related to social support, can help improve smoking cessation among pregnant women.

Exposure to other people's smoke. As described above, social support is an important determinant of smoking cessation attempts and success among pregnant women; and lack of positive support predicts failure to quit. Negative behaviors, such as smoking around pregnant women, especially can increase the urge to use a substance and promote relapse among smokers. This environmental determinant to relapse, thus, has been studied using several models and theories such as "withdrawal relief theories, conditioned compensatory response theories, conditioned competitive motivational theory, and social learning formulations" which attempt to explain the concept of *cue reactivity.* This concept involves an understanding of how being exposed to physical/substance cues can create reactions such as cravings and urges in an individual to use the substance (tobacco or alcohol) and to relapse (Niaura et al., 1988). An individual addicted to a substance might develop strong psychophysiological urges or cue-induced cravings (Ferguson & Shiffman, 2009) to use the substance when in its

physical presence (*physical cues*) and thus have increased risk of relapse. Further, being in the presence of negative affect and taking in even a small amount of the substance can also greatly increase the chances of relapsing (Niaura et al., 1988). Thus, a general framework of positive vs. negative behaviors from partners and friends differentially influence the likelihood of a cessation attempt (Mermelstein et al., 1983) among pregnant women.

Perhaps one of the most important types of negative behaviors in the support network that negatively influence a pregnant women's ability to quit smoking is exposure to others' smoke. Lack of support from partners who smoke was demonstrated to be a cause for continued smoking through pregnancy. Semi-structured interviews with about 200 pregnant women (29% smokers, 22% ex-smokers, & 49% never smokers) attending antenatal care revealed that 75% of the current smokers had partners who smoked compared with women who never smoked (Haslam et al., 1997).

That influence of friends and family was a barrier to smoking cessation among pregnant women (aged 15 years and above) was also shown in a review of seven qualitative studies by Ingall & Cropley (2009). A systematic literature review of randomized controlled trials (5 papers) examining relapse prevention or smoking cessation interventions among pregnant women postpartum was carried out by Levitt et al. (2007). Results from their reviews indicated that intensive interventions given to mothers (evaluated at the end of 6 months and 12 months) postpartum helped them gain more knowledge about the effects of exposure to passive smoking, and allowed less smoking at home (on a 7-point scale) (4.64 vs 5.09, F 17.12, $p < 0.001$) than those who did not receive an intensive intervention. Their reviews also showed that women were

more likely to stop smoking if they had partners who did not smoke or had partners who stopped smoking (OR = 3.87; CI = 1.6-3.96).

Another review on about 18 studies (in the past 10 years) addressed partner smoking during pregnancy. Among the 18 studies that they reviewed, three were theoretical studies. These studies indicated positive and negative interactions between couples, men's perceptions of smoking as a masculine behavior, and men with little knowledge about the effects of smoking on themselves and others, to be major inhibitors of smoking cessation among women. Ten studies in the review were categorized as descriptive and examined men's and women's attitudes to smoking cessation. Living with a current smoker was found to be a significant contributor to relapse among pregnant women in all studies, and relapse rates among those living with a partner who continued to smoke were six times more than those whose partner stopped smoking. Further, women were also found to perceive partner's support more strongly than from friends and family. The other five studies categorized as intervention also convey the same message and suggest the need for interventions to include pregnant women's partners (Gage, Everett, & Bullock, 2007).

Data (baseline and follow-up) from a sample (n = 688) of pregnant smokers was analyzed by McBride, Baucom, and colleagues (1998) to evaluate the relationship between partner's smoking and a woman's cessation during and after pregnancy. Of the 688 participants, 316 were "baseline quitters" (those who did not smoke in the past 7 days) and "baseline smokers" (those who smoked in the past 7 days). Partner's influence was analyzed among women who were either living with or were married to a smoking partner (n = 356), and among women living with a non-smoker (n = 332). Only women

(and not partners) were randomized to three interventions, that is, "usual care, pre-partum intervention, and both pre- and post-partum intervention" and partner's support was analyzed using a 5-item support scale. The results of this study showed that women who lived with non-smoking partners (58%) were significantly more likely to quit smoking as soon as they were pregnant than women who lived with smoking partners (35%) (p = 0.001), but this did not predict cessation during late pregnancy. A similar result was also observed in women perceiving support from partners. In another randomized controlled intervention by McBride, Baucom, and colleagues (2004), pregnant women (n = 583) and their partners were randomized to "usual care (UC), woman-only (WO), or partner-assisted (PA) intervention". They were followed at 28 weeks during pregnancy and at 2-, 6-, and 12-months postpartum. While participants in the WO group received counseling help and relapse prevention kits, participants in the PA group received benefits of WO group plus partners received counseling and support guides to help the woman build confidence, and additional smoking cessation aids. This study found no significant difference with respect to social support offered by partners to pregnant women in any of the groups.

Likewise, a cluster randomized controlled trial evaluated the effectiveness of cessation programs on both the pregnant woman (n = 901) and her partner's smoking behavior (Aveyard, Lawrence, Evans, & Cheng, 2005). Participants were randomized to "standard care, self-help manual and enhanced stage-based counselling, or self-help manual, enhanced stage-based counselling and use of an interactive computer program". One of the outcome measures of the study included assessing smoking status of the partners at booking for maternity care and to see if partners quit at the end of 30 weeks of

gestation and 10 days postpartum (n = 465). The result showed a 4-6% quit rate among partners of pregnant women, while quit rate was 6.5% for the women. Thus, more effort needs to be placed on helping partners of pregnant women to quit smoking.

A pilot study (part of a large randomized controlled trial) assessed pregnant women's perceived support and their partners' (n = 58 couples) reported support to help quit smoking (Pollak et al., 2001). Participants were divided into four categories: woman and partner smoke, woman smokes, but partner does not smoke, woman quit smoking, but partner did not, and woman quit smoking and partner does not smoke. Women's positive support for quitting, women's negative support for quitting, and partner support for quitting were analyzed, and results generally indicated that partners provided women with more positive and less negative support than was perceived by women. Similarly, Pollak and colleagues (2006) conducted a longitudinal study (for which data was obtained from a large randomized intervention trial) to predict "positive and negative support in early pregnancy (20 weeks or less) with cessation in late pregnancy (28 weeks)" in pregnant couples (n = 394). Smoking-specific support, support scores [using *summative (combination of couples' perspectives) & difference (dissimilarity of couples' perspectives)* models], and covariates such as women's and partners' smoking status along with woman's nicotine dependence were analyzed. The results indicated that women were 1.4 times more likely to quit for each unit of increase in the summative score for positive support (OR = 1.40, CI; = 1.02–1.90; $p = 0.03$). Women were also 1.4 times more likely to quit smoking for each unit of increase in the weak link for positive support (OR = 1.41; CI = 1.00–2.00; $p = 0.05$), thus indicating the need for interventions

to analyze cessation rates in couples based on both scales of support, and not solely relying on opinions from either the woman or her partner.

Another randomized trial on smoking cessation evaluated the risk of relapse (within one year after delivery) among women (n = 175) who quit smoking during pregnancy in Poland. The results showed that women who quit smoking before 14 weeks of pregnancy had lower risk of smoking relapse within 12 months after delivery (OR = 0.2; CI: 0.1–0.8) if they had a household member or a partner who smoked (Polanska, Hanke, & Sobala, 2005). Ockene and colleagues (2002) assessed spontaneous smoking cessation in a randomized clinical trial among low-income pregnant women (n = 601) attending WIC clinics and found that having a partner who smoked (exposure to environmental smoke) could increased the rate of relapse (OR = 0.62; CI = 0.41–0.96).

Virtually no studies have examined racial/ethnic differences in exposure to other people's smoking among pregnant women, and how this related to the likelihood of quitting. One cross-sectional survey study (Roberts-Clarke, Morokoff, Bane, & Ruggiero, 2002) of 198 low-income pregnant women who attended prenatal care at six urban obstetrics clinics examined factors associated with quitting, including partner smoking, among a biracial sample of whites (71.8%) and Latinas (28.2 %). A baseline survey assessing smoking characteristics was completed by all participants and included variables such as smoking status, smoking status of parents and partners along with three other measures to assess nicotine dependence. The study concluded that Latinas (62.5%) had lower levels of addiction to cigarettes (as measured by the three indexes of addiction) and were also less likely to have partners who smoked than white women (69%).

Further, a study used focus group discussions and open-ended questions on low-income pregnant women (n = 57) from different ethnic groups, including whites, African Americans, and Native American women to assess their attitudes and perceptions of smoking, and found that pregnant women often found quitting difficult when they were around other people who also smoked and lacked knowledge of dealing with risks from passive smoking (Dunn, Pirie, & Lando, 1998), indicating yet again that exposure to other people's smoke is an important determinant to smoking during pregnancy.

Although smoking rates during pregnancy are significant among African American women, and this sub-population has considerable difficulty quitting smoking, no studies have examined exposure to others' smoking as a risk factor for failure to quit or relapse during pregnancy. Given the varying evidence with regard to racial differences, and the importance of being exposed to other people's smoke in determining quitting smoking among pregnant women, this thesis thus, seeks to explore these modifiable risk factors in a sample of low-income pregnant women.

Conclusion

According to Thompson (2007), a nation's development and health can be hindered by a combination of poverty, economic development, and the poor health of women, because this combination can lead to high rates of maternal and neonatal mortality and morbidity. In addition, smoking during and after pregnancy can further deteriorate a woman's, fetus's, infant's, and other children's health, especially among those with poor socioeconomic backgrounds. Therefore, understanding potential determinants to smoking cessation among pregnant women is necessary. Among these modifiable determinants, social support with regard to being exposed to others' smoking

is important to recognize issues of relapse among this population. Despite these disturbing facts and evidence pertaining to probable determinants of relapse among low-income pregnant women, there is a scarcity of research examining: a) the relationship between the likelihood of quitting smoking among pregnant women and their exposure to other people's smoke b) the indices of exposure to other people's smoke that are most strongly associated with quitting smoking, and c) if there are any racial differences in these associations. This study, therefore, seeks to examine whether several indices of exposure to other people's smoking is associated with the likelihood of quitting smoking during pregnancy among low-income women, and whether these relationships are similar for white and African American women.

CHAPTER 3

Methodology

Research Design

Data for this thesis were obtained from the MOMS (Monitoring of Maternal Smoking) study, which was conducted at the University of Memphis, Center for Community Health from 2001 to 2003. This was a prospective observational study targeting low-income pregnant women. The primary aim of the study was to identify factors associated with quitting and continued smoking during pregnancy for low-income black and white pregnant smokers. Participants were recruited, on average, during the 21st week of pregnancy and followed until six-months after delivery. Funding for this research study was granted by The Urban Child Institute (TUCI). The protocol and informed consent document were approved, and permission for conducting the research was granted, by the University of Memphis Institutional Review Board (IRB).

This cross-sectional study utilized baseline data. The independent variables were various indices of exposure to other people's smoking and race. The dependent variable was quitting status. Variables considered analytically as potential confounders included woman's age, race, income, education, nicotine dependence, depressed mood, gestational age, and motivation and confidence to quit. This study was approved by The University of Memphis IRB.

Participants

To be eligible for the study, participants had to: a) be pregnant, b) be at least 18 years of age, and c) report having smoked regularly during the month prior to finding out they were pregnant. However, they did not need to be currently smoking at the time of

the interview in order to participate. Participants were recruited from a large public prenatal clinic ("The Med") and several Women, Infant, and Children (WIC) clinics.

A total of 382 women who were screened met the eligibility criteria. Of those, 177 women declined and 255 women agreed to participate in the study. A total of seven participants identified their race/ethnicity as something other than non-Hispanic white or non-Hispanic black. Since this study focused on comparing correlates of quitting among black and white women only, these seven participants were excluded from the present analyses, leaving a total of 248 participants. Of these 248 subjects, 103 were African American (41.5%) and 145 were non-Hispanic white (58.5%).

Procedures

Data collectors were graduate students from the University of Memphis. They underwent human subjects' protection training, and then were trained by the study investigators on the protocol, including procedures for recruiting subjects, obtaining informed consent, and collecting data. Once participants were recruited and the study was described to them and their questions answered, they were asked to sign an informed consent. Then a structured interview was completed and a breath sample obtained to measure expired carbon monoxide (CO), an indicator of recent smoking.

Measures

Exposure to other people's smoking. Five variables were collected that assessed exposure to other people's smoke, and were analyzed as independent variables in the present study, including:

Restriction of smoking in the home. Participants were asked how smoking was handled in their home (i.e., "No one is allowed to smoke," "Only special guests may

smoke," "People are allowed to smoke only in certain areas," "People are allowed to smoke anywhere"). This variable was recoded to indicate whether smoking was restricted in the home ("Smoking is allowed in the home" vs. "Smoking is not allowed in the home").

Number of regular smokers living in the home. Participants were asked how many people living in their home smoked on a daily basis. This was coded as a continuous number.

Exposure to other people's smoke in the home. Participants were asked "On average, how many hours per day are you exposed to other people's cigarette smoke at home?" Responses ranged from 0-24 hours. Because responses were bi-modally distributed near 0 hours per day and 24 hours per day, responses were dichotomized as "not exposed" (0 hours reported) vs. "exposed" (1-24 hours reported).

These three variables on smoke exposure in the home (smoking policy in the home, number of regular smokers living in the home, and exposure to other people's smoking in the home) were created for a previous study (Bliss, Garvey, & Ward, 1999) conducted by the Principal Investigator of the MOMS study, and have been shown to predict the likelihood of quitting smoking among adults (Garvey, Bliss, Hitchcock, Heinold, & Rosner, 1992).

In addition, 2 variables assessed exposure from specific members of the participant's social network:

Partner's smoking behavior. Participants were asked about their husband or partner's smoking status (i.e., "You don't have a husband or partner" "Has never smoked cigarettes" "Used to smoke cigarettes but quit before you found out you were pregnant"

"Used to smoke cigarettes but quit after you found out you were pregnant", "Smokes cigarettes now"). This variable was recoded to indicate whether participants "had a partner who smoked" vs. "had a partner who did not smoke"; responses were dichotomized as "No" vs. "Yes".

Proportion of friends who smoke. Participants were asked to specify the proportion of their friends who smoked (i.e., "None of them," "A few of them," "About half of them," "Most of them," "All of them"). This variable was distributed normally and was treated as a 5-level continuous variable in statistical models.

Assessment of quitting status. Quit status was assessed in the following way: Participants were classified as having quit smoking if the following criteria were met: 1) they reported that they had stopped smoking after they found out they were pregnant and were not smoking now 2) they reported that it had been 7 days or longer since they had smoked, and 3) their expired CO level was < 10 ppm.

Potential covariates. Several variables were assessed as potential confounders of the association between the independent and dependent variables, including:

Demographics. Sociodemographic information was obtained by self-report and included age, marital status, race, educational level, and annual household income.

Reproductive history. Participants were asked their due date and date of last menstrual period. Gestational age was calculated with number of days between these two days.

Nicotine dependence. Nicotine dependence prior to pregnancy was assessed retrospectively by the Fagerström Test for Nicotine Dependence (FTND). This measure is a widely used and well-validated six-item questionnaire assessing degree of nicotine

dependence. The FTND has been found to possess adequate internal consistency (α = .61), and to be significantly related to biochemical measures of smoking exposure (Heatherton, Kozlowski, Frecker, & Fagerström, 1991). The questionnaire was modified to reflect the three-month period of time prior to when participants found out they were pregnant.

Smoking history and patterns. Smoking history and patterns information was obtained from participants about their current smoking status, and the number of cigarettes they smoked both currently and in the month prior to finding out they were pregnant.

Quitting motivation and confidence. Participants' level of motivation to quit smoking and confidence related to quitting during their pregnancy were assessed with two separate items. Participants rated their level of motivation to quit smoking during pregnancy on a five-point scale ranging from 1 ("Not at all motivated") to 5 ("Extremely motivated"). Similarly, participants rated "how sure" they were that they could keep from smoking during their pregnancy (1= "Not at all sure" to 5 = "Extremely sure"). Items were phrased using "how sure", because in pilot testing some women were unclear of the meaning of "confidence". Both motivation and confidence have been widely used in previous studies (Garvey, Bliss, Hitchcock, Heinold, & Rosner, 1992); Ward, Klesges, Zbikowski, Bliss, & Garvey, 1997) and have been shown to predict likelihood of quitting in this sample (Vander Weg, Ward, Scarinci, Read, & Evans, 2004).

Center for epidemiologic studies- Depressed Mood Scale (CES-D). The CES-D is a 20-item questionnaire that was developed by the National Institute of Mental Health to be used as a screening instrument for the assessment of depressive symptoms. The

CES-D has good internal consistency (α = .85), test-retest reliability (.45 to .70), and both construct and predictive validity (Radloff, 1997; Thomas et al., 1999). Participants were asked to indicate the occurrence and frequency of depressive symptoms during the past week using a four-point Likert scale.

Statistical Analyses

All data analyses were performed using Statistical Package for the Social Sciences (SPSS) version 18.0. An alpha level of .05 was set as the criterion for significance.

Preliminary analyses were conducted to select potential confounders to include in statistical models. We selected several variables to examine as potential confounders, based on the extant literature regarding sociodemographic, smoking history-related, and psychosocial correlates to smoking cessation and exposure to other people's smoking. These were variables that were not considered to be mediators of the association of exposure to others people's smoking and quit status, but were significantly correlated with the outcome variable (quit status) and with at least one independent variable (restriction of smoking in the home, number of regular smokers in the home, exposure to other's smoke in the home, partner's smoking behavior, and proportion of friends who smoke regularly). Variables that met these criteria were included in models as covariates. In addition, we included the subject's gestational age as a covariate, although it was not significantly related to the dependent variable or any independent variables, in order to control for varying lengths of time since finding out one was pregnant, as greater gestational age would convey a longer opportunity to quit smoking.

First, descriptive analyses of participant characteristics, including comparisons for black and white participants were conducted using t-tests and chi-square analyses. Next, to examine whether race modified the associations of exposure to other's smoking with quitting status, multiple logistic regression models were created for each independent variable, regressing quit status on the independent variable, race, and a race by independent variable interaction. A standard set of covariates was also included in these models (age, education, nicotine dependence, and gestational age). For each model, if the interaction term was non-significant ($p > .05$), the model was rerun with the interaction term removed. If race was non-significant ($p > .05$) in the subsequent model, this term was removed, and the model was re-run to arrive at a final model. To determine the strongest independent exposure variables to predict quitting status, a final logistic regression model was run that included all independent variables that were significantly related to quit status in the above models, along with the covariates.

CHAPTER 4

Results

Descriptives and Race Differences in Subject Characteristics

Of the 248 pregnant women who participated in this study, 145 were non-Hispanic white (58.5%) and 103 were non-Hispanic black (41.5%). As presented in Table 1, the mean age of the participants was 24.2 (SD = 5.1) years. Compared to whites, blacks were less likely to be married or have a live-in partner, and to have graduated from high school. Blacks were more likely to have an annual household income of less than or equal to $15,000 than whites. The mean gestational age for the entire sample was 21.5 weeks, with no significant differences between blacks and whites (p = .618). White women were more likely to smoke cigarettes, be nicotine dependent, have more number of smokers in home, have more friends who smoke, and less likely to restrict smoking at home than did black women. White women also reported high motivation to quit smoking during pregnancy compared to black women.

Table 1

Characteristics of the Sample (N = 248)

Variable	Total Sample (n = 248)	Blacks (n = 103)	Whites (n = 145)	P for Black vs White
Demographics				
Non-Hispanic whites (%)	58.5			
Non-Hispanic blacks (%)	41.5			
Age (years, mean ± SD)	24.2 (5.1)	24.8 (5.4)	23.8 (5.0)	.131
Married or live-in partner (%)	44.4	28.2	55.8	<.000
Unmarried, divorced, or widowed (%)	55.6	71.8	44.2	<.000
Household income (% ≤ $15, 000)	54.5	72.6	41.7	<.000
High School diploma (%)	59.7	49.6	66.9	.001
Pregnancy-related Variables				
Gestational age (weeks, mean ± SD)	21.5 (9.0)	21.9 (8.8)	21.1 (9.2)	.618
Smoking History and Patterns				
Amount smoked (cigs/day)	18.6 (12.4)	12.6 (11.6)	23.1(12.1)	<.000
FTND score (mean ± SD)	4.5 (2.4)	4.1 (2.2)	4.8 (2.4)	.011
Quit smoking during pregnancy (%)[1]	21.8	21.4	22.1	.894
Environmental Tobacco Exposure				
Restriction of smoking in home (%)[2]	46.0	38.8	51.0	.057
Number of regular smokers in the home (mean ± SD)	0.9 (1.0)	0.6 (0.6)	1.1 (1.1)	.000
Exposure to other people's smoke in the home (%)[3]	54.7	60.8	50.3	.105
Partner's smoking behavior (%)[4]	57.3	50.5	62.1	.069
Proportion of friends who smoke[5] (mean ± SD)	3.2 (1.4)	2.9 (1.4)	3.4 (1.2)	.000
Psychosocial variables				
CES-D (mean ± SD)	21.7 (11.3)	21.2 (11.2)	22.0 (11.5)	.565
Motivation (mean ± SD)	3.2 (1.2)	3.5 (1.2)	3.1 (1.2)	.019
Confidence (mean ± SD)	2.6 (1.4)	2.8 (1.3)	2.4 (1.5)	.061

Notes.

[1]Coded as 0 = Did not quit smoking during pregnancy or 1 = Quit smoking during pregnancy

[2]Coded as 0 = People not allowed to smoke in home or 1 = People allowed to smoke in home

[3]Coded as 0 = Not exposed to other people's smoke or 1 = Exposed to other people's smoke

[4]Coded as 0 = Does not have partner/husband who smokes or 1 = Has partner/husband who smokes

[5]Coded as 0 = None of them; 1 = A few of them; 2 = About half of them; 3 = Most of them; 4 = All of them

Selection of Confounders

After selecting potential confounders (age, income, race, marital status, education, nicotine dependence, motivation and confidence to quit, and gestational age), analyses were conducted to check for significant correlations between the potential confounders with the independent variables and the dependent variable. This was done in three steps.

First, analyses were conducted for each potential confounder and each independent variable (e.g., race with restriction of smoking in the home, income with restriction of smoking in the home, education with smoking unrestricted in the home). This procedure was then repeated for all independent variables (restriction of smoking in the home, number of regular smokers in the home, exposure to other's smoke in the home, partner's smoking behavior, and proportion of friends who smoke regularly). In the second step, correlations were tested for each potential confounder with the dependent variable (quit status) (e.g., race with quit status, income with quit status, education with quit status) and to obtain significant correlations. Finally, all correlations were compared to see which covariates were significantly related to the five independent variables and the dependent variable. This led to the selection of three covariates (age, education, and nicotine dependence), along with gestational age, which were then used as a standard set of covariates throughout our analyses.

Intercorrelations among Independent Variables

Correlation coefficients were used to test for associations among the five independent variables (restriction of smoking in the home, number of regular smokers in the home, exposure to other's smoke in the home, partner's smoking behavior, and proportion of friends who smoke regularly). Preliminary examination of the results

indicated no problems with high intercorrelations among the predictor variables in the data ($r < 0.8$ for all variables). A report of the presence of any smoking allowed in the home was highly correlated with the exposure of smoke at home ($r = .591$). Table 2 shows the correlations among the variables.

Table 2

Intercorrelations of Independent Variables (N = 248)

	Restriction of smoking in the home	Number of regular smokers in home	Exposure to other people's smoke in the home	Partner's smoking behavior	Proportion of friends who smoke
Restriction of smoking in the home	1.000				
Number of regular smokers in home	.170*	1.000			
Exposure to other people's smoke in the home	.591*	.412*	1.000		
Partner's smoking behavior	.080	.372*	.335*	1.000	
Proportion of friends who smoke	.062	.288*	.120	.110	1.000

*Correlation is significant at $p < .01$
Note N = 248-1 = 247 for Exposure to other people's smoke in the home

Association of Exposure to Other People's Smoking and Quitting Status

To identify if the association of exposure to other people's smoking and quitting status was influenced by race, separate logistic regression models were constructed initially for each of the five independent variables. These models included the independent variable (restriction of smoking in the home, number of regular smokers in the home, exposure to other's smoke in the home, partner's smoking behavior, and proportion of friends who smoke regularly), race, a race by independent variable interaction term, and covariates (age, education, and nicotine dependence). For each of the five independent variables, the race by independent variable interaction term was not significant (all p-values > .05). As such, models were re-run with the interaction terms excluded, and the race term was examined. In all five models, the race term was not significant (all p-values > .05). Models were then re-run with the race term omitted to arrive at a final model for each of the five independent variables. Results of each of these models are presented below, and also shown in Tables 3-7.

Restriction of smoking in the home. In a multiple logistic regression model, this independent variable was not a statistically significant correlate (OR = .683; CI = .341-1.366; p = .281) of quit status among pregnant women, indicating that there was no difference on women's quitting status irrespective of whether smoking was allowed at home or not (Table 3).

Table 3

Multiple Logistic Regression of Restriction of Smoking in the Home to Quit Status

	Beta	OR	95% C.I.		P value
Restriction of smoking in home	-.381	.683	.341	1.366	.281
Age	-.075	.928	.859	1.002	.056
Nicotine Dependence	-.270	.763	.656	.889	.001
Gestational Age	.004	1.004	.999	1.010	.120
Education[1]					.025
Education (1)[2]	-1.259	.284	.114	.705	.007
Education (2)[3]	-.628	.534	.235	1.214	.134

Notes.

[1]Coded as Education = did not complete high school

[2]Coded as Education (1) = high school graduate or GED

[3]Coded as Education (2) = some college, business, technical school, or college graduate

Number of regular smokers in home. This independent variable was a statistically significant correlate (OR = .594; CI = .377-.934; p = .024) of quit status among pregnant women, indicating that an increase of one extra person who smoked in the house is associated with 59.4% decrease in the likelihood for quitting (Table 4).

Table 4

Multiple Logistic Regression of Number of Regular Smokers in Home to Quit Status

	Beta	OR	95% C.I.		P value
Number of regular smokers in home	-.522	.594	.377	.934	.024
Age	-.098	.907	.836	.984	.020
Nicotine Dependence	-.252	.777	.666	.906	.001
Gestational Age	.005	1.005	.999	1.010	.088
Education					.023
Education (1)	-1.285	.277	.110	.694	.006
Education (2)	-.632	.531	.231	1.224	.138

Exposure to other people's smoke in the home. This independent variable was a statistically significant correlate (OR = .360; CI = .182-.713; p = .003) of quit status among pregnant women indicating that women who were exposed to other people's smoking in the home were only 36% as likely to quit smoking (Table 5).

Table 5

Multiple Logistic Regression of Exposure to Other People's Smoke in the Home to Quit Status

	Beta	OR	95% C.I.		P value
Exposed to other people's smoke in the home	-1.020	.360	.182	.713	.003
Age	-.081	.922	.852	.998	046
Nicotine Dependence	-.260	.771	.660	.900	. 001
Gestational Age	.004	1.004	.999	1.010	.128
Education					.038
Education (1)	-1.205	.300	.119	.757	.011
Education (2)	-.560	.571	.246	1.323	.191

Partner's smoking behavior. This independent variable was not a statistically significant correlate (OR = .644; CI = .332-1.249; p = .193) of quit status among pregnant women, indicating that there was no difference on women's quitting status irrespective of whether they had a partner/husband who smoked or not (Table 6).

Table 6

Multiple Logistic Regression of Partner's Smoking Behavior to Quit Status

	Beta	OR	95% C.I.		P value
Partner's smoking behavior	-.440	.644	.332	1.249	.193
Age	-.079	.924	.855	.998	.045
Nicotine Dependence	-.274	.761	.654	.885	.001
Gestational Age	.005	1.005	.999	1.010	.102
Education					.024
Education (1)	-1.267	.282	.114	.699	.006
Education (2)	-.631	.532	.233	1.215	.134

Proportion of friends who smoke. This independent variable was not a statistically significant correlate (OR = .892; CI = .695-1.146; p = .372) of quit status among pregnant women, indicating that there was no difference on women's quitting status irrespective of whether they had friends who smoked or not (Table 7).

Table 7

Multiple Logistic Regression of Proportion of Friends who Smoke to Quit Status

	Beta	OR	95% C.I.		P value
Proportion of friends who smoke	-.114	.892	.695	1.146	.372
Age	-.080	.923	.855	.996	.040
Nicotine Dependence	-.262	.770	.659	.899	.001
Gestational Age	.004	1.004	.999	1.010	.127
Education					.018
Education (1)	-1.312	.269	.109	.667	.005
Education (2)	-.657	.518	.228	1.180	.118

Final Multivariate Model

To determine the most robust, independent correlates of quitting smoking, a final logistic regression model was created, regressing quit status on statistically significant values of exposure (exposure to other people's smoke in the home, and number of smokers in the home), plus covariates (age, education, nicotine dependence, and gestational age).

Exposure to other people's smoke in the home remained statistically significantly related to quitting (OR = .442; CI = .209-.931; p = .032), indicating that women who were exposed to other people's smoking in the home were only 44.2% as likely to quit smoking. The final multivariate model is presented in Table 8 below.

Table 8

Multiple Logistic Regression of Independent Variables on Women's Quit Status

	Beta	OR	95% C.I.		P value
Independent Variables					
Exposure to other people's smoke in home	-.817	.442	.209	.931	.0320
Number of regular smokers in home	-.302	.740	.460	1.189	.7400
Age	-.090	.913	.840	.991	.0300
Nicotine Dependence	-.252	.777	.665	.909	.0020
Gestational Age	.005	1.005	.999	1.010	.1070
Education					.0380
Education (1)	-1.210	.298	.117	.758	.0110
Education (2)	-.581	.559	.240	1.305	.1790

CHAPTER 5

Discussion

The purpose of this study was to examine the relationship between several indices of exposure to other people's smoke on the likelihood of quitting smoking among low income pregnant women, and to determine whether these associations differed between African Americans and whites. Indices of exposure to others' smoking included the presence of a smoking restriction in the home, the number of regular smokers residing in the home, whether the participant reported regular exposure to other's smoke in the home, whether the subject had a partner who smoked, and the proportion of friends who smoke regularly. While many of these indices have been examined in previous studies (Aveyard et al., 2005; Dunn et al., 1998; Gage et al., 2007; Levitt et al. (2007); McBride & colleagues (1998); Polanska et al., 2005), this is the first study to systematically examine multiple indices and to focus on a particularly vulnerable population for exposure to secondhand smoke for failure to quit smoking during pregnancy – low income women. Further, this is the first study to investigate racial differences in these exposure/outcome associations.

The major finding of this study was that living with others who smoke and being regularly exposed to other people's smoke in the home were the strongest correlates of failing to quit smoking. While these indices were related to quitting, even after controlling for important confounders, other indices were not related to quitting, including the existence of smoking restrictions in the home, having a partner who smokes, and having a higher proportion of friends who smoke. These associations were similar for black and white low income women.

Two closely related correlates of quitting smoking have been identified in this study. One of them is exposure to others' smoking in the home, which was a major predictor of quit status among pregnant women. This study showed that women who were exposed to other people's smoking in the home were only 36% as likely to quit smoking. Although few studies have directly measured exposure to others' smoking on quitting among women, this result is consistent with several closely linked studies in the past, which have shown that being exposed to others' (family, friends, etc) smoke, and especially partner's smoke is significantly associated with relapse among low-income pregnant women. For instance, being married to a smoker increases the likelihood of not quitting smoking by three times among women when compared to not being married with a smoker (McBride et al., 1992; Severson, Andrews, Lichtenstein, Wall, & Akers, 1997).

Similarly, having a greater proportion of smokers at home was found to be significantly associated with quitting smoking among pregnant women. This study showed that women who lived with more number of smokers in the home were only 59.4% as likely to quit smoking. This finding suggests that exposure to others' smoking may influence a pregnant woman's ability to quit is a dose response factor, but that the likelihood of quitting decreases in proportion to the number of smokers in one's home. This result is in agreement with previous studies which indicate that women often find quitting difficult when they are around other people who smoke (McBride & Pirie, 1990; McBride et al., 1992; Severson, Andrews, Lichtenstein, Wall, & Akers, 1997), and lack knowledge of dealing with risks from passive smoking (Dunn, Pirie, & Lando, 1998).

Numerous studies have examined the influence of partner smoking on the likelihood of quitting. Lack of support from partners was demonstrated to be a cause for

continued smoking through pregnancy (Haslam et al., 1997). Among prospective observational studies, three studies showed that women with a partner who smoked were 35-70% less likely to quit smoking during pregnancy and six times more likely to relapse post-partum (Aveyard et al., 2005; Gage et al., 2007; McBride et al, 1998). It is unclear why the results of the present study do not confirm these findings. This is possibly due to the fewer number of participants (57.3%) who had smoking partners.

Likewise, few studies have shown that women who allowed less smoking at home were more likely to quit smoking than those who did not (Levitt et al., 2007) and the results from this study do not show significant relationship to smoking cessation among women and smoking being allowed at home. One reason could be the fewer number of women (46%) who allowed smoking in home, and it is difficult to say if this is consistent across literature due to the smaller number of studies which examined this variable.

Previous studies have examined the influence of friends' smoking on the likelihood of quitting smoking among pregnant women along with the influence of partners' smoking (Ingall & Cropley, 2009). However, the results from the present study do not show a significant relationship between the influence of having friends who smoked on quitting status among pregnant women. This difference in the findings is probably due to the small sample size (n = 248), and also due to the proportion of women who had fewer smoking partners (57.3%) and friends, and fewer percentage (46%) of women who allowed smoking in the home.

Race did not modify the association of quitting for any of the study's indices of exposure to others' smoking. Stated differentially, quitting smoking was influenced by exposure to others' smoking to a similar extent in black and white women. White women

allowed more smoking at home, had higher number of smokers in home, and higher number of friends who smoked than black women. Despite these differences, black women were not more likely than white women to quit smoking, indicating that other influences beyond exposure to other's smoking determine quitting. Previous studies which examined racial differences found that both white and black women have difficulty quitting smoking (Avery & Stallings, 2003; Ockene et al., 2002; Yu et al., 2002). However, there is virtually no evidence in the experimental literature which supports this finding. One study examined factors associated with quitting, including partner smoking, among a biracial sample of whites and Latinas, and found that Latinas were more likely to quit smoking than whites, but did not include black women as part of the study. This finding suggests the need for more studies to examine racial differences and exposure to others' smoke on quitting smoking among women.

Exposure to others' smoking was conceptualized to influence the likelihood of quitting smoking, via its role as a "cue" that elicits reactions such as cravings and urges in an individual to use the substance (tobacco or alcohol) when people around them use the substance, and to relapse (Niaura et al., 1988). This environmental determinant to relapse has been studied using several models and theories such as "withdrawal relief theories, conditioned compensatory response theories, conditioned competitive motivational theory, and social learning formulations" on how an individual addicted to a substance might develop strong psychophysiological urges or cue-induced cravings (Ferguson & Shiffman, 2009) to use the substance when in its physical presence (called *physical cues*). This exposure to *physical cues* is further hypothesized to lead individuals to relapse. Additionally, negative affect (such as, being exposed to an addicting

substance when used by a partner or a friend or a family member) and taking in even a small amount of the substance can also greatly increase the chances of relapsing (Niaura et al., 1988), and the findings of this study support this theory. According to the significant findings of this study, exposure to others' smoke in the home and presence of a higher proportion of smokers in the home, strongly support this theory. However, this study was not able to evaluate any cue reactivity variables that would be expected to mediate exposure and quitting associations such as conditioned withdrawal responses. Further research in this area is needed.

The current study has several strengths. First, the study sample was fairly large for a biethnic sample of low-income pregnant women for the assessment of a large number of risk factors. Second, the study incorporated a biochemical verification of quit status with expired CO. That exposure to others' smoking influences cessation among pregnant women is supported by the theory of *cue reactivity* on which our study is based, and is the third strength of our study. Finally, this is one of the few studies which examined multiple indices of exposure to others' smoking to cessation among pregnant women, and racial differences in these associations.

This study also has a few limitations. First, given the cross-sectional design of this study, it is impossible to make causal inferences. For instance, it is difficult to predict whether reducing exposure to others' smoke in the home assists pregnant women to quit smoking, and if this is a cause or an effect of the decision to quit. The second limitation from the current study is unknown reliability and validity of some instruments used to assess exposure to others' smoking at home, and motivation and confidence. Finally, there was a variation in the gestational age (4 to 40 weeks), and quit attempts at a later

stage in pregnancy may not have been included in this study among those women who were interviewed at an earlier stage which included only baseline data.

The results of this study suggest future cessation interventions to incorporate certain strategies for low income pregnant women. First, interventions for pregnant women should incorporate all other smokers in the home. Since the presence of more number of smokers at home can hinder cessation among women, incorporating other smokers and helping them quit could improve quitting smoking among women. Second, helping all household members who smoke to quit or to avoid smoking inside the home is vital to reducing exposure to smoke for the pregnant women, thereby improving chances of cessation. Third, more interventions must be designed to examine racial differences on these indices of exposure to smoking cessation among low-income pregnant women.

To sum up, these findings indicate that several demographic and environmental characteristics are likely to be important determinants to quitting smoking among low income pregnant women. The correlates of quitting were similarly associated with both racial groups, indicating that both black and white women were equally likely to quit. These findings are especially important for future interventions as they will add new insight into potentially modifiable determinants of smoking cessation among low income black and white pregnant women.

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