PERINATAL SMOKING AND ITS RELATED FACTORS

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DEDICATION

This dissertation is dedicated to all of the moms in the Nurse-Family Partnership program. It is my hope that this work will provide insight into just one aspect of how nurses can support you with achieving optimal health and well-being for you and your baby.

It is truly a blessing you allow us to be part of your life during your transition into motherhood.

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Ashley Jones

PERINATAL SMOKING AND ITS RELATED FACTORS

The smoking rate of low-income pregnant women is almost 4 times the rate for higher-income women. A better understanding of smoking within the low-income population is needed. The purpose of this dissertation was to study smoking and related factors for pregnant and postpartum women living in poverty. The first component used Rodger's evolutionary concept analysis method and uncovered three attributes, four antecedents, and three consequences for smoking cessation. The second (N = 1,554) and third (N = 71,944) components were a secondary data analysis of first-pregnancy Medicaid-eligible women enrolled in the Nurse-Family Partnership program from 2011-2016. The second component explored patterns of smoking and depression and their associations. Eight distinct patterns of smoking and depression were found. Smokers were more likely than nonsmokers to have depressive symptoms at the end of pregnancy (OR = 1.37 [1.04, 1.81] and 12 months post-delivery (OR = 1.93 [1.47, 2.51]. The third component investigated covariates present during early pregnancy and their relationships with smoking status and sought to find best fitting predictive models. Multivariable logistic regression showed cigarette use in the 3 months prior to pregnancy and at program intake were significant predictors for smoking status at the end of pregnancy and 12 months post-delivery. Interactive Matrix Language, Structured Query Language, and iterations of logistic regression identified 5 covariates (high school education, cigarette use prior to pregnancy, smoking status at pregnancy baseline, depression, and self-mastery) for the best fitting model at the end of pregnancy and three additional covariates (post-secondary education, marital status, and race) for the 12 months post-delivery

model. The area under the receiver operator characteristic curve was 0.9681 for the end of pregnancy model and 0.9269 for 12 months post-delivery model, indicating excellent prediction ability of the models. Results can be integrated in smoking prevention education, screening, and cessation intervention programs.

Carol Shieh, DNSc, RNC-OB, MPH, FAAN, Chair

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LIST OF ABBREVIATIONS

Abbreviations	Terms
CDC	Centers for Disease Control and Prevention
TRA	Theory of Reasoned Action
TPB	Theory of Planned Behavior
NFP	Nurse-Family Partnership
EPDS	Edinburgh Postnatal Depression Scale
WIC	Women, Infants, and Children
PHQ	Patient Health Questionnaire
CO	carbon monoxide
ppm	parts per million
OR	odds ratio
CI	confidence interval
PRAMS	Pregnancy Risk Assessment Monitoring System
AUC	area under the curve
ROC	receiver operating characteristic

CHAPTER ONE

This chapter provides an introduction to the dissertation topic and the significance of pregnancy and postpartum smoking in low-income first time pregnant women. The chapter continues with discussing the aims of the dissertation study, and provides the connection among the three chapters within the dissertation. This is followed by a discussion of the theory informing the conceptual framework, and the approach to the study. Finally, a brief overview of the methods and measurements concludes the chapter.

Background and Significance

Over 16 million people in the United States live with diseases caused by smoking and more than 480,000 people die annually from smoking-related causes.[1] Additionally, 5.6 million children alive today will die prematurely as a result of smoking if current trends continue.[1] Initiatives implemented through various organizations to reduce smoking during pregnancy became mainstream in the 1990s, leading to a 38% decrease in women smoking during pregnancy between 1992 and 2002. [2] Although smoking during pregnancy continued to decrease from 13.3% in 2000 to 10% in 2011, relapse back to smoking after pregnancy is around 40%.[3]

Too many women continue to smoke during pregnancy, and of those who quit during pregnancy, the number who return to smoking postpartum is high. National efforts for smoking cessation and relapse prevention among pregnant and postpartum women exist, many which aim to support national goals such as the Healthy People 2020 goals; however, achievement of target goals is suboptimal nationwide.[4] For example, the Healthy People 2020 target goal for reducing postpartum relapse [at 4 months post-delivery] among women who quit smoking during pregnancy is 38.2%, but the national

average for relapse is currently 42.4%.[4,7] When looking up to one year post-delivery, only about one-third of women who quit smoking during pregnancy remain smoke free.[1] Other studies report that more than 50% of women who have quit smoking during pregnancy experience relapse by 12 months post-delivery.[5,6] Even interventions reporting positive results with cessation during pregnancy also report high relapse rates post-delivery.

Smoking cessation studies containing both an intervention and a control group have demonstrated higher abstinence rates in the intervention group throughout the duration of the intervention.[8-11] While this may seem encouraging that interventions are working, there are still high rates of relapse after the intervention has ceased, and many previous studies are not designed specifically for pregnant and postpartum women. While smoking cessation interventions are available for the maternal-child population, the interventions often are implemented during pregnancy and/or the early postpartum period only, [12] leading to a large knowledge gap for the first year after pregnancy when relapse rates are highest.

Smoking is influenced by socioeconomic status. Adults living at or below the federal poverty level have higher prevalence of cigarette smoking than adults living above the federal poverty level.[3] Disparities related to smoking cessation also exist specifically within the maternal population, and women with a lower socioeconomic status have historically been targeted by tobacco companies.[13] Additionally, pregnant and postpartum women living at or below the poverty line (i.e. low-income women) are disproportionately impacted by smoking, with 4 times as many pregnant women on Medicaid continuing to smoke during pregnancy compared to privately insured women (14% vs. 3.6%).[14] This dissertation provides insight for this specific population.

Associations have been found between [any] mental illness and smoking in adults. A significant difference exists in the percent of adults who smoked in the past month when comparing any mental illness and no mental illness.[15] More than 1 in 3 adults (36.1%) who have a mental illness also smoke cigarettes, whereas only around 1 in 5 (21.4%) adults without a mental illness smoke.[16] When looking at gender, smoking, and mental illness, almost half (47.9%) of women with a mental illness also smoke cigarettes.[16] Major depression is a common mental illness. Depression affects around 2.2 million adolescents (age 12-17 years) and 16.2 million adults (age $\geq$ 18 years) in the U.S.[17] and has been associated with smoking.[18]

Self-mastery is a psychological construct that identifies one's sense of control over the influences in one's life,[20] and has been used in previous research.[21-25] Correlations have been identified between mental health outcomes and level of self-mastery.[19] Additionally, smoking has previously been found to be associated with lower levels of self-mastery,[26] although no recent research has looked specifically at self-mastery and smoking.

The high rates of relapse between pregnancy and the extended postpartum (e.g. 12 months post-delivery) period supports the need for more research in this area. Additionally, while studies have been conducted examining self-mastery and addictions such as drug and alcohol dependence [24] or mental health,[27] little research has been conducted on self-mastery and smoking, and none specifically in the population of pregnant and postpartum women.

The following definitions and terminology are used throughout this dissertation: (1) "extended postpartum" is defined as the first 12 months after the birth of a baby,[28] and

is used interchangeably with "12 months post-delivery", (2) "probable depression" is defined as an Edinburgh Postnatal Depression Scale (EPDS) score $\geq$ 10, and is used interchangeably with "positive depression screen" and "depression", (3) "positive smoking status" is defined as a self-report of smoking > 0 cigarettes, and is used interchangeably with "smoking", (4) "baseline" is defined as the time-point of program intake, which is $\leq$ 28 weeks pregnant, and is used interchangeably with "program intake" and "early pregnancy", and (5) "covariate" is defined as a variable present at baseline, and is used interchangeably with "predictor" and "background variable".

Aims of the Dissertation

This dissertation aimed to examine factors related to prenatal and postpartum smoking. Findings contribute to the science of smoking cessation specifically in the population of pregnant and postpartum low-income women. The following questions were addressed:

Question 1. What factors are important to consider within the concept of smoking cessation for pregnant women living in poverty?

Question 2. What is the relationship between smoking status and depression, and their respective patterns?

Question 3. What factors predict pregnancy and postpartum smoking relapse?

In order to answer the research questions, this dissertation was divided into three separate yet logically connected chapters.

Logical Connection among the Three Chapters

The three chapters share a logical connection to studying smoking and its related factors in low income pregnant and postpartum women. **Chapter 2** of this dissertation

provides an analysis of the concept of smoking cessation in low-income pregnant women, including various attributes, antecedents, and consequences of smoking cessation in this population. The specific aim of the analysis was to clarify the phenomenon of smoking cessation specifically in the context of low income pregnant women. The findings from the concept analysis provided insight into the conceptual framework (Figure 1.1).

The purpose of **Chapter 3** was to determine patterns of smoking status and its relationship with depression throughout pregnancy and up to 12 months post-delivery among women with a history of smoking prior to pregnancy. Additionally, this chapter identified concurrent patterns of smoking and depression starting at pregnancy until 12 months post-delivery. The purpose of **Chapter 4** was to assess the relationship between baseline covariates and smoking status at two different time-points: end of pregnancy and 12 months post-delivery. Additionally, this chapter identified factors that predict smoking status at the two time-points.

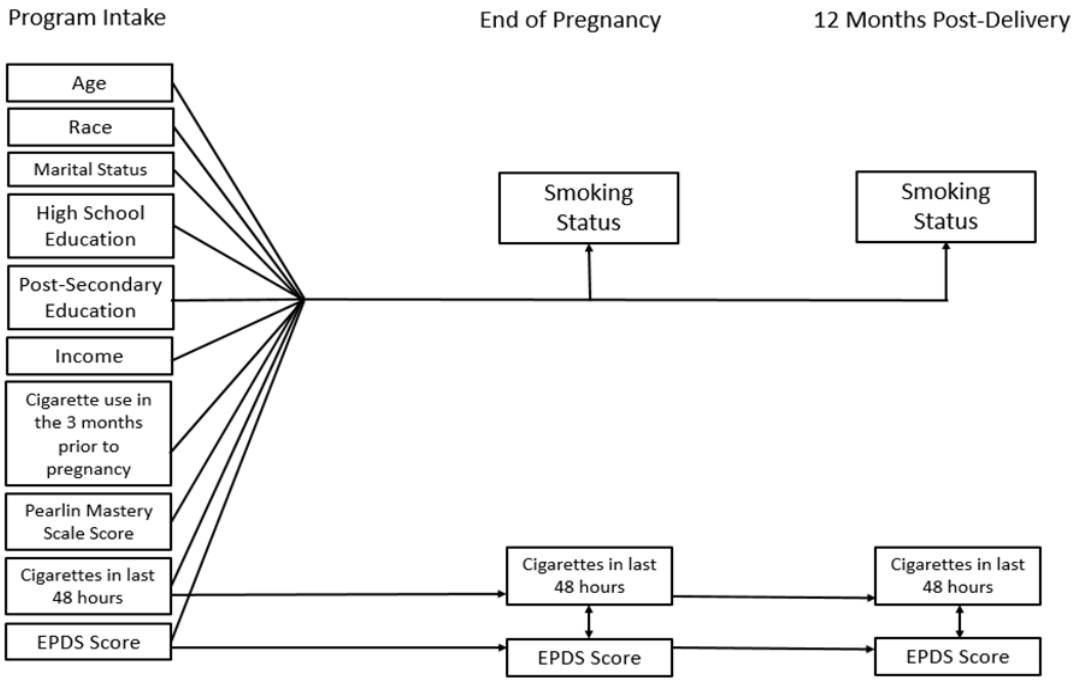


Figure 1.1. Study Conceptual Framework

Approach

The approach for this dissertation consisted of a methodological framework with theoretical foundations. One assumption underlying this dissertation was that women typically do not spontaneously start smoking during pregnancy, as it is generally accepted that women know smoking during pregnancy is harmful.[29] This section will discuss the theoretical foundation, conceptual framework, and dissertation methods.

Theoretical and Conceptual Framework

Behavior change research and theories began to emerge with the inception of health psychology, which resulted from criticisms of the dominant medical model in the 1970s.[30] As a result, health psychology led health behavior change research with a focus on the importance of ecological models and psychosocial processes in health and illness.[30] The 1964 Surgeon General's report on smoking propelled the need for smoking cessation research, and stated that "the tobacco habit should be characterized as an habituation rather than addiction".[31] The report also characterized this habitual use of tobacco as being primarily influenced by psychological and social drives, thus setting the basis of early tobacco research through theories of psychology and sociology.

Practice theories have been developed to support smoking cessation interventions, while grand theories have been used to support the development of middle-range theories that help with understanding the phenomenon of smoking. A previous review [32] identified multiple theories commonly used in nursing for studying smoking cessation: Self-Efficacy Theory (Bandura, 1977), Health Belief Model (Becker & Maiman, 1975), Theory of Reasoned Action (Azjen, 1980), Theory of Planned Behavior (Azjen, 1991),

Transactional Model of Stress and Coping (Lazarus, 1966), and the Relapse Prevention Model (Marlatt, 1985).

The Theory of Reasoned Action (TRA) was proposed to help with understanding the relationship between attitudes, intentions, and behaviors.[33] The TRA postulates that behavioral intention, attitudes and subjective norms are the most important determinants of behavior, and are important for predicting the likelihood of performing a specific behavior.[33] The Theory of Planned Behavior (TPB) [34] is an extension of the TRA, and was later proposed to also incorporate perceived behavioral control as a contributing factor to behavior. The inclusion of perceived behavioral control arose from Azjen's belief that one's perception of control [in addition to intention] will affect behavior differently than only attitudes and motivations.[35] The TPB accounted for perceived behavioral control and its independent impact on behavior (Figure 1.2), while considering various background variables. This study did not perform model testing of the TPB; rather the framework for this study is derived from constructs present in the TRA/TPB, such as background variables, perceived control, and behavioral outcomes.

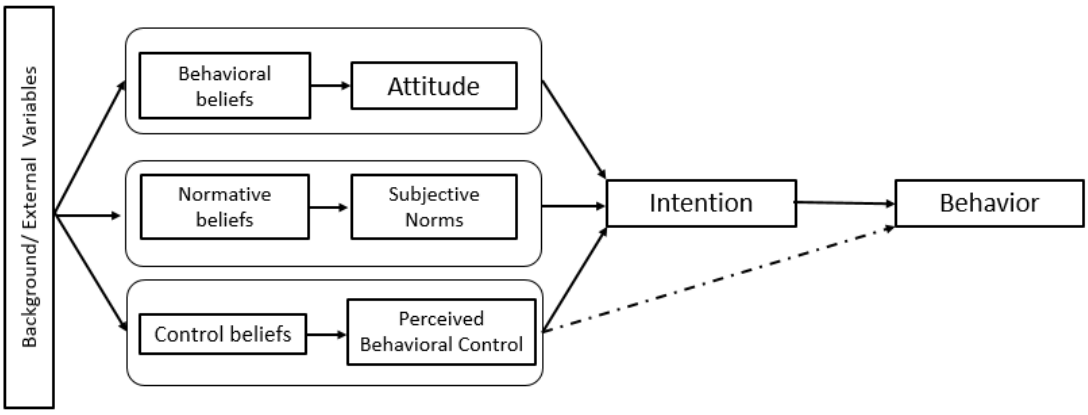


Figure 1.2. Theory of Reasoned Action/Theory of Planned Behavior Framework

Variables. Empirical support exists for the background variables (covariates) in this study. Smoking history and self-reported confidence have been identified as significant factors predicting relapse.[6,36] Additionally, mood and stress have been supported as possible variables correlated to resuming smoking post-delivery.[37,38] However, not all studies show positive correlation with mood and stress,[5] warranting further research on mental health variables related to smoking cessation one year after birth. Current literature on the determinants of smoking provides evidence that variables related to smoking exist across multiple disciplines, such as biological, behavioral, and sociocultural. [5, 37, 39-41]

Self-mastery is correlated with positive health behaviors and has been suggested as an important psychosocial factor for modifying the relationship between disability and depression, [42] yet no research has been conducted on self-mastery and smoking behaviors. Postpartum depression has also been associated with perinatal smoking behaviors, [43] and women who report depression during pregnancy are less likely to quit smoking than women who do not report depression.[44] A recent study found that responses to postpartum relapse treatment may be moderated by prenatal depressive symptoms at the end of pregnancy.[45] However, little research has been conducted looking at the trajectory of prenatal depression throughout the first year after birth as a correlate of smoking relapse.

Methods

Many studies conducted on smoking in pregnant and postpartum women only address pregnancy and shortly after birth, or do not extend to 12 months postpartum. This study utilized a retrospective method to assess smoking and related factors across a

24-month time period, by looking at smoking during the 3 months prior to pregnancy, early pregnancy, the end of pregnancy, and up to one year post-delivery.

Design. This dissertation study was a secondary analysis of existing national data from the Nurse-Family Partnership (NFP) program spanning from 2011-2016. NFP is an evidence-based home visitation program in which Registered Nurses provide intensive services through home visits to first-time mothers and their babies around 60 times over the course of 2.5 years. Target outcomes for NFP include: improving pregnancy outcomes, promoting healthy attachment and parenting skills, and increasing early childhood development success.[46] NFP addresses smoking through referrals to interventions (e.g. state quitline, Baby and Me Tobacco Free, etc) as well as program specific handouts for discussions around smoking. A RAPComm application was submitted and approved by the NFP National Service Office (NFP-NSO). Approval was also granted for IRB exempt status through the Indiana University Office of Research Compliance.

Sample. The study sample was comprised of women who had enrolled in NFP and completed the program through at least 12 months. Additional study eligibility criteria included having a singleton birth. Eligibility for NFP services include: no previous live births (i.e. first-time mothers), enrollment $\leq$ 28 weeks pregnant, meeting income eligibility requirements (typically defined as eligibility for Medicaid), and living within an area serviced by a local NFP implementing agency. NFP currently is implemented in 42 states plus the U.S. Virgin Islands, and as of September 2017 it was currently serving 33,467 families nationally across 586 counties.[47] See Appendix A,

Figure A1 for a chart of sample eligibility criteria, and sample size for the samples used in each chapter.

Measures and Data Collection. Forms used for data collection were created by Nurse-Family Partnership for use during program implementation. Data collection was completed by trained nurse home visitors. Forms were available in English or Spanish. Interpretation services were utilized when serving clients from other languages. Data management occurred through storage in a password secure IU Box Health account. Data analysis was performed using SAS 9.4 (SAS Institute, Inc., Cary, NC, USA).

Variables. Program data collection forms provided demographic data for the sample. Table 1.1 provides variables and data collection form source. Additional study variables were also collected through program data collection forms, and asked upon program intake.

Table 1.1

Variable Sources

Variable	Data Collection Form
Race	Demographics
Age	Demographics
Cigarette Use During Pregnancy	Health Habits
Cigarettes Smoked in Last 48 Hours	Health Habits
Income	Demographics
Marital Status	Demographics
High School Completion	Demographics
Higher Education	Demographics
Edinburgh Postnatal Depression Scale	Edinburgh Postnatal Depression Scale

Smoking status. Smoking status was measured by asking the women the number of cigarettes smoked in the previous 48 hours. This was assessed at: (1) program intake (0-28 weeks pregnant), (2) 36 weeks pregnant (e.g. end of pregnancy), and (3) 12 months post-delivery. Additionally, a history of smoking prior to pregnancy was assessed at

program intake by asking how many cigarettes were usually smoked in a day during the 3 months before becoming pregnant.

Depression. The Edinburgh Postnatal Depression Scale (EPDS), a 10-question, Likert-type scale with response options ranging from 0 to 3, was used to measure depression. Reverse coding is applied to 7 questions, with score summation ranging from 0 to 30. A cut-off score of 10 is considered a positive depression screen, and an indication of the presence of depression. The EPDS has been demonstrated as a reliable and valid measure of depression during pregnancy [49] and the postnatal period.[50] The EPDS was assessed at: (1) program intake (0-28 weeks pregnant), (2) 36 weeks pregnant, and (3) 12 months post-delivery.

Self-mastery. The Pearlin Mastery Scale is a 7-question, 4-point Likert scale measuring level of self-mastery, or the belief that a person is in control of his/her life's circumstances. Responses range from Strongly Disagree to Strongly Agree (numerical values 1-4), with 2 questions requiring reverse coding. Total score summation ranges from 7 to 28, with higher scores indicating higher levels of self-mastery. Self-mastery was measured at program intake. The Pearlin Mastery Scale has been demonstrated as a reliable and valid measure of mastery.[51, 52]

Contribution to Theory and Practice

The results presented in this dissertation generate knowledge related to additional determinants of perinatal smoking, which can be integrated in smoking cessation interventions to improve pregnancy outcomes and reduce infant mortality rates. Additionally, findings of this study will guide continued enhancement of tobacco use

screening and treatment interventions that are specific to the population of low-income pregnant and postpartum women.

CHAPTER TWO

This chapter presents the results of an evolutionary concept analysis with a review of the literature surrounding smoking cessation in low-income pregnant women, including attributes, antecedents, and consequences. Findings are demonstrated through an exemplar. A discussion of the current literature, understanding of the concept, and practice implications surrounding smoking cessation in the context of pregnant women living in poverty concludes this chapter.

Introduction

Smoking is a significant public health problem, contributing to over 480,000 deaths per year, or one in every five deaths.[53] In the United States, the overall prevalence rate for smoking during pregnancy is 7.2% with large rate variation per state ranging from 1.7% to 27%.[54] During pregnancy, smoking affects not only the mother's health but also health outcomes of the developing child. Smoking during pregnancy contributes to five of the fifteen leading causes of infant mortality nationwide.[55] It is also linked to stillbirth, spontaneous abortions, sudden unexpected infant deaths, low-birth weight, asthma, and child behavioral problems.[56, 57]

Smoking cessation efforts began in 1964 as a result of the landmark United States Surgeon General's report "Smoking and Health," which highlighted growing evidence to support negative health effects from smoking.[58] The 387-page report mainly focused on cancer, cardiovascular disease, and other negative health effects from smoking in men, and included only one short paragraph discussing the association of maternal smoking and infant birth weight. Gender-based intervention was not available until 1980 when the Surgeon General's report, "The Health Consequences of Smoking for Women," was

published, [59] which highlighted differences in smoking between men and women. Additionally, the 1980 report contained an entire chapter focused on the threats to pregnancy and newborns, and identified smoking during pregnancy as a topic of emerging importance.

Disparities in smoking cessation have also been reported between those living above and below the estimated income level needed for basic necessities of life (the poverty line). Smoking cessation is less likely to occur for people living below the poverty line than for those living above it.[60] It has been reported that 26.3% of adults living below 100% of the poverty line smoke compared to only 6.9% for those living 600% above the poverty line.[61] Additionally, 14% of pregnant women on Medicaid continue to smoke during pregnancy compared to only 3.6% of privately insured women.[54] In order to facilitate development of effective cessation support for pregnant women living in poverty, it is important to identify attributes, antecedents and consequences related to smoking cessation specific to this population.

The term "smoking cessation" during pregnancy can have different meanings for pregnant women, perinatal care teams, and researchers. For example, a pregnant woman may view smoking cessation as temporarily quitting during pregnancy, a perinatal care team member may define smoking cessation as quitting during pregnancy and remaining smoke free indefinitely, or researchers may define smoking cessation as a reduction in cigarette use or biochemical measures below certain cut-offs. There is a need for congruence in definitions and assumptions in order to align efforts for efficacious smoking cessation during pregnancy. The purpose of this concept analysis was to

understand the phenomenon of smoking cessation in the context of pregnant women living in poverty.

Methods

Rodgers' (2000) evolutionary method guided this concept analysis (Table 2.1). The evolutionary method allows for concepts, such as pregnant women living in poverty, to be analyzed within a specific time, setting, and sample as opposed to distinguishing a concept from its context as is commonly done in other concept analysis methods.[62] Additionally, the evolutionary method is a heuristic process, producing results for future application and testing to continue concept development.

Table 2.1.

Primary Activities of the Evolutionary Method of Concept Analysis

1. Identify the concept of interest and associated expressions (including surrogate terms).
2. Identify and select an appropriate realm (setting and sample) for data collection.
3. Collect data relevant to identify:
    a. the attitudes of the concept; and
    b. the contextual basis of the concept, including interdisciplinary, sociocultural, and temporal (antecedent and consequential occurrences) variations.
4. Analyze data regarding the above characteristics of the concept.
5. Identify an exemplar of the concept, if appropriate.
6. Identify implications, hypotheses, and implications for further development of the concept.

Note: This list indicates tasks to be completed rather than sequential steps to be taken. Adapted from Rodgers (2000).

Rodgers (2000) suggests data collection for the evolutionary method should be clearly explained, and rigorous sampling be conducted with clear inclusion/exclusion criteria. For this analysis, an extensive literature search was conducted using multiple databases to ensure comprehensive analysis from an interdisciplinary viewpoint. Cochrane Library, CINAHL, and PubMED were used to gather literature from areas such

as nursing, medicine, and psychology. All databases were searched using the strategy: "smoking cessation" AND "poverty" AND "pregnan*". Additionally, a Medical Subject Heading (MeSH) search was completed through PubMED using the strategy: ("Smoking Cessation" [Mesh]) AND ("Poverty" [Mesh]), AND "pregnan*". (Figure 2.1).

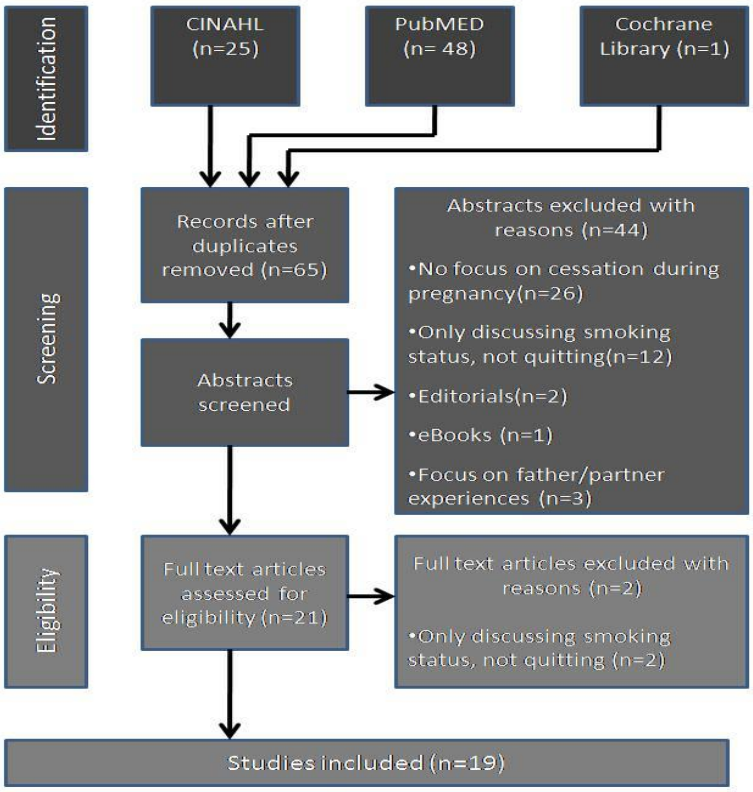


Figure 2.1. PRISMA Diagram, adapted from Moher, Liberati, Tetzlaff, and Altman (2009)[83]

The purpose of this concept analysis is specific to women; since smoking cessation literature did not look at gender differences until after the 1980 Surgeon General's report on smoking and women, searches were limited to include articles published after 1980. Abstracts were reviewed using the following inclusion criteria:

discussion of smoking cessation interventions or definitions; women during pregnancy; and women living in poverty, low-income, on Medicaid, or below poverty guidelines.

After abstract review, 21 articles met inclusion criteria and were retained for further analysis. A full review of the articles resulted in two additional articles not meeting inclusion criteria. Therefore, a total of 19 articles were included for analysis, with 6 from public health, 6 psychology, 5 nursing and 2 medicine. Discipline allocation was determined by a combination of factors, including author credentials and/or university departments, publication and journal title, and study purpose/framework. Each article was read twice and assigned an identification number related to its identified discipline. A coding matrix was completed for each article using suggested data collection techniques by Rodgers (2000), and the matrix included identification of attributes, antecedents, consequences, references, surrogate terms, and related concepts for each article (see Appendix B, Table B1).

Results

Current consensus in the literature on the concept of smoking cessation for pregnant women living in poverty is still very ambiguous and dependent on disciplinary lens. Researchers in medicine and psychology define smoking cessation as complete abstinence from smoking during pregnancy based on self-report or specified biometrical measures.[63-64] However, nursing and public health researchers consider reduction of cigarette use, intention to quit, or temporary abstinence during pregnancy as a defining characteristic for smoking cessation.[67-69] Regardless of discipline, there is consensus in all of the literature on the negative impacts to mother, child, and family if smoking is continued and cessation does not occur during pregnancy.

Attributes

Attributes are the "real definition" of a concept, and analyzing the ways in which a term is used can support exploration of the underlying concept.[62] Attributes were identified and subsequently analyzed to determine how the term "smoking cessation" has been defined in research, and to explore the concept within the context of pregnant women living in poverty. The literature reviewed provides a diverse view of defining characteristics, and attributes were grouped into three main categories: biochemical, intrapersonal, and physical (Figure 2.2).

Biochemical attributes. Biochemical definitions were clearly identified across all disciplines and were mostly defined by expired carbon monoxide (CO) levels and urine cotinine levels. [64,66,69-71] However, even if there is a quantitative biochemical measure, variation in exactly what levels are definitive of smoking cessation still exists. For example, one study[66] defined smoking cessation as an expired CO level of less than 10 ppm, while another[70] used the cutoff level of equal to or less than 6 ppm. An even wider array of disagreement exists for urine cotinine levels, with smoking cessation being operationalized as ≤ 80 ng/mL after five days remaining smoke-free[70] to ≤ 20 ng/mL after seven days smoke free.[64]

Intrapersonal attributes. Intrapersonal or self-identified smoking cessation is another way of defining smoking cessation for pregnant women living in poverty. Similar to biochemical definitions, self-report of smoking status has been used in multiple studies to define smoking cessation. [64,65,72] Pregnant women self-evaluate their smoking status by answering "Yes" or "No" and/or reporting number of cigarettes smoked. Although self-report of smoking status has generally been accepted as a valid

measure of smoking cessation, some studies suggest self-reported cessation can be underreported by up to 23% when compared with validated biochemical measurement. [73-75]

Physical attributes. Physical attributes refer to nicotine addiction level and how a woman perceives her own health related to smoking. One study[65] defined nicotine addiction level by amount of cigarettes per day prior to pregnancy and length of time between awakening and smoking the first cigarette of the day. Self-image during pregnancy can be defined as a heightened self-awareness that potentially influences behaviors during pregnancy, such as smoking cessation.[71] Less addiction to nicotine and a high self-image in pregnant women has been associated with higher rates of smoking cessation. [63-65, 71]

Contextual Basis of Smoking Cessation

Rodgers' (2000) evolutionary method also calls for discussion of the concept's antecedents, consequences, and variations to promote discussion and understanding of the concept within its context. In this case, the context is pregnant women living in poverty. A summary of antecedents and consequences are found in Figure 2.2.

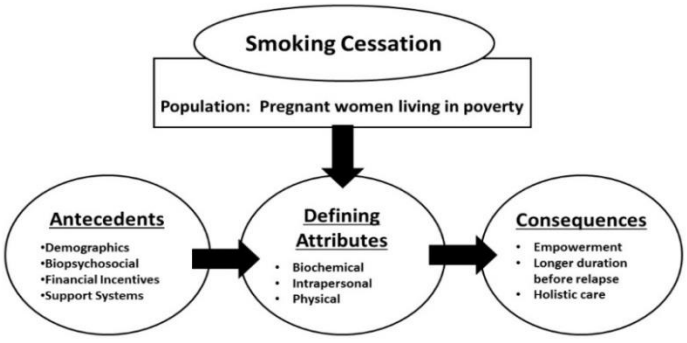


Figure 2.2. Contextual Basis for Smoking Cessation for Pregnant Women Living in Poverty

Antecedents. Antecedents or pre-existing factors supportive of smoking cessation in pregnant women living in poverty can be summarized into the following main sociodemographic characteristics: (a) demographics; (b) biopsychosocial; (c) financial incentives; and (d) support systems.

Demographics. Demographic factors include education, mental health or perceived stress, smoking history, and age. The specific antecedents associated with increased likelihood of smoking cessation in pregnant women living in poverty include: (a) high school graduate or higher; (b) improving mental health; (c) less than 10 years of smoking history; (d) older maternal age; (e) first pregnancy; and (f) lower perceived stress. [63, 64, 66, 73, 74]

Biopsychosocial. Biopsychosocial antecedents demonstrate the complexity of variables associated with smoking cessation and interactions between biological, psychological, and social factors promoting smoking cessation for pregnant women living in poverty. For example, a psychological factor such as motivation to quit can be influenced either positively or negatively by social factors, such as family support, and should not be viewed as independent factors. There is supportive evidence for biopsychosocial factors that will improve likelihood of cessation during pregnancy. Biological factors include less nicotine addiction. Psychological factors include high motivation to quit, contemplating or preparing to quit, and intensive counseling. Social factors include appropriate health care messaging from family and providers and a positive support system. [67-69, 70, 74, 76-78] Strong support systems in both family/friends and providers lead to a higher chance a woman will quit smoking during pregnancy.[63-66, 69, 75, 76]

Financial incentives. Financial incentives were also strongly associated with smoking cessation in one study.[70] The review of randomized trials conducted in socioeconomically disadvantaged pregnant women found a seven-fold cessation rate during pregnancy when financial incentives were utilized. Eligible literature reviewed for this concept analysis generally focused on physical addiction, behavior change and sociological factors and not on financial incentives.

Support system. Support systems include both interpersonal level support (i.e. friends, family, social network) and community level support (healthcare providers, community organizations, etc.). Investigators have documented successful smoking cessation in pregnant women being associated with general support from and trust in a healthcare provider, and discussions between patient and provider about smoking cessation. [69, 75, 76]

Consequences. Consequences are important for understanding what occurs as a result of the phenomenon.[62] The primary consequences identified in the literature within the context of pregnant women living in poverty were empowerment, a longer duration of cessation prior to relapse, and the need for holistic care.

Empowerment. Women who were empowered in smoking cessation through education from providers, counseling, social support, or resolution of stressors were able to remain smoke-free for longer periods of time. Additional consequences from smoking cessation include pregnant women being able to achieve additional goals such as remaining smoke-free permanently, increased knowledge about the negative effects of smoking on a fetus/child, better health for the mother and baby, and being able to address other complex life issues. [63,67,68,70,73,75,79]

Longer duration before relapse. Outcomes from smoking cessation can be assessed by smoking resumption rates and in different lengths of time before relapse occurs after quitting. In general, successful smoking cessation in pregnant women is likely to result in low smoking resumption rates not only during pregnancy but also after birth, with evidence for low rates of continued smoking cessation at six months post-partum. [64,66,69,71,72,74,78]

Need for holistic care. Pregnant women living in poverty often face many life situations that increase their chances of smoking. When a health care provider focuses on multiple aspects of a woman's life (e.g. physical, social, emotional, and economic), she/he can provide positive support for the woman to quit smoking by attending to the woman's other needs in a holistic way. Multifaceted and combined care, such as patient education from providers while addressing sociocultural issues, or policy implementation and women-centered harm reduction care, can support a woman with quitting smoking during pregnancy. [68, 73, 76]

Variations. Variations are analytic components of the evolutionary approach that can potentially affect the understanding of the phenomenon.[62] Surrogate terms, related concepts and references are important variations that were identified.

Surrogate terms. In reviewing the literature, various other terms related to "smoking cessation" were identified. Tobacco reduction, quitting smoking, abstinence [from smoking], and ex-smoker were all terms used to describe smoking cessation. When used, the majority of the literature used surrogate terms interchangeably; however, different meanings can be applied to these surrogate terms. For example, tobacco cessation can be a more general term, and has been used to describe all forms of tobacco

regardless of nicotine delivery route (e.g. smokeless tobacco versus combustion and inhalation), whereas smoking cessation generally encompasses nicotine delivery through smoking.

Related concept and references. It is important to understand key terms (Table 2.2.) for the concept. Many of the related concepts for smoking cessation come from the disciplines of psychology, sociology, and public health

Table 2.2

Key Terms for Continued Understanding of the Concept

Self-efficacy	Smoking relapse
Empowerment	Perceptions
Personal will	Fetal awareness
Support	Self-perception
Smoking trajectories	Perceived stress
Motivation	Smoking hassles
Psychiatric disorders	Level of addiction
Temporary cessation	Behavior modification

References help to "identify the scope of the concept to enhance its clarity and effective application" (Rodgers, 2000, p. 92). Application of the concept of smoking cessation in the context of pregnant women living in poverty occurs at multiple levels of intervention. For example, the scope of applicable settings for smoking cessation interventions range from personal to community organizations and includes various healthcare provider locations ranging from telephone-based help-lines and home visitations, to hospital clinics and private offices. [64,72,73,76,79,81] The majority of interventions and studies related to smoking cessation in pregnant women have taken place in community-based clinic settings such as Women, Infants, and Children (WIC) offices or community health centers. [63, 65-68, 70, 74, 78, 80]

Philosophical and Theoretical Influences

Many of the theoretical influences in smoking cessation research are based on theories originating in psychology, such as social cognitive theory, operant conditioning, stages of change, and empowerment theory; [70,77,79] however, the dynamic nature of the complexities with smoking cessation supports the need for an interdisciplinary received view. The nursing view of smoking cessation is heavily influenced through interventions based in other disciplines, such as psychology (cognitive behavioral therapy/behavioral modification). Additionally, there has been an emphasis on qualitative research to understand the lived experience of smoking cessation in order to develop best practices for interventions and implementation of the most efficient and effective treatment plans.

Concept Exemplar

Rodgers' (2000) evolutionary method calls for identification of an exemplar that embodies the gestalt of the concept within the context being explored.[62] The exemplar identified for this concept analysis is found in Lundquist et al. (2012), and identifies a woman with a history of sexual abuse, addiction, and comorbid mental health disorders (bipolar and major depressive disorder). Additionally, the pregnant woman was homeless, had very little social support, and had spontaneously reduced [but not quit] the number of cigarettes she smoked daily upon learning of her pregnancy. Higher carbon monoxide breath test results (13ppm) allowed opportunities for nursing education, and holistic nursing care was provided to the woman. Additional support was provided through Nicotine Anonymous and the state quit-line, which helped the woman to quit smoking during pregnancy, and increased her motivation for a healthy baby. She had setbacks when in contact with family members; however, ongoing inclusive treatment

supported her sobriety. Ongoing treatment also helped her with GED completion, job attainment, stable housing, and continuation of her smoking cessation she had recently achieved. This model case demonstrates the intricacy of addressing smoking cessation in the context of pregnant women living in poverty, and provides an evidence-based example of the attributes, antecedents, and consequences of smoking cessation that have been found in this analysis (see Appendix C Table C1 for exemplar show-case of concept analysis findings).

Discussion

Using Rodgers' (2000) evolutionary method, this chapter describes definitions, attributes, antecedents, and consequences relevant to the concept of smoking cessation in the context of pregnant women living in poverty. This analysis found smoking cessation defined differently by researchers and among disciplines. Some used biomedical measures and others adopted self-report formats to define smoking cessation. In order to standardize interventions, there is a vital need for well-accepted cut-off levels when biochemical measures are used. For those who plan to study smoking cessation in pregnant women living in poverty, clear conceptual and operational definitions for smoking cessation are encouraged.

Researchers must be aware of the complex socioeconomic disadvantages women living in poverty face related to smoking cessation. Future research on smoking cessation with pregnant women living in poverty should represent a multipronged approach to assess social support, provider influences, physical addiction, and socioeconomic factors. Continued research is recommended to explore the relationship between financial incentives and smoking cessation in pregnant women living in poverty due to the small

scope of the review. There is also a need for future research on the consequences of quitting smoking, specifically related to relapse and permanent cessation.

Many of the articles in this analysis presented backgrounds and introductions that focused mainly on negative effects of smoking, instead of positive effects of quitting. The results and discussion sections also expressed views slanted toward the negative with regard to smoking, rather than a positive view of quitting. While an understanding of negative effects of smoking is important to determine the urgency of addressing the issue, it is essential to establish a body of knowledge for antecedents and attributes of smoking cessation in order to develop smoking cessation best practices for pregnant women living in poverty.

Practice Implications

Pregnant women are more likely to remain smoke free when they have adequate counseling, mental health support, and education on stress management in addition to physical addiction cessation support. Interdisciplinary approaches are essential; public health nurses can adopt aspects from medicine to validate smoking cessation status, while using approaches that have been successful in psychology and sociology can enhance the heuristic function of smoking cessation. Public health nurses are encouraged to immerse in current interdisciplinary literature or attend workshops to be familiar with evidence-based interventions for smoking cessation. Additionally, public health nurses encountering pregnant women living in poverty with smoking cessation needs should have adequate pharmacotherapy education, an understanding of socioeconomic factors affecting smoking cessation, and the ability to provide appropriate referrals to more intensive psychological support or medical intervention.

Limitations

As with any concept analysis, it should be interpreted within the context of its limitations. In order to provide adequate consensus of the concept across disciplines, "at least 30 items from each discipline…or 20 percent of the total population, whichever is greater, should be selected for the sample" (Rodgers, 2000, p. 89). This criterion for the evolutionary method of concept analysis was not feasible due to the minimal number of studies meeting eligibility criteria. Due to the specific context (setting and sample) for this concept analysis that resulted in a smaller sample, it is recommended to repeat analysis of this concept within the context of pregnant women living in poverty in the future as evidence continues to build and a larger sample for concept development can be achieved. However, this analysis is considered to be sufficient due to similar related concepts and attributes noted within disciplines.

Conclusion

In order to provide innovative care related to smoking cessation, a body of knowledge should be developed that directly relates to care which addresses the whole person through issues such as stress, mental health, social support and behavioral modification. There is much room to advance the concept of smoking cessation in the context of pregnant women living in poverty. To date, much of the research has been conducted from a psychological or sociological lens. Use of existing theories, such as social cognitive theory, self-efficacy theory, and operational conditioning can help develop specific theories addressing patient education, motivation and socioeconomic factors involved in promoting smoking cessation.

CHAPTER THREE

This chapter presents the results of smoking status during pregnancy and the first year postpartum, patterns of smoking status and probable depression, and their respective relationships. Frequency, means, correlation, and logistic regression were used to analyze data from a national sample of women enrolled in the Nurse-Family Partnership home vitiation program with a history of smoking during the 3 months prior to pregnancy.

Introduction

Rates of smoking during pregnancy have decreased dramatically in the last 25 years, with most recent national prevalence of women who reported smoking during pregnancy at 7.2%.[84] However, large disparities in smoking prevalence exist. For example, the most recent reported rate of smoking prevalence during pregnancy among women with Medicaid insurance is at 14.0% and 5.1% in uninsured women compared to 3.6% prevalence in women with private insurance.[85] Additionally, almost one half of women with a history of smoking in the 3 months prior to pregnancy do not achieve cessation during pregnancy.[86]

Poor health outcomes with continued maternal smoking during pregnancy are well known for both the woman and the baby, such as low-birthweight, stillbirth, spontaneous abortions, placental abruption, and perinatal mortality.[87,88] More recent research has also demonstrated a long term effect of maternal smoking during pregnancy on the child's antisocial behavior during adolescence and adulthood, [89] and higher rates of major depression, bipolar disorder, conduct disorder, and cigarette smoking in offspring.[90]

Postpartum smoking relapse is a common phenomenon occurring in the women who quit smoking during pregnancy. Relapse rates have been reported as high as 42.8% by 4 months postpartum.[91] Relapse to smoking after delivery can expose the infant to second- and third-hand smoke, leading to increased risk of sudden infant death syndrome (SIDS), stroke, heart disease, and respiratory infections in the child.[85] The most recent updates to the clinical practice guidelines for treatment of tobacco use also emphasizes the need for postpartum relapse prevention.[92]

The prevalence of maternal depression during pregnancy is around 13% [93] while the prevalence of postpartum depressive symptoms ranges from 8.0% to 20.1%.[94] Similarly to smoking during pregnancy, depression during pregnancy can impact birth outcomes such as preterm delivery and the baby being small for gestational age.[95] Additionally, postpartum depression can affect the maternal-child attachment, the ability of the mother to parent her infant, as well child behavior problems, increased infant crying, and language development delays in the baby.[93]

Smoking and Depression

Previous research has indicated a relationship between smoking and depression, specifically during pregnancy. A cross-sectional study of 34,633 women from the Pregnancy Risk Assessment Monitoring System (PRAMS) identified that women who reported depression and/or anxiety in the 3 months prior to pregnancy were more likely to be smoking during pregnancy, and also had a lower likelihood of quitting by the end of pregnancy compared to women not reporting a history of depression or anxiety.[96] PRAMS is a national surveillance system for population-based data related to maternal attitudes and experiences for the time-period before and during pregnancy, and

concurrent smoking status and depression during pregnancy or postpartum.[97] A limitation to the PRAMS study was that the study combined depression and anxiety into one variable. There was no differentiation between the two mental health factors, as indicated by the variable being established by answering yes/no to either or both of the following two questions: (1) "During the 3 months before you got pregnant, did you have anxiety?", and (2) "During the 3 months before you got pregnant, did you have depression?" Another study [98] examined the relationship between major depressive episodes (MDE) and smoking among 8,513 pregnant women and found that women with a history of MDE within the year prior to pregnancy were over two times more likely to be smoking during pregnancy compared to women without a history of MDE (adjusted *OR* = 2.50[1.85, 3.40]). However, this study and the previous study using PRAMS data only looked at how a history of depression prior to pregnancy influenced pregnancy smoking status, and did not use concurrent measures of depression during pregnancy.

The relationship of smoking and concurrent depression during pregnancy and postpartum is less established. A study of 127 women participating in a clinical trial aimed at smoking cessation during pregnancy and the postpartum period found that pregnant smokers reported more symptoms of depression as measured by the Beck Depression Inventory (BDI) compared to quitters; however, the difference did not reach a statistical significance.[99] While the BDI has previously been shown to be highly predictive of major depressive episodes in pregnant populations, [100] recent research has suggested the Edinburgh Postnatal Depression Scale (EPDS) may be a more effective screening tool to use during pregnancy. For example, one study [101] looked at receiver operator characteristic curves (ROC) and identified values for the area under the curve

(AUC) in both the EPDS and BDI in a sample of middle to low income pregnant teenagers. The ROC AUC value for the EPDS was 0.90 (CI 0.87-0.92) compared to 0.87 (CI 0.84-0.89) for the BDI, indicating a higher overall accuracy of the EPDS as a more effective screening for depression in this population. Further research utilizing the EPDS to understand the relationship of [probable] depression and smoking is needed.

Patterns of Depression and Smoking

Depression patterns during pregnancy and postpartum have been previously researched. A study of 3,006 first-time mothers [102] looked at depression for four different time-points: the third trimester of pregnancy, 1 month postpartum, 6 months postpartum and 12 months postpartum. The study used EPDS with a cut-off score of 12 to indicate probable depression, and identified six distinct trajectories of depression across end of pregnancy and the extended postpartum. The sample was comprised of mostly Caucasian (83.2%), college educated (56.6%), higher socioeconomic class women with private insurance (76.8%), and the authors acknowledged the limited generalizability of results. Additional research on depression patterns in other populations of first-time mothers, such as those on Medicaid insurance are needed.

Another study on pregnancy and postpartum depressive symptom patterns [103] identified four distinct trajectories of depressive symptoms in a sample of 1,036 Norwegian women. The study used EPDS scores to investigate depressive symptoms across seven time-points throughout pregnancy and postpartum (8-25 weeks pregnant, 26-29 weeks pregnant, 30-34 weeks pregnant, 36 weeks pregnant, 6 weeks postpartum, 6 months postpartum, and 12 months postpartum). The trajectories identified were: (1) pregnancy only depressive symptoms, (2) postpartum only depressive symptoms, (3)

moderate-persistent depressive symptoms, and (4) minimum symptoms. Similarly to the previous study,[102] the sample consisted of educated women (mean education in years = 15.05). Additionally, the sample consisted of women with an older maternal age (mean age 30.26 years) and mean EPDS scores well below clinical cut-off levels during pregnancy and postpartum (ranging from 2.88 to 4.54). Further research on depressive symptom patterns among a sample of women with higher mean EPDS scores, as well as other sociodemographic backgrounds, is warranted.

Smoking patterns have been used to study the relationship between maternal characteristics, smoking pathways and smoking outcomes. Empirical data indicate that women smokers demonstrate several patterns of smoking, cessation, and relapse. For example, a study [104] using latent class analysis with a nationally representative population-based cohort of 8,650 biological mothers identified five longitudinal patterns of smoking over six time-points (3 months prior to pregnancy, third trimester, 9 months, 2 years, preschool, and kindergarten). The patterns identified were: (1) pregnancy-inspired quitters (women who had higher probabilities of smoking early pregnancy but gradually decreased probability during pregnancy and beyond); (2) delayed initiators (women who had a low probability of smoking before and during pregnancy/early postpartum with a gradual increase in probability through child's entrance into kindergarten); (3) persistent smokers (women who continued smoking throughout all time-points); (4) temporary quitters (women who had a low probability of smoking during pregnancy but had higher probabilities 3 months prior and after child's birth); and (5) nonsmokers (women who had low probability throughout 3 months prior to 5 or 6 years post-delivery). Their results indicated an overall pattern of smoking cessation

during pregnancy with higher probability of relapse starting at 9 months after delivery. The study did not assess changes occurring concurrently between smoking behavior and depression, which the authors acknowledged is an important component in understanding the parallel process of smoking behaviors and depression to promote cessation.

An earlier study [105] used latent class analysis to analyze smoking and depression trajectories across 7 time-points (from before pregnancy across 33 months post-delivery) in a sample of 4,286 mothers. They identified seven smoking trajectories: (1) persistent smokers, who continued smoking; (2) non-smokers, who were never smoking; (3) temporary quitters, who quit early during pregnancy but also relapsed during later pregnancy; (6) temporary quitters, who quit during pregnancy but relapsed by the end of 1 year post-delivery; (4) temporary quitters, who smoked during pregnancy, were quit early after child's birth but relapsed at 33 months; (5) postnatal quitters, who smoked during pregnancy but quit after delivery; and (7) successful quitters, who quit during pregnancy and did not relapse. EPDS scores were measured over the same 7 time-points to analyze in conjunction with smoking. Findings suggested that smoking and depression trajectories were related, but there was also a drop in depression scores during early postpartum when relapse to smoking was high. The authors concluded that their findings illustrated the complexity of depression and smoking, stating "strength, nature, and direction of causation may differ across the trajectories" (Munafò et al., 2008, p. 1619), and recommended future studies to continue exploring trajectories of smoking and depression.

In sum, while rates for smoking during pregnancy have decreased, relapse rates during the first year after giving birth remain high. Additionally, women with a history

of smoking in the 3 months prior to pregnancy have much less success with cessation during pregnancy. A relationship exists between smoking and depression during pregnancy, but less is known about the continuation of that relationship during the extended postpartum period (e.g. the first year of the infant's life). Furthermore, there is a need for additional research on the concurrent changes of smoking and depression at multiple time-points during pregnancy and throughout the extended postpartum period.

Purpose and Aims

The purpose of this study was to explore the patterns of smoking status and probable depression over an 18 month-time period, and examine their relationship at three different time points ($\leq$ 28 weeks pregnant, 36 weeks of pregnant, and 12 months post-delivery). The terms "probable depression", "positive depression screen", and "depressive symptoms" are all used interchangeably herein to refer to an EPDS score $\geq$ 10. The specific aims for this study were:

Aim 1: Identify patterns of smoking status and probable depression across an 18 month-time period, from early pregnancy ($\leq$ 28 weeks pregnant) to the end of pregnancy (36 weeks pregnant) and 12 months post-delivery.

Aim 2: Identify the point-prevalence of smoking and probable depression in early pregnancy ($\leq$ 28 weeks pregnant), at the end of pregnancy (36 weeks pregnant), and at 12 months post-delivery.

Aim 3: Identify smoking relapse rates at the end of pregnancy (36 weeks pregnant) and at 12 months post-delivery.

Aim 4: Assess the relationship between smoking status and probable depression in early pregnancy (≤ 28 weeks pregnant), at the end of pregnancy (36 weeks pregnant), and at 12 months post-delivery.

Methods

Design

This study was a secondary analysis of existing data from the Nurse-Family Partnership (NFP) program, a national home visitation program for low income women during the woman's first pregnancy and two years after the birth of their babies. NFP is an evidence-based home visitation program in which registered nurses provide intensive services through home visits to families about 60 times over the course of 2.5 years. The program aims to improve pregnancy outcomes, promote healthy attachment and parenting skills, and increase early childhood development success.[106] NFP has served over 270,000 families across 42 states and the U.S. Virgin Islands, with implementations servicing 599 counties across the United States.[107] Eligibility for NFP services include: no previous live births, ≤ 28 weeks pregnancy, meeting income eligibility requirements (typically defined as eligibility for Medicaid), and living within an area serviced by a local NFP implementing agency.

Sample

Nationally, NFP has reported a median age of 19 with the following participant demographics: 52% Caucasian and 29% African-American, 84% unmarried, 55% having completed high school, and a median household income of $9,000 per year.[108] The sample used for this study was a subset (N=16,998) from the national NFP dataset meeting the following inclusion criteria: (1) self-reported smoking status greater than 0

cigarettes/day within the 3 months prior to pregnancy ("smoking history"), (2) enrollment in the NFP program through an implementing agency between the years of 2011 and 2016, and (3) completion of at least 12 months of the program. The definition of smoking history used in this study aligns with previous research using the same criteria to define a history of pre-pregnancy smoking.[96] Women were excluded from the study sample if they did not have a history of smoking, were enrolled prior to 2011 or after 2016, and did not complete at least 12 months of the program. Additionally, women were excluded if they did not have complete data for smoking and depression variables. After applying inclusion and exclusion criteria, the total sample for this study was 1,554 women. Approval for this study was granted by the NFP-National Service Office and the Indiana University Office of Research Compliance.

Measures

Primary data was collected by baccalaureate prepared Registered Nurses at NFP implementing agencies, who received over 40 hours of training in the NFP model prior to enrolling clients and beginning data collection. Training includes interviewing techniques for data collection and specified time-frames for data collection. Data collection forms were completed in either English or Spanish; if a client spoke a different language, interpretation services were utilized and data collection was completed on English forms. The data codebook for this study can be found in Appendix D, Table D1.

Demographic and Background Variables. Demographic variables were collected through program data collection forms at program intake ($\leq$ 28 weeks pregnant). Demographic variables for this study included: (1) age; (2) ethnicity; (3) race; (4) marital status; (5) living situation; (6) high school educational level; (7) post-

secondary education; and (8) income. Additionally, the background variable of cigarette use during pregnancy (prior to program intake) was collected at intake (≤ 28 weeks pregnant).

Smoking Status and Relapse Rates. The number of cigarettes smoked in the previous 48 hours was collected at intake (≤ 28 weeks pregnant), end of pregnancy (36 weeks pregnant), and 12 months post-delivery. Smoking status was determined by creating a new binary (smoking/non-smoking) variable from the question "How many cigarettes were smoked in the previous 48 hours" at intake (≤ 28 weeks pregnant), end of pregnancy (36 weeks pregnant), and at 12 months post-delivery. A self-report of "0" cigarettes smoked in the previous 48 hours was coded as a non-smoking status and a self-report of anything greater than 0 cigarettes smoked in the previous 48 hours was coded as a positive smoking status. Relapse rates were indicated by women who had a positive smoking status at the time-point immediately following a non-smoking status. For instance, relapse rate at the end of pregnancy (36 weeks pregnant) was determined by looking at the number of women who did not smoke at program intake (≤ 28 weeks pregnant) but did smoke at the end of pregnancy (36 weeks pregnant).

Depression. The Edinburgh Postnatal Depression Scale (EPDS) was used to identify probable depression in the sample. The EPDS is a validated tool for use during the perinatal period, and detects depressive symptoms from a psychological perspective such as mood, low self-esteem and psychological distress, rather than the somatization of depression such as the physical symptoms of pain, fatigue, and gastrointestinal distress.[109] The EPDS is a 10-question, 4-point Likert type scale with response options ranging from 0 to 3. Scores are then summed for a final scale score ranging from 0 to 30. Acceptable

sensitivity and specificity for depression has been demonstrated during the postpartum period.[110] One study including a sample of 262 postpartum women found the overall internal reliability of the EPDS using Cronbach alpha calculation to be 0.79, [111] while another study with a sample of 5,169 postpartum women found the overall reliability to be 0.80.[112]

Additionally, the EPDS has been validated for use during pregnancy with recommendation for a cut-off score of 11 in first trimester, and 10 in second and third trimester indicating a positive screen for depression.[113] Since enrollment to NFP could take place in the first or second trimester, an overall EPDS cutoff score of greater than or equal to 10 was used for this study to create a new binary variable for depression status. The EPDS score was used in this study to indicate the status of probable depression (e.g. a positive depression screen), and not to categorize the severity of the depressive symptoms. An EPDS score $\geq$ 10 was coded as "1" indicating a positive depression screen/probable depression, and a score of < 10 was coded as "0" indicating a negative screen for depression/unlikely depression. The EPDS scores were collected at: (1) program intake ($\leq$ 28 weeks pregnant), (2) end of pregnancy (36 weeks pregnant), and (3) 12 months post-delivery. The Cronbach coefficient was calculated for the EPDS in this sample, showing acceptable reliability at pregnancy intake ($\alpha = 0.85$), end of pregnancy ($\alpha = 0.84$), and 12 months post-delivery ($\alpha = 0.87$).

Statistical Analysis

The analysis for this paper was generated using SAS software 9.4 (SAS Institute Inc., Cary, NC, USA).[114] For individual EPDS scales missing 25% or less of the scale response options, individual mean imputation was completed to obtain an overall scale

score, as individual mean imputation has been shown to produce favorable results.[115] Descriptive and frequency statistics were used to determine sample characteristics. The highest amount of missing sample characteristics data (ranging from 0.26% to 34.88%) was related to household income (34.88%) and higher education (21.81%). No imputation was made for missing demographic data. Continuous variables were assessed for outliers using the following criteria: (1) age $\leq$ 10 or > 60; and (2) number of cigarettes smoked in the previous 48 hours > 240. Outliers were removed when calculating means and standard deviations for age (n = 4). Univariate procedures were utilized to test distribution of the data, and significance level was set at $p = 0.05$.

Due to the large amounts of missing smoking and EPDS data in the original dataset, an analysis of the missing data was completed to determine if there were any significant differences between complete cases and missing data cases. Dummy variables were created for both smoking and depression screen data, with missing data cases coded as "1" and complete cases coded as "0". Chi-square tests were then run for each variable to determine if a significant difference existed between those missing data and those with complete cases. If a significant chi-square was identified, further analysis of effect sizes using Cohen's D with proportions was completed. All variables demonstrated a small effect size ($h \approx 0.20$). It was concluded the statistical significance demonstrated in chi-square tests was due to the p-value being overly sensitive to the large original sample size, and there was no clinical reason to assume the missingness was not at random. Therefore, listwise deletion was the method used for handling missing data in analyses; women missing smoking status or depression data at any of the three time-points were excluded, resulting in a final sample of N = 1,554.

Aim 1 (patterns). In order to identify patterns of smoking status and probable depression from baseline to 12 months post-delivery, binary variables were used for analysis. For smoking status, the number of cigarettes smoked "0" was considered "Not Smoking", and greater than 0 was considered "Smoking". For depression, EPDS scores < 10 was considered a negative screen for depression and coded as "0", and a score of ≥ 10 was considered a positive screen for depression and coded as "1". Smoking status and depression variables were assessed across the three time points for each woman.

Eight possible patterns were proposed for smoking status and probable depression from the observed variables (Table 3.1). For instance with smoking, pattern one was identified from a woman reporting smoking at all three time points, while pattern 2 was identified from a woman reporting smoking at intake and end of pregnancy, but not smoking at 12 months post-delivery, etc. See Appendix E, Table E1 for smoking and depression screening pattern descriptions.

Table 3.1.

Coding for Smoking and Probable Depression Pattern Identification

Intake	End of Pregnancy	12 Months Post-Delivery	Pattern Label
1	1	1	1
1	1	0	2
1	0	1	3
1	0	0	4
0	1	1	5
0	1	0	6
0	0	1	7
0	0	0	8

Notes: Average # of cigarettes smoked in the last 48 hours report =0 recoded as "0", average # of cigarettes smoked in the last 48 hours report >0 recoded as "1"; EPDS Score <10 recoded as "0", EPDS score ≥10 recoded as "1"

Aims 2 (point-prevalence) and 3 (smoking relapse). Frequency statistics were used to calculate point-prevalence rates of smoking and probable depression at each time-point. Additionally, relapse rates for smoking were identified for end of pregnancy and

12 months post-delivery. This was completed by creating two new binary (0/1) variables, one for relapse at the end of pregnancy and one for relapse at 12 months post-delivery. The variables were created from the smoking patterns. Positive relapse was coded as "1" and no relapse was coded as "0". Frequency statistics were then completed for the new relapse variables to identify relapse rates at each time-point.

Aim 4 (relationship of smoking and probable depression). For this aim, cross-sectional Chi-square analyses were completed at each of the three time-points (baseline, end of pregnancy, and 12 months post-delivery) to determine the association between smoking status and probable depression. If a significant association was found, then comparative analysis was performed to assess differences in EPDS scores between smokers versus non-smokers, and differences in the number of cigarettes smoked between women with a positive depression screen versus women with a negative depression screen. Finally, logistic regression was used when a significant association was found between smoking status and depression to identify the likelihood of having a positive depression screen in smokers compared to non-smokers, and the likelihood of having a positive smoking status for women who had a positive depression compared to those with a negative depression screen.

Results

Sample Characteristics

Demographic and Background Variables. Details about sample characteristics are in Appendix E, Table E2. Almost two-thirds of the women were Caucasian (64.21%, *n* = 960), two-thirds had received either a high school diploma or GED (66.71%, *n* = 1,034) and the majority were not married (86.39%, *n* = 1,339) yet living with others

(90.84%, *n* = 1,408). Many of the women (65.91%, *n* = 667) were living at or below 100% of the 2017 Federal Poverty level and just under one-fifth (19.17%, *n* = 194) were dependent on a parent/guardian. Of the total sample of women who had smoked cigarettes within the 3 months prior to pregnancy, 84.31% (*n* = 1,306) reported also smoking cigarettes during pregnancy before enrolling into NFP (≤ 28 weeks pregnant).

Aim 1: Smoking and Depression Patterns

Smoking Patterns. The 8 observable smoking patterns can be categorized into five main patterns: (1) continuation of smoking throughout pregnancy and extended to 12 months post-delivery (pattern 1, *n* = 322, 20.72%), (2) continuation of cessation throughout pregnancy and extended to 12 months post-delivery (pattern 8, *n* = 694, 44.66%), (3) cessation at end of pregnancy or after delivery (patterns 2 and 4, *n* = 67, 4.31%), (4) relapse (patterns 3, 5 and 7, *n* = 464, 29.85%), and (5) fluctuation between smoking and cessation throughout the 18 month time-period (pattern 6, *n* = 7, 0.45%) (Figure 3.1).

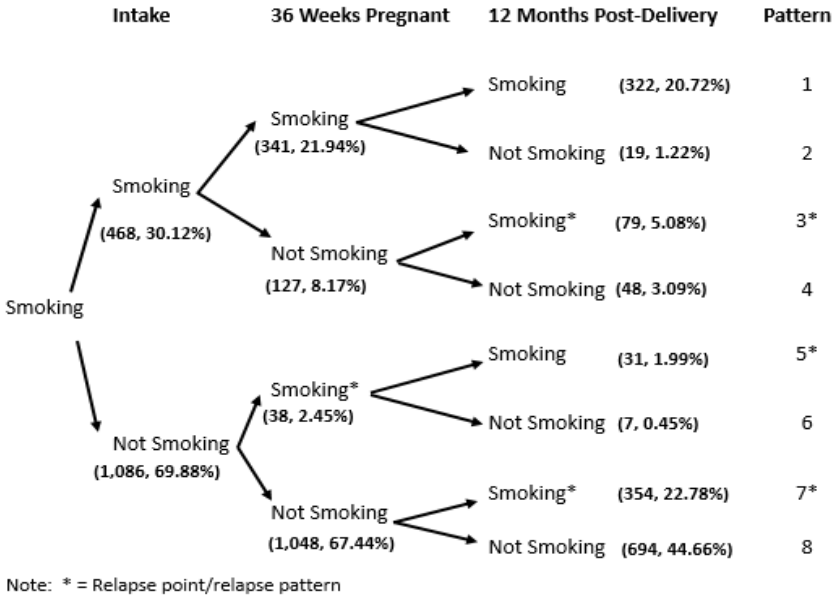
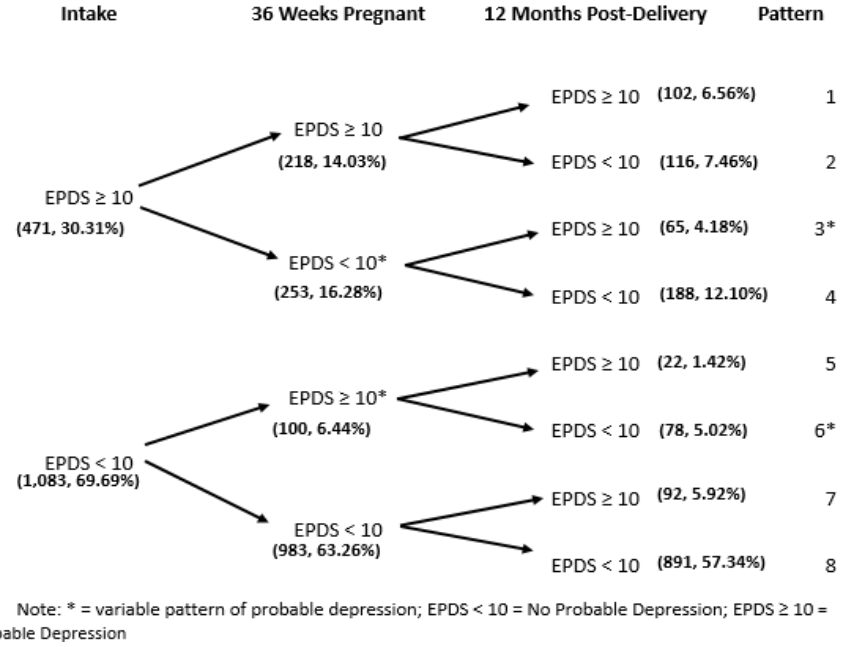


Figure 3.1. Smoking Patterns (N = 1,554)

Depression patterns. Analysis of the 8 observable patterns for a positive or negative depression screen in women with a history of smoking prior to pregnancy can also be categorized into five main patterns (Figure 3.2). The patterns are: (1) women with persistent EPDS scores ≥ 10 (pattern 1, *n* = 102, 6.56%), (2) women with persistent EPDS <10 (pattern 8, *n* = 891, 57.34%), (3) women with positive screen remission (patterns 2 and 4, *n* = 304, 19.56%), (4) women with new development of a positive depression screen (patterns 5 and 7, *n* = 114, 7.34%), and (5) women with fluctuating depression screens (patterns 3 and 6, *n* = 143, 9.20%).



Note: * = variable pattern of probable depression; EPDS < 10 = No Probable Depression; EPDS ≥ 10 = Probable Depression

Figure 3.2. Probable Depression Patterns (N = 1,554)

Aims 2 and 3: Point-Prevalence, Means, and Smoking Relapse Rates

Appendix E, Table E3 provides the smoking and depression screen characteristics of the sample.

Smoking point-prevalence. The point-prevalence of smoking at program intake was 30.12% (*n* = 468), at the end of pregnancy was 24.39% (*n* = 379), and at 12 months post-delivery was 50.58% (*n* = 786).

Mean number of cigarettes smoked. The average number of cigarettes smoked in the previous 48 hours at program intake was 2.65± 6.94 cigarettes (*n* = 1,550), at the end of pregnancy was 2.10 ± 5.42 cigarettes (*n* = 1,550), and at 12 months post-delivery was 5.74 ± 8.89 cigarettes (*n* = 1,550).

Depression point-prevalence. For the point-prevalence of probable depression in women with a history of smoking in the 3 months prior to pregnancy, 30.31% (*n* = 471) had an EPDS score ≥ 10 at intake, 20.46% (*n* = 318) had an EPDS score ≥ 10 at end of pregnancy, and 18.08% (*n* = 281) had an EPDS score ≥ 10 at 12 months post-delivery.

Mean EPDS scores. The mean EPDS score at program intake was 7.51 ± 5.10 (*n* = 1,550), at end of pregnancy was 5.88 ± 4.76 (*n* = 1,550), and at 12 months post-delivery was 5.47 ± 5.10 (*n* = 1,550).

Smoking relapse point-prevalence and overall relapse rates. Smoking relapse point-prevalence is defined by the number of women with a positive smoking status at the time-point subsequent to a negative smoking status time-point. The smoking relapse point-prevalence at the end of pregnancy was 2.45% (*n* = 38) and at 12 months post-delivery was 27.86% (*n* = 433). Additionally, of the 38 women who relapsed back to smoking from intake to the end of pregnancy, 7 (0.45%) had quit smoking again at 12 months post-delivery. The overall relapse rate was identified by adding the total number of women who relapsed at the end of pregnancy and also had a positive smoking status at 12 months post-delivery, to the number of women who had a positive smoking status at

12 months post-delivery after having a negative smoking status at the end of pregnancy. The overall relapse rate for the sample was 29.85% (n = 464).

Aim 4: Relationship between Smoking and Depression

Cross-sectional Chi-square analysis for smoking status and probable depression demonstrated statistically significant associations between smoking and depression at the end of pregnancy ($\chi^2 = 5.11$, $p = 0.0237$), and 12 months post-delivery ($\chi^2 = 23.63$, $p < .0001$) (Table 3.2). The association between smoking and depression at intake failed to achieve statistical significance ($\chi^2 = 1.80$, $p = 0.1796$).

Table 3.2.

Mean Analysis as a Function of Smoking Status, Depression Screen (N = 1,550)

Mean EPDS Scores (M ± SD(N))

Time-Point	Smokers		Non-Smokers	
Intake	8.07 ± 5.21	(466)	7.27 ± 5.03	(1,084)
End of Pregnancy*	6.34 ± 5.10	(378)	5.73 ± 4.64	(1,172)
12 Months Post-Delivery**	6.01 ± 5.35	(783)	4.92 ± 4.76	(767)

Mean Number of Cigarettes Smoked (M ± SD(N))

Time-Point	EPDS ≥ 10		EPDS < 10	
Intake	2.21 ± 4.70	(470)	2.84 ± 7.71	(1,080)
End of Pregnancy*	2.75 ± 7.16	(318)	1.94 ± 4.85	(1,232)
12 Months Post-Delivery**	7.70 ± 9.78	(281)	5.30 ± 8.63	(1,269)

*Notes: Outliers removed from total sample for means calculation; EPDS = Edinburgh Postnatal Depression Scale; Kruskal-Wallis test (non-parametric ANOVA) was used to identify significant differences between groups; *significant at p < .05; **significant at p <.0001*

Mean number of cigarettes smoked in the previous 48 hours at intake was higher in women with a negative depression screen, while at end of pregnancy and 12 months post-delivery the mean was higher in women with positive depression screens. Mean EPDS scores were higher at all three time-points for smokers as compared to non-smokers (Table 3.3).

Table 3.3.

Association of Smoking Status and Probable Depression (N = 1,554)

Time-Point		Probable Depression % (N)	No Probable Depression % (N)	$\chi 2$	p
Intake	Smoking	32.48% (153)	29.09% (315)	1.80	0.1796
	Not smoking	67.52% (318)	70.91% (768)		
End of Pregnancy	Smoking	29.25% (93)	23.14% (286)	5.11	0.0237
	Not smoking	70.75% (225)	76.86% (950)		
12 Months Post-Delivery	Smoking	63.70% (179)	47.68% (607)	23.63	<.0001
	Not smoking	36.30% (102)	52.32% (666)		

Notes. Chi-Square analysis

Likelihood of a positive depression screen based on smoking status. Table 3.4 provides the results of logistic regression identifying the likelihood of a positive depression screen based on smoking status for time-points with a significant association (e.g. end of pregnancy and 12 months post-delivery).

Table 3.4.

Likelihood of Probable Depression for Smokers Compared to Non-Smokers at Intake, End of Pregnancy, and 12 Months Post-Delivery

Time-Point	OR	95% CI	p
End of Pregnancy	1.37	[1.04, 1.81]	0.0259
12 Months Post-Delivery	1.93	[1.47, 2.51]	<.0001

Note: no significant association at intake time-point; OR=Odds ratio; CI = Confidence Interval; statistical test = logistic regression

Women who were smoking at the end of pregnancy were 1.37 times as likely to have a positive depression screen compared to women who were not smoking (p = 0.0241, 95% CI = [1.04, 1.81]). Of the 379 women who were smoking at the end of pregnancy, 29.25% also had a positive depression screen (n = 93). At 12 months post-delivery, women who were smoking were 1.93 times as likely to have a positive depression screen compared to women who were not smoking (p = <.0001, 95% CI =

[1.47, 2.51]). Of the 786 women smoking at the end of pregnancy, 63.70% also had a positive depression screen (n = 179).

Likelihood of smoking based on a positive depression screen. Table 3.5 provides the results of logistic regression identifying the likelihood of smoking based on depression screen for time-points with a significant association between smoking and depression (e.g. end of pregnancy and 12 months post-delivery).

Table 3.5

Likelihood of Smoking for Women with Probable Depression Compared to Women without Probable Depression at Intake, End of Pregnancy, and 12 Months Post-Delivery

Time-Point	OR	95% CI	p
End of Pregnancy	1.37	[1.04, 1.81]	0.0241
12 Months Post-Delivery	1.93	[1.47, 2.51]	<.0001

Note: no significant association at intake time-point; OR=Odds ratio; CI = Confidence Interval; statistical test = logistic regression

At the end of pregnancy, women with a positive depression screen were 1.37 times as likely to also be smoking compared to women with a negative depression screen (95% CI = 1.04, 1.81, p = 0.0241). Of the 318 women who had a positive depression screen at the end of pregnancy, 29.25% were also smoking (n = 93). At 12 months post-delivery, women with a positive depression screen were 1.93 times as likely to also be smoking compared to women with a negative depression screen (p = <.0001, 95% CI = 1.47, 2.51). Of the 281 women who had positive depression screen at 12 months post-delivery, 63.70% were also smoking (n = 179).

Discussion

This study was conducted to assess patterns and changes in smoking as they relate specifically to women who have a history of smoking in the 3 months prior to pregnancy, and the prevalence and relationship of smoking and depression during pregnancy and up

to 12 months post-delivery. Smoking and depression patterns, the prevalence of smoking and depression, the rates of smoking relapse during and after pregnancy, and the concurrent relationship between smoking and depression were investigated at three time points (≤ 28 weeks pregnant, 36 weeks pregnant, and 12 months post-delivery) using a national sample from the Nurse-Family Partnership home visitation program for first-time mothers.

The findings of significant associations between perinatal smoking and depression in this study align with previous research. For instance, postpartum depression was found to be associated with smoking behaviors in a previous study on a PRAMS data sample of women who reported smoking in the 3 months prior to pregnancy. [116] Additionally, an association was found between pregnancy smoking and higher postpartum EPDS scores in a smaller sample from a mid-size northeastern city.[117]

Patterns of Smoking and Depression

This study identified 8 observable patterns that can be grouped into five categories of patterns for smoking status and depressive symptoms. These findings are similar to previous findings[21] which identified five distinct smoking patterns, and are slightly different from previous research that has identified four or six distinct depression trajectories.[102, 103, 118] The differences could possibly be due to the use of observable data for depression at each time-point in this study, instead of longitudinal latent class analysis for identification of latent pathways. Additionally, differences in depression patterns could be attributed to different sample characteristics. For example, previous research [118] that identified only four depression trajectories consisted mostly of middle and high maternal social class, while this study sample consisted entirely of women with a low

socioeconomic status (SES). It could be that depression patterns have distinct attributes based on socioeconomic classes. Continued research across all socioeconomic subgroups is needed to determine what characteristics contribute to differences in depression patterns.

A unique contribution of this study is the investigation of both smoking and depression simultaneously across the perinatal continuum at three distinct time-points over an 18 month period. Among the 8 smoking patterns found in this study, there were two distinct stable patterns identified for smoking status across three time points: one where women did not have any changes in their smoking status (continuation of smoking) and one where women had a consistent change in their smoking status (continuation of cessation). While understanding these two patterns are useful for developing interventions towards smoking cessation, it is also important to consider the less stable patterns of smoking a woman might take during pregnancy and up to 12 months post-delivery. The other patterns (delayed cessation, relapse, and fluctuation between smoking and cessation) accounted for over 1/3 of the sample (34.61%) and demonstrated the lability of smoking cessation during pregnancy and the extended postpartum period. This suggests that smoking cessation is a complex issue needing continued follow-up even after a woman has reported she quit smoking. Providers should not assume that because a woman was successful with quitting she will no longer need support for smoking cessation.

This study identified similar patterns of depression. While the majority of women had a stable probable depression pathway (either continually screening positive or continually screening negative for depression), 36.10% of women had a pattern

consistent with fluctuating positive and negative depression screens at either one or both time-points.

Additionally, this study contributed identification of unique patterns of smoking relapse. A woman could be smoke-free at intake but relapse to smoking at the end of pregnancy, or be smoke free during pregnancy but smoking again at 12 months post-delivery. The findings from this study support the notion that smoking relapse is common and can occur at various time points. In fact, one of the strengths of this study is the analysis of smoking and relapse patterns across multiple time-points in conjunction with cross-sectional prevalence. This approach helps identify the fluidity associated with smoking cessation and relapse and the trajectory a pregnant woman might take related to her smoking status and EPDS scores during pregnancy and throughout the first 12 months after the baby's birth. Nevertheless, future research is recommended to continue exploration into various patterns and factors predicting which pattern a woman might take. This understanding can help to develop targeted interventions during pregnancy and support prevention of postpartum relapse.

Smoking and Depression: Prevalence and Changes

This study found smoking rates at the end of pregnancy to be 24.39%, which is similar to the smoking rates at the end of pregnancy identified for Medicaid-eligible pregnant women in a previous study.[119] These results differ from another previous national study that found women with Medicaid insurance had a smoking prevalence at the end of pregnancy of 17.6%; [120] however, the national dataset used for that study was only from 27 states. With NFP implementations in 42 states, it could be possible the sample used for this study is more representative of a national prevalence. Future

research is needed to continue investigating the true prevalence of smoking during pregnancy, specifically as it relates to socioeconomically disadvantaged pregnant women.

The sample consisted of all women with a history of smoking in the 3 months prior to pregnancy; however, only 84.13% reported smoking during pregnancy at baseline. Additionally, the number of women who reported smoking in the previous 48 hours of program intake (≤ 28 weeks pregnant) was only 30.12%. One potential explanation for this dramatic drop in prevalence is spontaneous cessation of smoking once they found out they are pregnant. Spontaneous cessation rates of 23% were found in a previous convenience sample of low-income patients at a community health clinic. [122] An over-inflation of self-reported smoking cessation due to the social desirability of not wanting to disclose smoking could have also contributed to the large drop of prevalence.

The concept of temporary cessation is interesting to consider in light of findings from the current study. In this sample of women who smoked in the three months prior to pregnancy, 30.12% were smoking at the baseline time-point at program intake (≤ 28 weeks pregnant). The smoking prevalence was even lower at the end of pregnancy, dropping to 24.39% of women who had smoked prior to pregnancy reporting they were smoking at the end of pregnancy time-point; however, 50.58% reported smoking at the 12 months post-delivery time-point. One previous study of 328 pregnant women identified that 43% who had quit during pregnancy had intentions to return to smoking within 6 months after delivery, [121] indicating many intended only a temporary cessation from smoking during pregnancy. Future research is warranted to identify smoking cessation intentions and changes in smoking status.

Another interesting finding is the change in mean number of cigarettes smoked in the previous 48 hours at the pregnancy time-points for the entire sample of women with a history of smoking in the 3 months prior to pregnancy (2.97 cigarettes, and 2.36 cigarettes, respectively) and the mean number of cigarettes at the 12 months-infancy time-point (5.46 cigarettes). Based on the mean cigarette usage, the sample appears to be representative of less addicted light smokers. While previous research has lacked consistent definitions on what constitutes light versus heavy smokers, [123] there has been some research on smoking cessation and the severity of nicotine addiction. For example, lower addiction to nicotine has been associated with smoking abstinence in patients involved in a community-based drug treatment program.[124] However, there has been minimal research specific to nicotine dependence levels and smoking cessation in pregnant women, as well as in postpartum relapse. Level of addiction may be an important factor to consider in future research for understanding smoking cessation during pregnancy and the risk for relapse postpartum.

This study also provides insight into understanding the changes in depression throughout pregnancy and 12 months post-delivery. When looking at the changes in depressive symptoms it is interesting to note the rate of depressive symptoms moving from a higher prevalence at intake (32.5%) to lower prevalence at end of pregnancy (21.31%) and 12 months post-delivery (19.07%). This pattern does align with previous research, and contributes understanding for women with a history of smoking prior to pregnancy. Similar results were found in a sample of low socioeconomic status using a cut-off score of 12 for the EPDS to indicate probable depression.[125] Prevalence of postpartum depressive symptoms decreased through 20 months postpartum; however, at

22 months symptoms of depression began to increase again. Continued research looking at patterns extending beyond 12 months post-delivery is warranted.

It is also interesting to note that patterns consisting of probable depression during pregnancy (either intake or 36 weeks) that continued at 12 months post-delivery occurred less frequently than patterns demonstrating probable depression during pregnancy and no probable depression after pregnancy. These findings are in contrast to previous research that demonstrated women with depression during pregnancy remaining depressed after pregnancy.[102] A decrease over time in the positive depression screening rates in the current study could be attributed to effectiveness of the NFP intervention. The intervention provides support for improving mental health, such as program curriculum addressing depression and/or referrals to providers for EPDS scores $\geq$ 10. Further analysis of this sample with variables related to mental health referrals and treatment would help with understanding possible contributing factors for the decreasing prevalence in probable depression over time.

Smoking Relapse Rates

One finding interesting to note is the smoking relapse rate of only 27.84% at 12 months post-delivery. While it is important to consider this finding in the context of the overall findings (e.g. many women continued smoking during pregnancy, leading to reduced relapse rates but still high prevalence rates at 12 months post-delivery), it is in contrast to high relapse rates identified in previous literature for postpartum relapse to smoking after the infant's birth. For example, PRAMS data from the years 2000-2010 has identified national relapse rates of 44% [by 4 months post-delivery].[91] Even interventions aimed to support smoking cessation have similarly high relapse rates. A

mean relapse rate of 43% by 6 months post-delivery has been identified for smoking cessation interventions initiated during pregnancy. [126]

One reason for the lower rate in this study might be that even though the sample was not specific to a smoking cessation intervention, the sample did come from a home-visitation intervention program designed to support women with improvement in multiple health and development outcomes for both mom and child over the course of 2.5 years. The lower relapse rates may be in part due to the intervention effect of the program this sample was identified from. In that case, postpartum relapse prevention interventions may prove more effective when addressing factors aligning with the intervention model this sample came from, and also when utilizing home visitation services for smoking cessation support during pregnancy and postpartum.

Lower smoking relapse rates in this study could also be attributed to the demographics of the sample. For instance, the women in this sample are women pregnant with their first baby. It might that be primiparous women's health beliefs are impacted differently than multiparous women, and subsequently their health behaviors and motivation to change. Additionally, the women in this sample are younger women. Previous research [91] has suggested women with younger maternal age are more likely to relapse to smoking; however, their sample consisted of both primiparous and multiparous women. The first pregnancy may moderate the relationship between age and smoking relapse, and further research looking at relapse as a function of parity is needed.

Strengths and Limitations

Findings of this study contribute to knowledge in perinatal smoking science. A strength of this study is the use of a national sample of low-income pregnant women with

a history of smoking in the 3 months prior to pregnancy. A large sample allows for different statistical methods being performed. Additionally this study examined longitudinal changes of smoking and depression and their concurrent relationship across three time points in 18 months.

There are, however, limitations to consider. One limitation of this study is the use of self-reported smoking data. Misclassification rates of self-reported smoking in perinatal women have been found to range from 26.6%-35%, [127] and may be in part due to stigma felt during pregnancy. The Nurse-Family Partnership program is implemented by Registered Nurses, and is centered on the execution of a 2.5 year intensive visitation schedule and relationship development between the client and nurse. It is possible the client might feel less stigmatized and more trusting within this setting to share more accurate self-reported data. Nonetheless, it is recommended to conduct future studies assessing smoking status pathways by using biochemical validation.

A second limitation of this study is the length of time between assessments of smoking status at end of pregnancy and 12 months post-delivery. Many smokers working on cessation require multiple quit attempts.[88] It may be possible that relapse rates postpartum are underestimated. If the woman was in the middle of a quit attempt at the time of the 12 month assessment, it might appear she has been smoke-free the entire year instead of reflecting the relapse and current cessation attempt. Additionally, only looking retrospectively to the previous 48 hours could potentially impact the smoking status for that time-point, and subsequently the smoking pattern. It is recommended future research utilize more frequent smoking status assessments and a longer retrospective period.

A third limitation to this study is the large amount of missing data, especially for the EPDS. One reason for this is not all NFP implementation sites nationally use the EPDS for depression screening. Some sites use the PHQ-9, another validated depression screening tool. The EPDS was used for this study instead of the PHQ-9 due to the EPDS being more reflective of underlying psychological constructs of depression instead of physical symptoms, [109] which aligned more closely with the framework of this study. Future research will want to use more advanced statistical methodologies for addressing missing data.

Finally, generalizability of the study findings may be limited because this study included only first time pregnant women who received home visitation intervention. Multiparous women without additional support from a home visiting nurse may have different outcomes in smoking and probable depression, and further research is needed.

Implications for practice

While limitations of this study hinder practice implications which are generalized to other smoking populations, results can provide insight into practice changes for low-income women pregnant with their first child, specifically with NFP. For example, results indicating a relationship between smoking and probable depression at the end of pregnancy and 12 months post-delivery suggest a need for more frequent concurrent assessment of smoking and depression screening. Nurse Home Visitors with NFP are well positioned to conduct smoking assessments and depression screenings; it may be that when a woman in early pregnancy screens positive for either smoking or probable depression, she could then receive more frequent concurrent assessment of smoking and depressive symptoms. Additionally, clients who [upon program intake] report having a

history of smoking in the 3 months prior to pregnancy should receive support in addition to program curriculum throughout the first year after delivery specifically related to smoking and depression.

Conclusion

The results of this study corroborate previous research on prevalence rates and associations of smoking and depression in pregnant and postpartum women. Additionally, identifiable patterns of smoking status and depression exist. Understanding the saliency and unique patterns of smoking status and depression during pregnancy and throughout the first 12 months post-delivery can help develop smoking relapse screening tools and targeted interventions for pregnant and postpartum women. Due to the high percentage of women who continue cigarette use during pregnancy, or relapsed back to smoking during pregnancy/postpartum, research supporting better interventions for cessation as well as improved screenings to support prevention of postpartum relapse are needed.

CHAPTER FOUR

This chapter presents the results of analyzing the relationship of demographics, cigarette use, depression, and self-mastery with smoking status at two time points: end of pregnancy and 12 months post-delivery. The analysis also identified the best fitting logistic model for predicting smoking status at the end of pregnancy, and at 12 months post-delivery.

Introduction

Smoking during and after pregnancy has negative health consequences for the smoking mother. The Surgeon General's Report on women and smoking indicates that women who smoke tend to have early menopause, altered menstrual functions, lower bone density, ectopic pregnancy, and spontaneous abortion compared to women who do not smoke.[128] The Centers for Disease Control and Prevention (CDC) also reports that smoking increases the risk for chronic diseases, as well as certain cancers, such as liver and colorectal cancers.[129]

Exposure to smoking during pregnancy and the early years of a child's life also has harmful effects on the child's health and development. With 80% of a child's brain development occurring before age of 3,[130] detrimental neuro-developmental effects related to smoke exposure cannot be ignored. Second-hand smoke exposure (defined as smoke exposure directly in the home or by exposure in public places) and third-hand smoke exposure (defined as exposure to smoke residues remaining on skin, hair, clothes, etc.) pose various risks to the child's health. Smoking exposure during infancy has known consequences impacting the child during early childhood into adolescence, such

as behavioral problems,[131] increased risk for asthma, wheezing, and altered immune function,[132] changes in brain structure and function,[133] and altered DNA methylation.[134]

Additionally, large disparities in smoking cessation exist for women of lower socioeconomic status. Low-income women are not only more likely to smoke during pregnancy, but have higher rates of relapse postpartum.[135] For instance, a report of birth certificate data identified a much higher rate of smoking before pregnancy in women with Medicaid insurance (17.0%) versus women with private insurance (5.7%).[136] The report also found the same disparity in prevalence of smoking during pregnancy for women with Medicaid (14.0%) versus women with private insurance (3.6%).[136]

Understanding factors that influence smoking during pregnancy and postpartum is important, particularly among low-income women. Previous research has identified multiple correlates and predictors of smoking during pregnancy and the postpartum period. These correlates/predictors can be grouped into four main categories: demographic factors, cigarette use during pregnancy, depression, and self-mastery.

Demographic Factors

Demographic factors related to smoking status during pregnancy and post-delivery, such as age and marital status, have been studied in previous research. For example, in a study of 138 Polish pregnant women who quit smoking prior to or during pregnancy, 50% had relapsed back to smoking within 3 months post-delivery.[137] Women who were unmarried (60.3%) were significantly more likely to relapse. Additionally, more recent research from a cohort study (n = 979,198) using U.S. birth certificate data found that younger (< 20 years) and older ($\geq$ 35 years) maternal age were negatively

associated with smoking cessation during pregnancy, while marriage had a strong positive association with smoking cessation during pregnancy.[138]

Racial disparities and smoking have also been identified in the perinatal population. For example, birth certificate data from 46 states and the District of Columbia showed disparities in smoking prevalence rates among racial/ethnic groups.[136] While overall the smoking prevalence during pregnancy was 8.4%, the prevalence of smoking for non-Hispanic American Indian or Alaska Natives was much higher than non-Hispanic Asian (18.0% vs 0.7%). Similarly, Caucasian women had a prevalence rate of smoking that was almost twice the rate of smoking in African-American women (12.2% vs. 6.8%). Additionally, other research investigating factors contributing to smoking during pregnancy identified that African-American and Asian women had much lower odds of smoking during pregnancy compared to Caucasian women (*OR* = 0.317 and 0.213, respectively) .[139]

Education and income level have also been correlated with smoking status. A previous study recruited 248 low-income pregnant women who smoked regularly during the month prior to finding out they were pregnant from WIC (Women, Infants, and Children) clinics and also from the obstetrics services of an inner-city public hospital.[140] In this previous study, education and income levels were found to be significantly associated with smoking status during pregnancy. Women with an annual household income > $15,000 were 2.96 times (*95% CI* = 1.519, 5.730) more likely to not be smoking than women with a household income $\leq$ $15,000. Additionally, women with a high school diploma were 2.073 times (*95% CI* = 1.034, 4.154) more likely to not be smoking during pregnancy than women without a high school diploma. Another study[138]

found that having at least some college education was associated with successful smoking cessation during pregnancy. While previous research has identified demographic factors associated with smoking status short-term during pregnancy, there is a need for additional research to determine demographic factors present during pregnancy that are associated with long-term smoking status [after pregnancy].

Cigarette Use

Severity of cigarette use prior to pregnancy has been reported to be associated with smoking status during pregnancy. A cohort study,[138] using logistic regression to investigate relationships of cigarette use before pregnancy with prenatal smoking cessation, found that pre-pregnancy heavy smokers ($\geq$ 20 cigarettes per day) were less likely to quit smoking during pregnancy compared to women who smoked less than 20 cigarettes per day prior to pregnancy. Another study[141] including 107 women who were enrolled in a research clinic for smoking cessation and relapse prevention looked at the differences in the mean number of cigarettes smoked per day, and compared women who abstained from smoking with women who reduced or continued smoking. A significant difference was found in the number of pre-pregnancy cigarettes smoked per day for women who abstained from smoking (mean = 12.3 cigarettes/day) compared to women who reduced or continued smoking during early pregnancy (mean = 18.8 and 16.7 cigarettes/day, respectively).

Depression

A relationship also exists between depression during pregnancy and smoking. For instance, a recent study[142] screened smoking status using self-report and urine cotinine levels, and screened depression using the Edinburgh Postnatal Depression Scale (EPDS)

for pregnant women at their first prenatal visit. Results demonstrated higher EPDS scores in smokers (mean score = 10.0) than quitters (mean score = 6.8). The study also found EPDS scores to be one of the three best predictors for smoking during a later stage of pregnancy ($p = 0.027$). The other two predictors were readiness to quit and number of children, indicating that if a woman is less ready to quit and has more children, she will be more likely to be smoking later in pregnancy. The study included a smaller sample ($n = 126$) comprised mostly of African-American women (80%) who were multiparous mothers with a mean age of 26.

Another study[143] of 127 pregnant women found that depressive symptoms was a significant predictor of smoking status during pregnancy. The study also identified a significant difference in depression/anxiety symptoms between women who quit smoking during pregnancy and women who continued smoking during pregnancy. Even after controlling for sociodemographic variables (age, education, insurance, marital status, and parity) and smoking variables (age of smoking onset and pre-pregnancy cigarettes smoked per day), women with higher depression scores had significantly increased odds of continued smoking ($OR = 2.39[1.22, 4.70]$).

Self-Mastery

The concept of self-mastery arose out of psychological and sociological research on stress and coping. The seminal work of Pearlin, Menaghan, Lieberman, and Mullan (1981) developed a framework identifying a "process of stress", and demonstrated the saliency of self-mastery as its own psychological construct independent of life circumstances. Similar to self-mastery is self-agency, which is a concept of "self", emerging from research in psychology.[145] Self-mastery and self-agency share the same

theoretical origins in early concept development of "self", as both are related to the internal cognitive processing that impacts how one views life in relation to oneself. Self-mastery is defined as "the extent to which people see themselves as being in control of the forces that importantly affect their lives" (Pearlin, et al., 1981, p. 340). The Pearlin Mastery Scale was developed through psychometric testing to assess self-mastery, and has been used in subsequent research on the concept of self-mastery.

Table 4.1.

Behaviors/Conditions and Populations Studied using the Pearlin Mastery Scale

Behaviors/Conditions
Sexual health behaviors (rapid subsequent pregnancy, sexuality/intimacy) [1, 4]
Physical/Mental Health Outcomes (overall health status, coronary/aortic calcification, alcohol use/social roles, pain) [2, 5, 9, 7]
Financial behaviors [3]
Mental health disorders (anxiety) [5]
Substance use/abuse disorders [6]
Health related quality-of-life [8]

Population
Adults with diagnosed psychiatric disorders [1]
Army infantry combat units [3]
Pregnant and Postpartum women [4]
College freshman [5]
Twins registry [6]
Middle-aged drinkers (men and women) [7]
Patients with Type 2 Diabetes [8]
Older adults [9]

Note: [1]Bonfils, Firmin, & Salyers (2015); [2]Caputo (2003); [3]Carlson, Britt, & Goff (2015); [4]DeSocio, Kitzman & Cole (2003); [5]Gallagher, Schoemann, & Pressman (2011); [6]Kendler & Myers (2015); [7]Kuntsche, Knibbe, & Gmel (2010); [8]Raaijmakers et al. (2014); [9]de Waal et al. (2016)

More recently, behavioral research is incorporating assessments of self-mastery (Table 4.1). Self-mastery has been studied in various populations, including: adults with psychiatric disorders,[146] patients with type 2 diabetes,[147] middle-aged drinkers,[148] twins,[149] army infantry combat units,[150] older adults,[151] and college freshmen.[152] The majority of these studies investigate physical or mental health behaviors; however,

additional behaviors have also been recently studied, such as financial behaviors.[150] The Pearlin Mastery Scale has also been used in research among nulliparous low-income pregnant/postpartum women. One study[153] examined the relationship between self-agency, and subsequent pregnancy interval and maternal responsivity. The study used the Pearlin Mastery Scale to assess self-agency, and found a significant relationship between self-agency endorsement, and longer duration before subsequent pregnancy and higher maternal responsivity.

Higher levels of self-mastery have been correlated with improved physical and mental health outcomes. For example, the effect of socioeconomic status, perceived discrimination, and sense of self-mastery on physical and mental health outcomes was studied using a sample from the 1979 cohort from the National Longitudinal Survey of Youth (NLSY79).[154] Participants were enrolled in the NLSY79 cohort at the age of 14-21. The nationally representative sample was comprised of adults in the NLSY79 cohort who were 40-41 years old at the time of the study. Eligible study participants were administered an additional health survey to collect data on demographic variables, lifestyle, and health. Mastery, perceived discrimination, and poverty were treated as the three main independent variables in multiple regression modeling, with the two dependent variables of physical health status (as measured by the Physical Component Summary of the SF-12 Health Survey) and mental health status (as measured by the Mental Component Summary of the SF-12 Health Survey). Only sense of self-mastery was a significant predictor of both physical health and mental health status, and the author concluded improving sense of self-mastery was an important factor for impacting health status.

Self-mastery has also been studied to assess its relationship with other mental health factors, such as anxiety. A longitudinal study on the protective effect of self-mastery on anxiety was conducted in college freshmen.[152] The study found self-mastery predicted a lower level of anxiety. The authors concluded that self-mastery was a protective factor for experiencing anxiety; college freshman with higher levels of mastery had significantly lower levels of anxiety. The sample was a convenience sample of college freshmen, and having anxiety was not part of the inclusion criteria. Individuals were not included in the study based on their level of anxiety, which acknowledged by the authors made it difficult to generalize to populations experiencing anxiety.

In sum, previous research has identified age, race, marital status, education, smoking habits, and depression as correlates and predictors of smoking outcomes during pregnancy, but little research has looked longitudinally at factors present during pregnancy and smoking outcomes extending to 12 months post-delivery. Additionally, no research has been found to date that has examined the relationship of self-mastery and smoking during pregnancy and the extended postpartum period. This study was designed to understand baseline covariates present during pregnancy that predict smoking status both during pregnancy and at 12 months post-delivery, and also to identify a predictive model for the probability of smoking at the end of pregnancy and 12 months post-delivery.

Purpose and Aims

The purpose of this study was to identify covariates (demographics, probable depression, self-mastery and cigarette use prior to pregnancy) that predict the probability

of smoking at the end of pregnancy and 12 months post-delivery. This study was guided by the following aims:

Aim 1. Assess the relationship between baseline covariates and smoking status at two different time-points: the end of pregnancy and 12 months post-delivery.

Aim 2. Identify the best fitting predictive model for smoking status at two different time-points: the end of pregnancy and 12 months post-delivery.

Methods

Design

This secondary analysis based on longitudinal data was conducted to accomplish the study aims. The dataset used in this study was from the Nurse-Family Partnership (NFP) Program national dataset. Details for the NFP program and data collection of the primary data are discussed elsewhere [in Chapter 3 of this dissertation]. Briefly, eligibility criteria for NFP services are: (1) primiparous women, (2) $\leq$ 28 weeks gestational age at enrollment, (3) income eligibility (e.g. eligible for Medicaid), and (4) living within an NFP implementing agency service area.

Sample

Eligibility criteria for this study were: (1) enrollment in the NFP program between January 2011 and December 2016, (2) completion of at least 12 months of the NFP program, and (3) singleton births, resulting in a sample of 72,035 women. This study was approved by the NFP-National Service Office and the Indiana University Office of Research Compliance.

Measures

Covariates were collected at program intake (e.g. during pregnancy, ≤ 28 weeks pregnant) and included the following: (1) age; (2) race; (3) marital status; (4) high school education; (5) post-secondary education; (6) yearly household income; (7) if they had used cigarettes prior to pregnancy (8) number of cigarettes smoked in the 48 hours at baseline; (9) probable depression; and (10) level of self-mastery. See Appendix F, Table F1 for covariate response options. Outcome variables (smoking status) were measured at 36 weeks pregnancy and again at 12 months post-delivery. Figure 4.1 shows the study framework of covariates and smoking and their relationships.

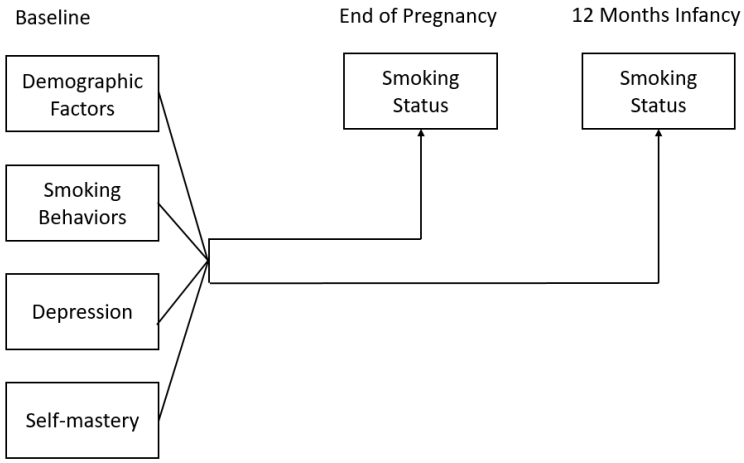


Figure 4.1. Study Framework

Demographics. Age, race, marital status, high school completion, post-secondary education, and yearly household income were the demographic covariates used in this study. See Appendix D for data codebook containing data collection questions and response options for demographic covariates.

Cigarette use. Two questions provided data for covariates related to smoking. The first question was, "During the 3 months before you became pregnant, how many cigarettes did you usually smoke in a day?" and consisted of a discrete response option.

A new binary variable was created to indicate smoking status prior to pregnancy, with report of "0" cigarettes coded as "0" (not smoking) and any value greater than "0" coded as "1" (smoking). The second question was, "In the last 48 hours, how many cigarettes have you smoked?" and also consisted of a discrete response option. This variable was also recoded into a binary variable to indicate smoking status, with report of "0" cigarettes coded as "0" (not smoking) and any value greater than "0" coded as "1" (smoking).

Probable depression. The Edinburgh Postnatal Depression Scale (EPDS) was used to measure probable depression. Since the EPDS is a screening tool and not a diagnostic test, this study uses the term "probable depression" (used interchangeably herein with "positive depression screen") to operationalize the concept of depression. Originally this tool was developed for screening and detection of depressive symptoms postnatally[28] but has also been validated for use during pregnancy.[156]

The scale consists of 10 Likert-type items, with 4 response options ranging from 0 to 3. Items 3 and 5-10 are reversely scored. Items are then summed to create an overall scale score, ranging from 0 to 30. Results from previous research have recommended a cut-off score of 10 or 11 for indicating depression during pregnancy.[156] The EPDS score was recoded as a binary variable to indicate the presence of probable depression, with an EPDS < 10 coded as "0" (no probable depression/negative depression screen) and an EPDS score ≥ 10 coded as "1" (probable depression /positive depression screen). Cronbach's alpha for the EPDS has been shown in previous studies to be 0.86 during pregnancy.[157] Cronbach's alpha in the current study for the EPDS at pregnancy intake was 0.84.

Level of self-mastery. The Pearlin Mastery Scale[158] is a 7-question, 4-point Likert-type scale with response options from 1 to 4. Two items are reversely coded, and items are summed to produce a final scale score ranging from 7 to 28. While research has indicated that higher scores indicate a higher level of self-mastery, no formal cut-off points indicating high or low levels of self-mastery have been established. However, a scale score of 21 or less has been used in previous research to indicate low levels of self-mastery,[159] and was the cut-off score used to define high and low levels of self-mastery in this study. The Pearlin Mastery Scale score was recoded as a binary variable to indicate level of self-mastery, with a Pearlin Mastery Scale score $\leq$ 21 coded as "0" (low self-mastery) and a Pearlin Mastery Scale score > 21 coded as "1" (high self-mastery). The Pearlin Mastery Scale has demonstrated acceptable reliability in previous research in low income pregnant populations with a Cronbach's alpha of 0.75.[153] The Cronbach's alpha in the current study for the Pearlin Mastery Scale was 0.77.

Smoking Status. The outcome variables for smoking status were identified from self-reported number of cigarettes by asking the following question at end of pregnancy (36 weeks pregnant) and at 12 months post-delivery: "In the last 48 hours, how many cigarettes have you smoked?" A new binary variable was created to indicate smoking status, with a report of "0" cigarettes coded as "0" (not smoking) and any value greater than "0" coded as "1" (smoking).

Statistical Analysis

SAS software 9.4 (SAS Institute, Inc., Cary, NC, USA)[160] was used to complete all statistical analysis. The total sample of women meeting eligibility criteria was 72,035. Outliers were identified and removed for age <10 years or > 60 years (n = 91). No other

outliers were identified. The final sample for analysis was 71,944 women. Descriptive statistics were performed to assess frequency and means of study variables. Significance level was set at $p = 0.05$. Data distribution was analyzed using univariate procedures. Procedures used in this analysis for handling missing data are discussed elsewhere [chapter 3 of this dissertation]. Briefly, no reason was identified to believe the missing data was not at random, and listwise deletion was the method used for handling missing data during analysis.

Aim 1. Covariates and Smoking. Logistic regression modeling was used to assess the relationship of individual baseline covariates with the binary smoking status outcome at two different time-points: the end of pregnancy (36 weeks of pregnant) and at 12 months post-delivery. The categorical covariates were: (1) race, (2) marital status, (3) completion of high school, (4) post-secondary education, and (5) income level. The binary covariates were: (1) cigarette use prior to pregnancy, (2) smoking status at program intake, (3) probable depression, and (4) level of self-mastery. Age remained a continuous covariate. Sample sizes for logistic regression of individual covariates is listed in Appendix F, Table F1. The differences in sample sizes between the end of pregnancy and the 12 month post-delivery individual covariate logistic models are due to missing outcome variables, since the covariates were measured at baseline.

Aim 2. Predictive Modeling for Smoking Status. In order to determine the best fitting model for predicting the probability of smoking while controlling for multiple covariates, logistic regression analysis was completed for two time points: end of pregnancy and 12 months post-delivery. Data matrices of covariate names were created using Interactive Matrix Language (IML), and a SAS software macro code was written to

run a loop of iterations on logistic regression models with all possible combinations of covariates identified with IML. The Akaike Information Criterion (AIC) was used to identify the best fitting logistic model at the end of pregnancy and at 12 months post-delivery. The AIC determines the most parsimonious model while accounting for model complexity.[161, 162] The lowest AICs for all possible combinations of covariates were identified using Structured Query Language (SQL). Each SQL table was compared to find the combination of covariates with the lowest AIC at each time-point (end of pregnancy and 12 months post-delivery). Finally, the data matrices were used to identify the variables to include in the final two models. Complete cases were used for the final two logistic regression models: end of pregnancy (n = 19,304) and 12 months post-delivery (n = 10,817).

Multicollinearity of the covariates identified for inclusion in the final two logistic models was identified by using Spearman's rank correlation. No multicollinearity was identified (e.g. no variables had correlation coefficients > .85),[163] thus all variables remained in the analysis (see Appendix F Table F2).

Multivariable logistic regression was then completed using the covariates identified as part of the best fitting model for the end of pregnancy and 12 months post-delivery. Additionally, receiver operating characteristic (ROC) curves were constructed for the final model at each time point to identify the sensitivity of the final models to detect the probability of a positive smoking status.

Results

Demographics and Covariates

The total sample consisted of 71,944 women. See Appendix F, Table F3 for complete sample characteristics. The average age was 21.6 years (*SD* = 4.94). Almost half of the women were Caucasian (48.90%), while 29.31% were African American. Two-thirds (64.61%) of the women were not Hispanic or Latina. The majority (82.15%) of the women were single, and just over half (57.60%) were making less than $16,000/year. Additionally, 59.76% of women had completed high school, through either a diploma program or GED/Certification program. Of the women who completed high school, 25.80% had gone on for some college but not received a degree, 10.96% had completed vocational/certificate training, 10.05% had received an undergraduate degree, and 1.32% had received a graduate/professional degree. The percent of women who self-reported using cigarettes in the 3 months prior to pregnancy was 24.90%.

Mean scores for the Pearlin Mastery Scale and the EPDS are also listed in Table F3. The average Pearlin Mastery Scale score was 22.41 (*SD* = 3.32), with scores in this sample ranging from 7 to 28. Additionally, 56.09% had a high level of self-mastery (total score > 21), and 43.91% had a low level of self-mastery (total score $\leq$ 21). Average pregnancy EPDS score at intake was 6.51 (*SD* = 4.97), with scores ranging from 0 to 29. The percentage of women with EPDS scores $\geq$ 10 at intake was 24.48%.

Aim 1: Relationship of Covariates and Smoking Status

All covariates measured at program intake ($\leq$ 28 weeks pregnant) had a significant relationship with smoking status at the end of pregnancy and also at 12 months post-delivery. Among the significant covariates, smoking related factors

appeared to have the highest influence on smoking at each time-point. See Appendix F, Table F4 for results from logistic regression model for individual baseline covariates (unadjusted *OR*) predicting smoking at the end of pregnancy, and Table F5 for results from logistic regression models for individual baseline covariates (unadjusted *OR*) predicting smoking at 12 months post-delivery.

Age. Using logistic regression to identify the probability of smoking at the end of pregnancy and at 12 months post-delivery, age was found to be a significant predictor of smoking status at the two time-points. For every 1 year increase in age at baseline (program intake, $\leq$ 28 weeks pregnant), there was an increase in the odds of smoking at the end of pregnancy by 4% (unadjusted *OR* = 1.04[1.03, 1.04], p <.0001, n = 59,115), and an increase in the odds of smoking at 12 months post-delivery by 1% (unadjusted *OR* =1.01[1.00, 1.01], p = 0.0112, n = 45,627).

Race. Logistic regression modeling for the relationship between race and smoking status at the end of pregnancy (n = 55,651) and 12 months post-delivery (n = 43,171) suggested Caucasian women had the higher likelihood of smoking at both time points. Caucasian women were 3.3 times as likely to be smoking at the end of pregnancy as African-American women, (unadjusted *OR* = 0.30 [0.28, 0.33], p < .0001, reference category = Caucasian), and 2.2 times as likely to be smoking at the end of pregnancy compared to other races, multiracial, or women who declined to self-identify race (unadjusted *OR* = 0.45 [0.41, 0.49], p < .0001, n = 4, reference category = Caucasian). Similarly, at 12 months post-delivery, Caucasian women were 1.96 times as likely to be smoking compared to African-American women (unadjusted *OR* = 0.51 [0.48, 0.54], p < .0001, reference category = Caucasian) and 2.06 times as likely to be smoking compared

to other races, multiracial, or women who declined to self-identify *(*unadjusted *OR* = 0.49 [0.46, 0.53], $p < .0001$, reference category = Caucasian).

Marital status. Married women were significantly less likely to be smoking at the end of pregnancy (*n* = 58,330) and 12 months post-delivery (*n* = 44,341) compared to single women. Those who were single were 1.89 times as likely to be smoking at the end of pregnancy compared to married women (unadjusted *OR* = 0.53 [0.48, 0.59], $p < .0001$, reference category = single), and 2.22 times as likely to be smoking at 12 months post-delivery (unadjusted *OR* = 0.45 [0.41, 0.49], $p < .0001$, reference category = single). Interestingly, women who were separated, divorced, or widowed at baseline were 2.17 times as likely to be smoking at the end of pregnancy (95% CI = 1.86, 2.53, $p < .0001$), and 1.7 times as likely to be smoking at 12 months post-delivery (95% CI = 1.47, 1.96], $p < .0001$) when compared to single women.

Completion of high school. Logistic regression also identified significant differences in the likelihood of smoking based on high school education at the end of pregnancy (*n* = 58,317) at 12 months post-delivery (*n* = 44,343). At the end of pregnancy, women were less likely to be smoking if they had completed their high school diploma when compared to women who did not complete high school (unadjusted *OR* = 0.88 [0.82, 0.94], $p = 0.0002$); however, if they completed a high school GED/Certification program, they were much more likely to be smoking at the end of pregnancy compared to those who did not complete high school (unadjusted *OR* = 2.91 [2.62, 3.23], $p < .0001$). Similar results were found at 12 months post-delivery. Women who had a high school diploma at baseline were significantly less likely to be smoking at 12 months post-delivery compared to those who did not complete high school

(unadjusted *OR* = 0.85 [0.80, 0.90], $p < .0001$). Women who had a completed GED/Certification program at baseline were significantly more likely to be smoking at 12 months post-delivery compared to those who did not complete high school (unadjusted *OR* = 2.63 [2.39, 2.90], $p < .0001$).

Post-secondary education. Post-secondary education was categorized by 4 levels of higher education: (1) some college, but no degree, (2) vocational/technical training program, (3) undergraduate degree, and (4) graduate/professional degree. Significant differences were identified at the end of pregnancy (n = 42,630) and 12 months post-delivery (n = 33,060). Compared with women who had no post-secondary education, women were less likely to be smoking at the end of pregnancy if they had some college (unadjusted *OR* = 0.80 [0.74, 0.88], $p < .0001$), an undergraduate degree (unadjusted *OR* = 0.44 [0.37, 0.51], $p < .0001$), or a graduate/professional degree (unadjusted *OR* = 0.17 [0.08, 0.34], $p < .0001$). Interestingly, if they had completed a vocational/technical training program, their risk of smoking at the end of pregnancy was 1.14 times that of women with no post-secondary education (*95% CI* = 1.02, 1.27. p = 0.0242). Similar findings were evident for the relationship between pregnancy post-secondary education at baseline and smoking status at 12 months post-delivery.

Income. Significant differences in the likelihood of smoking based on income were identified at the end of pregnancy (n = 30,973) and 12 months post-delivery (n = 23,671). Women with incomes $\leq$ \$16,000 were 1.61 times as likely to be smoking at the end of pregnancy compared to women with incomes between \$16,001 and \$30,000 (unadjusted *OR* = 0.61 [0.53, 0.70], $p < .0001$, reference category $\leq$ \$16,000), 1.51 times as likely to be smoking at the end of pregnancy compared to women with incomes over

$30,000 (unadjusted *OR* = 0.66 [0.50, 0.88], *p* = 0.0049), and 2 times as likely to be smoking at the end of pregnancy compared to women dependent on a parent/guardian (unadjusted *OR* = 0.50 [0.45, 0.57], *p* < .0001).

Women with incomes ≤ $16,000 at baseline were 1.61 times as likely to be smoking at 12 months post-delivery compared to women with incomes between $16,001 and $30,000 (unadjusted *OR* = 0.65 [0.58, 0.73], *p* < .0001, reference category ≤ $16,000), 1.72 times as likely to be smoking at the end of pregnancy compared to women with incomes over $30,000 (unadjusted *OR* = 0.58 [0.45, 0.75], *p* <.0001), and 1.54 times as likely to be smoking at the end of pregnancy compared to women dependent on a parent/guardian (unadjusted *OR* = 0.65 [0.59, 0.72], *p* <.0001).

Cigarette Use. Women who had not smoked in the 3 months prior to pregnancy were significantly less likely to be smoking at the end of pregnancy compared to women who did report smoking prior to pregnancy (unadjusted *OR* = 153.15 [123.44, 190.01], *p* < .0001, *n* = 44,456, reference category = non-smoker). This result is logical, considering most women are aware of the negative effects from cigarette use, and would most likely not spontaneously begin smoking during pregnancy or postpartum without a recent prior history of smoking. Similar findings were found for the relationship between smoking prior to pregnancy and 12 months post-delivery smoking status (unadjusted *OR* = 51.22 [46.65, 56.25], *p* < .0001, *n* = 34,217).

Women who were smoking at baseline were also significantly more likely to be smoking at the end of pregnancy compared to women who were not smoking at baseline (unadjusted *OR* = 233.58 [210.71, 258.93], *p* < .0001, reference category = non-smoker).

Similar findings were found for the relationship between smoking at baseline and 12 months post-delivery smoking status (unadjusted *OR* = 58.89 [53.56, 64.77], $p < .0001$).

Probable depression. Women with an EPDS $\geq$ 10 at baseline were significantly more likely to be smoking at the end of pregnancy (unadjusted *OR* = 1.65[1.47, 1.86], $p < .0001$, n = 20,309), and at 12 months post-delivery compared to women with EPDS < 10 (unadjusted *OR* = 1.75[1.59, 1.93], $p < .0001$, n = 15,923).

Level of self-mastery. Women with low self-mastery at baseline were 1.09 times as likely to be smoking at the end of pregnancy (unadjusted *OR* = 0.92[0.86, 0.98], p = 0.0077, n = 57,196, reference category = low self-mastery) and 1.06 times as likely to be smoking at 12 months post-delivery (unadjusted *OR* = 0.94[0.89, 0.99], p = 0.0232, n = 43,776, reference category = low self-mastery) when compared to women with high self-mastery.

Aim 2: Best Fitting Predictive Models

While understanding the relationship between individual covariates and smoking status can help identify potential predictors, it is also important to account for the complexity of multiple variables influencing smoking status. Analysis results from IML, the macros for running loops of iterations of logistic regression, and SQL identified an overall best fitting model for all possible combinations of variables at each time-point. The best fitting model for end of pregnancy included 5 covariates (completion of high school education, cigarette use prior to pregnancy, smoking status at pregnancy baseline, EPDS, and level of self-mastery). The best fitting model for 12 months post-delivery included 8 covariates (post-secondary education, marital status, and race in addition to the five covariates also included in the end of pregnancy model). Based on identified

covariates, the area under the curve (AUC) for the receiver operating characteristic (ROC) curve at the end of pregnancy model was 0.968 (Figure 4.2).

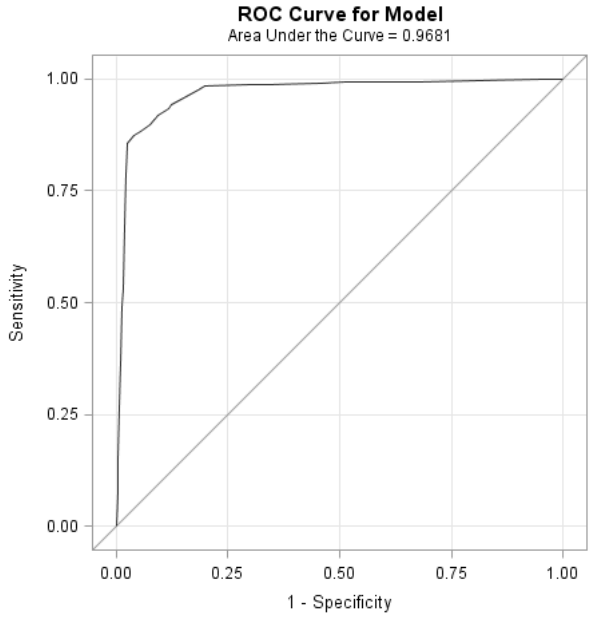


Figure 4.2. ROC Curve-Probability of Smoking at the End of Pregnancy Model

The AUC for the 12 months post-delivery model was 0.927 (Figure 4.3).

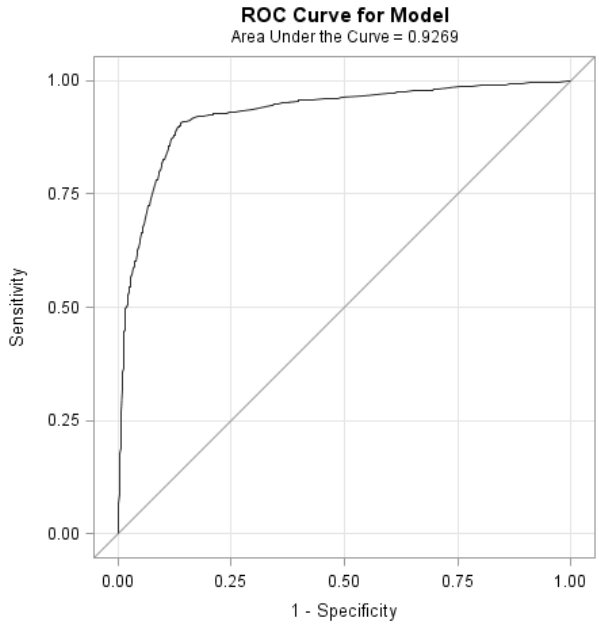


Figure 4.3. ROC Curve-Probability of Smoking at 12 Months Post-Delivery Model

This indicates a very high sensitivity of both models to properly detect the probability of smoking based on the covariates in the models. For the multivariable logistic regression models (adjusted *OR*, Tables F4 and F5), EPDS did not achieve statistical significance at the end of pregnancy, completion of high school did not achieve statistical significance at 12 months post-delivery, and the level of self-mastery did not achieve statistical significance at either time point. It is important to note that while these covariates did not reach statistical significance, fit statistics indicated they were part of the best fitting model and were important variables to control for; therefor they were not removed from final modeling.

End of pregnancy model. After controlling for the covariates in the end of pregnancy model, only cigarette use in the 3 months prior to pregnancy and smoking status at program intake remained significant predictors for smoking at the end of pregnancy. Women who used cigarettes in the 3 months prior to pregnancy were also more likely to be smoking at the end of pregnancy compared to women who did not use cigarettes in the 3 months prior to pregnancy (adjusted *OR* = 29.32[19.50, 44.08], $p <$ .0001). It is interesting to note the *OR* decreased from 153.15 (unadjusted) to 29.32 (adjusted) when controlling for high school education, self-mastery, probable depression, and smoking status during early pregnancy. Additionally, women who were smoking at program intake were significantly more likely to be smoking at the end of pregnancy compared to women who did were not smoking at program intake (adjusted *OR* = 49.49[40.83, 59.98], $p < .0001$). See Table 4.5.

12 months post-delivery model. After controlling for the covariates in the model, 6 baseline covariates remained significant predictors of smoking status at 12

months post-delivery: cigarette use in the 3 months prior to pregnancy ($p < .0001$), smoking status at intake ($p < .0001$), possible depression ($p = 0.0075$), postsecondary education ($p = 0.0002$), race ($p = 0.0144$), and marital status ($p = 0.0152$) remained significant predictors of smoking status. Women who used cigarettes in the 3 months prior to pregnancy were still significantly more likely to be smoking at 12 months post-delivery compared to women who did not use cigarettes in the 3 months prior to pregnancy (adjusted *OR* = 30.11[24.92, 36.39]). Women who were smoking at program intake were also still significantly more likely to be smoking at 12 months post-delivery compared to women who did were not smoking at program intake (adjusted *OR* = 10.21[8.27, 12.61]).

Additionally, women with a positive depression screen at the beginning of pregnancy were more likely to be smoking at 12 months post-delivery compared to women with a negative depression screen (adjusted *OR* = 1.27[1.07, 1.50], $p = 0.0075$). Compared to women with no post-secondary education, women were also less likely to be smoking at 12 months post-delivery if they had some college but no degree (adjusted *OR* = 0.78[0.65, 0.95], $p = 0.0120$), an undergraduate degree (adjusted *OR* = 0.54[0.40, 0.74], $p < .0001$), and a graduate degree (adjusted *OR* = 0.61[0.23, 1.62], $p = 0.3223$). Interestingly, women were more likely to be smoking at 12 months post-delivery if they had a vocational certificate when compared to women with no post-secondary education (adjusted *OR* = 1.07[0.84, 1.36], $p < .0001$).

African-American women were more likely to be smoking at 12 months post-delivery compared to Caucasian women (adjusted *OR* = 1.28[1.06, 1.55], $p = 0.0092$). Additionally, other races or women who declined to self-identify were slightly less likely

than Caucasian women to be smoking at 12 months post-delivery (adjusted *OR* = 0.93[0.75, 1.16], $p = 0.5298$). Women who were married had a decreased likelihood of smoking at 12 months post-delivery compared to single women (adjusted *OR* = 0.75[0.57, 0.92], $p = 0.0076$) while women who were separated, divorced, or widowed had an increase in the likelihood of smoking at 12 months post-delivery compared to single women (adjusted *OR* = 1.20[0.80, 1.79], $p = 0.3865$).

Discussion

This study investigated the relationship of baseline covariates with smoking status at the end of pregnancy and at 12 months post-delivery. It also identified the best fitting predictive model for smoking status at the two time points based on covariates present during early pregnancy.

Baseline Covariates

While all demographic covariates had a significant univariate relationship with smoking status at both time points, only race, marital status, and post-secondary education remained significant predictors after controlling for other covariates, and only in the 12 months post-delivery model. It may be these demographic covariates impact long-term smoking status differently. Another interesting finding among demographic covariates is the inconsistent findings for race and the probability of smoking at 12 months post-delivery between the univariate and multivariable logistic regressions. While univariate analysis identified a decrease in the odds of smoking at 12 months post-delivery for African-American women, the odds of smoking among African American Women at the same time point was increased when controlling for marital status, education, self-mastery, cigarette use during pregnancy, and depression scale scores. It is

difficult to explain why this happens. More research is needed on the complexity of disparities in smoking during pregnancy and the extended postpartum period.

Using logistic regression, this study identified two important predictors of smoking status during pregnancy and the extended postpartum: (1) cigarette use in the 3 months prior to pregnancy, and (2) cigarette use during early pregnancy ($\leq$ 28 weeks pregnant). The ability of these two predictors to influence smoking status is not limited to pregnancy but also to one year post delivery. These findings indicate smoking prior to pregnancy is a significant predictor of smoking status at both the end of pregnancy and 12 months post-delivery, even after adjusting for other significant predictors. With 1 in 4 women spontaneously quitting smoking upon learning of pregnancy,[37] it is important to address smoking history, and not just current smoking status during pregnancy at the time they begin prenatal care.

Results from this study also elucidate the need for better understanding of chronic and transient depression during pregnancy and the postpartum period. Chapter 3 of this dissertation identified a correlation between smoking status and depression at the end of pregnancy, and found just over half of the women who had a positive depression screen at intake had a negative depression screen at the end of pregnancy. It could be that there are latent constructs influencing an EPDS $\geq$ 10 at baseline that were not measured in this study. For example, one woman may have had underlying chronic depression, while another woman may have had transient depressive symptoms resulting from the news of the pregnancy. Both women would have screened high on the EPDS at baseline, but might lead to different behavioral outcomes. Women in this sample who had a positive depression screen at intake may have also been more likely to be referred to additional

mental health support during pregnancy (while women with a negative depression screen were not), and consequently may have received additional support for smoking cessation, leading to the decreased odds in smoking. In order to help with understanding these findings, future research will want to account for referrals to additional services during pregnancy, and also the change in depression screen between baseline and end of pregnancy (and not just baseline depression as a predictor).

The findings for self-mastery are intriguing as well. Baseline self-mastery was a significant predictor of smoking status, yet when controlling for other covariates, self-mastery did not remain significant. This demonstrates the complexity of the phenomenon of smoking in low-income pregnant and postpartum women. Additional psychometric testing of the Pearlin Mastery Scale and identification of latent constructs for self-mastery within this population may provide more insight. Additionally, level of self-mastery may have changed over time as a result of changes in self-efficacy and control beliefs, and may not have remained constant throughout the time-period. Future research will want to include additional self-mastery assessment at each time-point in order to understand the predictive capabilities of self-mastery in combination with other factors.

Predictive Models for Smoking

There were 5 covariates identified in the best fitting model at the end of pregnancy, and 8 covariates identified in the best fitting model for 12 months post-delivery. This demonstrates the complexity of smoking during pregnancy and after delivery, and may findings show different combinations of covariates work best for each time-point. This study extends understanding to multiple predictors of a positive smoking status over an 18 month time-period. For example, significant predictors identified in this study for smoking status at 12 months postpartum (when controlling for

other covariates) were: (1) cigarette use prior to pregnancy (2) number of cigarettes smoked in the previous 48 hours at program intake, (3) possible depression, (4) marital status, (5) post-secondary education, and (6) race. These findings are in contrast to previous research. The current study found that race, education, and marital status did significantly predict postpartum smoking, while another study[38] of 168 women who had smoked during pregnancy looked at substance use, maternal age, race, education, breastfeeding duration, and marital status as possible predictors of smoking status at 9 months postpartum and identified breastfeeding as the only significant predictor. One possible reason for this difference in findings might be the current study looked at possible predictors from multiple aspects of health, and addressed only low-income women, while the previous study did not look at any psychological components of smoking (such as depression and self-mastery), nor was the population specific to low-income women. The difference in findings suggests different socioeconomic classes may have different predictors of smoking, and future studies should explore these differences in predictors.

Implications for Practice

Implications are important to consider, specifically the impact of these findings on clinical practice and the development of interventions for smoking cessation support. While the findings from this study did identify all background variables having a significant (albeit individual) relationship with smoking status, it also demonstrated the complexity of the relationships by finding the importance of adjusting for other covariates when identifying predictors of smoking status. Interventions need to be designed to account for multiple background variables in order to support a decrease in

the risk of smoking at the end of pregnancy and at 12 months post-delivery. One such example might be an intervention during pregnancy that combines psychological support for smoking behaviors, support for reducing depressive symptoms, and assistance with the completion of high school and/or post-secondary education. The wrap-around supports for mental health and educational attainment, in addition to the counseling and psychological support for smoking cessation, are essential to support a decrease in the probability of smoking at the end of pregnancy and at 12 months post-delivery.

The findings from the multivariable logistic regressions predicting the probability of smoking has major implications for practice. The logistic regression equation (see Appendix F, Figure F1) can be used to identify the predicted probability a woman will be smoking when using the combination of the 5 covariates for the end of pregnancy model, and the combination of the 8 covariates for the 12 months post-delivery model. In essence, the models identified through this study are exceptionally accurate in predicting the probability someone will be smoking 18 months after becoming pregnant.

Knowing the predicted probability of long-term smoking can support improved relapse prevention, and enhance clinical assessment and decision making around nursing education and interventions. Implications of the predictive models can best be illustrated through an example. [Within the NFP population] a nurse could use data collected at program intake to estimate the risk for smoking at 12 months post-delivery using the following equation:

$$P(\text{smoking at 12 months post-delivery}) = \frac{e^{\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k}}{1 + e^{\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k}}$$

In this example, let's assume the nurse wants to estimate the predicted probability a client will be smoking 12 months after the baby is born in order to determine the most appropriate education and intervention services. The nurse identifies the following information upon enrolling the client into NFP: (1) completed high school education (X_1), (2) smoked cigarettes during the 3 months prior to pregnancy (X_2), (3) was not smoking cigarettes at program intake (X_3), (4) had an EPDS $\geq$ 10 (X_4), (5) had a Pearlin Mastery Scale score $\leq$ 21 (X_5), (6) a vocational certificate after high school (X_6), (7) is divorced (X_7), and (8) African-American (X_8).

Based on the 12 month logistic model, the predictive formula equation for this client would be:

$$p = \frac{e^{-3.6745+-0.210 + 3.405+ 0+ 0.235 + 0 + 0.064 + 0.178 + 0.250}}{1 + e^{-3.6745+-0.210 + 3.405+ 0+ 0.235 + 0 + 0.064 + 0.178 + 0.250}}$$

$$p = \frac{e^{0.2475}}{1 + e^{0.2475}}$$

The predicted probability for this example is 0.5614, indicating the client's risk of smoking at 12 months post-delivery is 56%. Relevant assessment of individual risk factors can identify modifiable risk factors that should receive nursing support and referrals. For example, additional support from a mental health provider to address her EPDS score and low self-mastery, as well as support in obtaining additional post-secondary education will help reduce her overall risk.

Limitations

While there are strengths to this study such as the longitudinal assessment and the in-depth regression analysis for predictive modeling, it is not without its limitations. One limitation is that the predictive models for end of pregnancy and 12 months post-delivery

are only applicable to the characteristics of the sample, specifically low-income pregnant women involved in a home visitation program. Future research will need to be conducted with samples including other socioeconomic statuses, as well as non-pregnant women to determine the generalizability of the models. Additionally, there may be other covariates that are important to account for when trying to predict smoking status long-term, such as smoking intentions, environmental influences, and physical addiction to nicotine. Operationalization of these concepts was not available for this study, and future behavioral research on smoking status will want to incorporate additional covariates in model testing. However, the very high AUC for both end of pregnancy (0.9681) and 12 months (0.9269) demonstrates how well the models are able to discriminate between smokers and non-smokers, and suggests that both models have a very accurate ability to identify more true positives while minimizing false positives in identification of smoking status outcome. Finding additional covariates for predicting the probability of smoking may not be needed.

A second limitation is the use of self-reported smoking data, which could have resulted in inaccurate data for smoking status. There has been conflicting evidence on accuracy of self-reported smoking status. For example, one study[166] identified misclassification rates during first and second trimester to be 35% and 31.9%, respectively; however, the authors also reported that Caucasian women were 87% less likely to have inaccurate classification. Over half of the sample for the current study self-reported their race as Caucasian. Additionally, previous research has suggested that the majority of pregnant women do disclose their smoking during pregnancy.[167]

Finally, a third limitation is the missing data. This limitation is further discussed elsewhere [in chapter 3 of this dissertation]. Briefly, one example of large amounts of missing data is related to the EPDS. The EPDS was used to operationalize depression in this study; however, not all NFP sites require the use of the EPDS to screen for depression. Since the final logistic models used complete cases only, this contributed to the reduction of the sample size for final modeling. The final sample did remain large enough to maintain statistical power. While missing data analysis suggested there was no reason to assume the missing data was not at random, there is still a potential for bias in the estimation parameters of the final logistic model for each time-point. Future research will want to use more advanced statistical methodologies for addressing missing data and/or possibly use other depression screen data (e.g. PHQ-9) that is collected at NFP sites not using the EPDS.

Conclusion

Multiple predictors exist for the probability of smoking at both the end of pregnancy, and at 12 months post-delivery. This study contributes understanding of physical factors and psychological factors that can influence and predict longitudinal smoking status. Understanding the predictive models for end of pregnancy and 12 months post-delivery can help identify nursing education and interventions to provide. Additionally, screening tools can be developed to support effective and tailored interventions for reducing smoking during pregnancy and after the child's birth.

CHAPTER FIVE

This chapter summarizes the findings from the dissertation, provides a synthesis of key findings, and discusses the strengths and limitations of the dissertation. The chapter concludes with recommendations for future research and implications to practice.

Summary of the Project

The purpose of this dissertation was to study smoking and its related factors specifically in low-income pregnant and postpartum women. This was accomplished by an analysis of the concept of smoking cessation followed by two secondary analyses of the Nurse-Family Partnership (NFP) national dataset, resulting in three distinct manuscripts. Findings from the three manuscripts were reported in three chapters of this dissertation (Chapters 2 through 4).

Chapter 2 was a concept analysis using Rodger's evolutionary method to identify various attributes and antecedents of smoking cessation in pregnant women living in poverty. A total of 19 publications were included in the analysis. The aim for chapter two was to clarify the phenomenon of smoking cessation in the context of low-income pregnant women.

Chapter 3 was a secondary analysis of women enrolled in NFP from 2011-2016 with a history of smoking in the 3 months prior to pregnancy, with the purpose to explore the relationship and patterns of smoking status and probable depression using three different time-points: early pregnancy ($\leq$ 28 weeks pregnant), the end of pregnancy (36 weeks pregnant) and 12 months post-delivery. The aims for chapter three were: (1) identify patterns of smoking status and depression across an 18 month time-period, from early pregnancy, to the end of pregnancy and 12 months post-delivery, (2) identify the

point-prevalence of smoking and probable depression in early pregnancy, end of pregnancy, and 12 months post-delivery, (3) identify smoking relapse rates at the end of pregnancy and at 12 months post-delivery, and (4) assess the relationship between smoking status and probable depression in early pregnancy, end of pregnancy, and 12 months post-delivery.

Chapter 4 was a secondary analysis of all women enrolled in NFP from 2011-2016 to understand the relationship between individual baseline covariates and smoking status at end of pregnancy and 12 months post-delivery. The chapter also identified a model for predicting the probability of smoking at the end of pregnancy and at 12 months post-delivery. The aims for chapter four were: (1) assess the individual relationship between baseline covariates and smoking status at the end of pregnancy and 12 months post-delivery, and (2) identify the best fitting predictive model for smoking at the end of pregnancy and 12 months post-delivery. This final chapter provides a synthesis of key findings from the dissertation project, the strengths and limitations, recommendations for future research, and a summary of the implications for practice.

Synthesis of Key Findings

Key findings from this dissertation identified considerations for research and practice related to smoking during pregnancy and the extended postpartum period in low-income first-time pregnant women. The first key finding from the analysis of the concept was three main categories of attributes and four main categories of antecedents for smoking cessation within the context of pregnant women living in poverty. The attributes are: (1) biochemical, (2) intrapersonal, and (3) physical. These attributes reflect major methods used to define smoking cessation. The antecedents identified are:

(1) demographic variables, (2) biopsychosocial variables, (3) incentive-based interventions, and (4) support systems. These antecedents are likely to correlate with smoking cessation or be the predictors of transient or long term smoking cessation. The antecedents and attributes suggest that research and practice will need to account for multiple levels of influence. They can be used to cultivate interventions for prenatal or postpartum smoking programs. When supporting low-income pregnant women with smoking cessation, theoretical and conceptual underpinnings from an ecological framework will be beneficial.

A second key finding from this dissertation is the smoking point-prevalence rates and smoking relapse rates, as well as point-prevalence rates of possible depression during pregnancy and up to 12 months post-delivery. The results help identify the number of women impacted by smoking and by depression during the perinatal period. Current rates are also important for a clear picture of the current state of the problem. The findings in this dissertation demonstrates that 30.12% of women continue to smoke at the beginning of pregnancy and 24.39% continue to smoke at the end of pregnancy, indicating a need for improved prevention and intervention during pregnancy. Conversely, compared to previous research indicating a high postpartum relapse, this study found only 29.85% of women had resumed smoking at 12 months post-delivery. This could be in part due to the sample coming from an intensive nurse home visitation intervention, and this should be taken into consideration when interpreting results.

A third key finding was the 5 main categories from the 8 observable patterns identified in Chapter 3. The finding of different patterns demonstrates the complexity of smoking cessation and depression during pregnancy and the extended postpartum period.

Results suggest that while many women who were smoking prior to pregnancy do quit at some point during pregnancy, around one out of four either continue to smoke, or relapse back to smoking during pregnancy. In addition, results suggest that a large number of women who did quit during pregnancy followed a pattern that resulted in resumption of smoking after the baby was born. The pattern analysis findings are foundational for identifying pivotal points during the perinatal period where trajectories of long-term smoking outcomes can be influenced. Future research will want to continue to identify when additional "pivot points" exist, and what factors contribute to the changes that occur in smoking status and depression scores at these critical points in time.

A final key finding was the covariates identified for the best fitting predictive model for smoking status at the end of pregnancy and at 12 months post-delivery. The use of fit indices as opposed to individual covariate significance level helped identify the best fitting model for all combinations of covariates, and the macro coding for logistic regression iterations provided an in-depth analysis to identify the best fitting model. The models demonstrated excellent discrimination, indicating the ability of the fitted data to accurately predict women who will be smoking at each time-point. When accounting for other covariates, high school education, psychological beliefs (e.g. probable depression and self-mastery), and smoking behaviors best predicted smoking status at the end of pregnancy. In addition to end of pregnancy model covariates, race and marital status were also determined to be important factors for predicting 12 months post-delivery smoking status (but not end of pregnancy). While most of the predictors are modifiable, it will be important to account for all of the factors and covariates when developing screening tools and interventions.

Strengths and Limitations of the Dissertation

A strength of this dissertation is the use of a large national dataset to contribute to the understanding of smoking, cessation, and relapse across an 18-month time period, specifically for low-income pregnant and postpartum women. Additionally, the insight provided into the complex relationship between smoking and depression to support understanding of both prevalence and patterns through the use of longitudinal data is also a strength of the dissertation. A final strength of this dissertation is the methodology used in predictive modeling for the probability of smoking at both the end of pregnancy and 12 months post-delivery. Establishing data matrices, using structured query language, and running iterations of logistic regression through a macro code supported an in depth analysis with a larger number of covariates.

While there are multiple strengths of this dissertation, it is not without its limitations. One limitation is the use of self-reported data, specifically as it relates to smoking status. The lack of biochemical validation for the confirmation of self-reported smoking status may have led to smoking status being underreported. A second limitation is the lack of generalizability for other smoking populations. This sample was specific to first-time low-income women involved in the NFP program. The socioeconomic differences in smoking during pregnancy were not examined outside the scope of women living in poverty; therefor generalizable conclusions on prevalence, predictors, and the relationship between smoking and depression during pregnancy and postpartum are limited to the extent of the population in this study. A final limitation to this study was the large amounts of missing data. The missing data analysis did not give any reason to conclude there were differences between women missing data and women with complete

data; however, this should still be considered when interpreting results. Advanced statistical techniques for imputation instead of Listwise deletion should be used with future research.

Recommendations for Future Research

Future research extending the results of this dissertation project are warranted. One recommendation for future research is to test a comprehensive screening tool including the covariates found in this dissertation to identify risk of postpartum smoking relapse. Screening tools can support identification of mental health and substance use disorders and should be regularly provided.[168] A screening tool for the risk of postpartum relapse could then guide development and implementation of tailored interventions for prevention of postpartum relapse. This will contribute to understanding effective interventions that support smoking cessation during pregnancy as well as smoking abstinence after delivery.

It is also recommended that future research improve the operationalization of depression and smoking constructs. Using diagnostic criteria instead of cut-off scores from screening tools will help to better understand actual depression versus probable depression. Additionally, it is important to consider that patterns of depression may be influenced by the underlying mechanism of the depressive symptoms; it will be important to differentiate between biological (e.g. changing hormones) and psychological (e.g. role adjustment) causes of depression during the perinatal period.

Implications for Practice

Findings from this dissertation illustrate the need for concurrent screening of depression and smoking when addressing smoking cessation and relapse prevention,

specifically during the first year after birth for low-income women. While improved screenings in practice is important, it is also necessary to consider additional needs for follow-up diagnosis and treatment.[169] Comprehensive screenings could potentially identify more women in need of services, so it will be important to have resources available for potential increase in needed interventions and treatment.

Current practice guidelines address interventions for the clinical management and prevention of tobacco use for pregnant women,[170, 171] but guidelines for women during the postpartum period are lacking. Practice guidelines specific to the time-period after delivery are needed. When aiming to address the clinical management and prevention of postpartum smoking and relapse, it will be important to concurrently address the psychological factors of depressive symptoms and self-mastery as well, and not just current smoking status and/or history. Additionally, the major finding of the two predictive models with an excellent ability to predict smoking status can support clinical decision making in practice. The predicted probability of smoking could be determined based on covariate data collected during early pregnancy ($\leq$ 28 weeks pregnant), allowing for tailored nursing interventions and support.

Conclusion

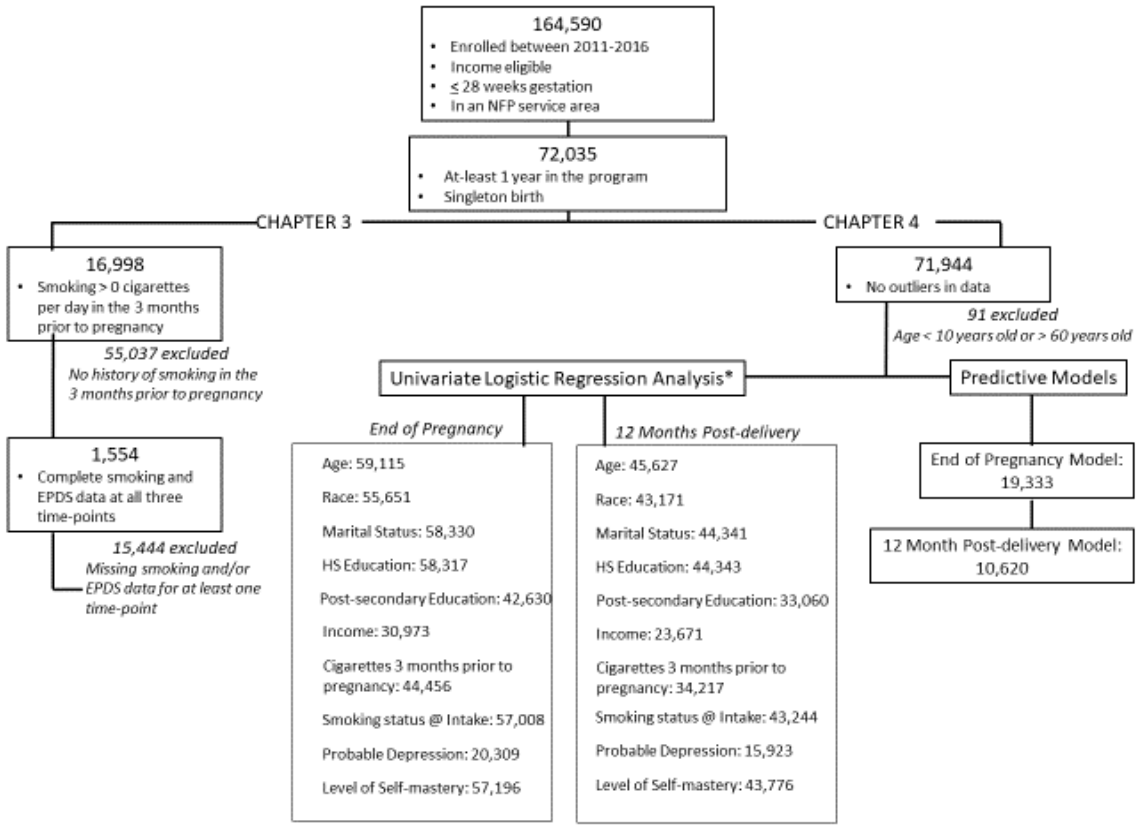
Smoking during pregnancy as well as postpartum relapse are a major public health concern. Poor health outcomes resulting from smoking during pregnancy are evident for the mother and the child. Additionally, previous research has demonstrated poor long-term health outcomes from maternal smoking during the early years of a child's life. While there has been success in reducing prevalence of smoking during pregnancy over the past few decades, the results from this dissertation project have

demonstrated there is still a high prevalence of smoking during pregnancy in low-income women pregnant with their first child. Findings also suggest a relationship between smoking status and probable depression. Identification of the specific patterns smoking and probable depression throughout pregnancy and postpartum will help to inform future research and interventions for smoking cessation. The results from this dissertation also distinguish several covariates present during early pregnancy that can predict both short-term smoking status during pregnancy as well as long-term smoking status at 12 months post-delivery. Findings of this dissertation are expected to help improve maternal and child health outcomes by identifying covariates and patterns important for smoking prevention, and ultimately lead to enhanced practice guidelines for supporting pregnant and postpartum women with smoking cessation.

APPENDICES

APPENDIX A. CHAPTER ONE TABLES AND FIGURES

Figure A1. Sample Selection and Size Flowchart



*Note: * Only cases without missing outcome variables were used for regression analyses; Univariate logistic regression sample sizes differ for end of pregnancy and 12 months post-delivery due to missing outcome variable data at the time-points.*

APPENDIX B. CONCEPT ANALYSIS LITERATURE REVIEW TABLE

Table B1.

Concept Analysis Literature Review Table

Citation	Attributes	Antecedents	Consequences	References	Surrogate Terms	Related Concepts
Borland, Babayan, Irfan, and Schwartz (2013)	"Comprehensive cessation strategies"; Multi-faceted including policy, programming, practice	Healthcare provider engagement; 5A's; geographical and sociocultural issues addressed; policy, programming, and practice changes; proper education breaking stigmas; women-centered, harm-reduction care	Limited referral and f/u of smoking status; limited support; need for NRT	Tobacco help-lines; MCH promotion network	Tobacco cessation; smoke-free; cessation; ex smoker	Socio-cultural factors of smoking
Browne, Shultis, and Thio-Watts (1999)	"Cessation programs as part of community-based PN support services that address the wide range of factors that influence women's health"; solution-focused approaches	Community outreach programs; solutions-focused approach to counseling; identification of social context and tobacco as a coping mechanism; high self-efficacy; empowerment	Trust in the community agencies and HC teams; other complex life-issues can be addressed	Community-based PN health-education (drop-in and outreach); peer to peer support; solutions-focused approaches	Tobacco cessation; tobacco reduction	Self-efficacy; empowerment; diverse needs
Pletsch, Morgan, and Pieper (2003)	Not defined	Personal determination; stress management and coping strategies	Improved stress management technqiues	Home visits; Smoke Free Families program	None identified	Personal will

Cluss, Levine, and Landsittel (2011)	"evidence-based smoking cessation services'; psychosocial cessation intervention; self-reported zero cigarettes in past week; CO of less than or equal to 8ppm	Nonwhite, younger women; first pregnancy; less addicted to nicotine; commercial insurance; tx started earlier in pregnancy; smoking fewer cpd prior to pregnancy; perceived risk to self and fetus; lower life stress; high social support; no husband/partner who smokers; lack of exposure to physical/sexual violence; lower depression and axiety; high attendance in tx sessions	CO monitoring as motivational tool; education on importance of CO to fetus' health; goals with coping strategies for stressful situations; identification of ongoing smoking triggers; relapse prevention information	Community programs; community health clinics; telephone	Tobacco control	Support for economically disadvantaged populations; use of CO monitoring as motivation; sustainability of community evidence-informed programs; evidence-informed cessation;
Eiden et al. (2013)	Quit smoking	High school education and above; low depression; low perceived stress (financial strain, maternal psychological sx of depression and hostility); reduction in depression during pregnancy and PP	Teaching r/t negative affect and replacing smoking with other pleasurable activities; combination of behavioral therapies to address craving and positive reinforcement	Large city hospital	Change in smoking pattern	Stability of cessation efforts; substance use expectancies; smoking outcome expectancies anger/hostility; level of stress; smoking trajectories
Hayes et al. (2013)	"Woman who stopped smoking having become aware of pregnancy or at time of first prenatal visit and stayed nonsmoking during and after pregnancy"	Multifaceted strategy including behavioral and improved social supports; fiscal and environmental measures	Reliance on measures other than self-report of quit status	Public prenatal clinics	Quitting smoking; staying quit	Instrinsic motivation; smoking status

Herbert, Gagnon, O'Loughlin, and Rennick (2011)	Not defined	Education on ETS exposure;	Less cigarettes smoked in the home; increased empowerment	Telephone calls; weekly group sessions	Effective cessation	Empowerment ideology; participatory experience; ETS exposure
Higgins et al. (2012)	Breath CO specimens less than or equal to 6 ppm; urine cotinine less than or equal to 80 ng/ml after 5 days smoke-free	Financial incentives; cessation counseling and management	Decreased need for financial incentives; identification of ETS; empowerment	University and community obstetric practices; local WIC offices	Abstinence	Behavioral economic research
Holtrop et al. (2010)	Not defined	Mental health issues addressed; substance abuse counseling with cessation counseling	High rate of resumption of smoking within 6 months PP	Enhanced prenatal services; PN clinics; local health departments; private non-profit health agencies	Quitting during pregnancy; quitters	Smoking and mental health; SES
Lundquist, Seward, Byatt, Tonelli, and Kolodziej (2012)	Not defined	Early identification and counseling for cessation; relationship with a consistent support person; culturally sensitive-care; knowledgable health care provider; positive, nonjudgemental feedback about bewnefits of smoking cessation and how to proceed; consistent core support person; engatement in medical and psychiatric tx	Better health for mother and baby	Not identified	Tobacco cessation	Substance use disorders; psychiatric disorders

Ma et al. (2005)	Self-report of not smoking for 7 days; cotinine levels of 20 ng/mL or less	Older or younger maternal age; fewer previous births; higher education; higher SES; white; receiving PN care; report of lower number of stressful life events; lower addiction to nicotine; insurance other than Medicaid;	Half of women who quit during pregnancy resume smoking within 6 months PP; tailoring cessation for age or level of addiction to enhance PP maintenance	Obstetric providers; pediatric providers; WIC providers	Ex-smoker; abstinence PP; stopping smoking; maintenance of abstinence	Ecological model of support; community-based approaches
Merzel, English, and Moon-Howard (2010)	Stopping smoking after finding out pregnant and not smoking currently; stopping smoking before pregnancy and not currently smoking	Younger age; fewer children;	Identification of women at risk for relapse; smoking resumption in former/current smokers smoking half ppd	Community-based organizations	Former smoker;	"stop but not quit" temporary cessation; levels of influence
Nichter et al. (2008)	"dynamic process in which individuals engage in several forms of work involving lifestyle change and the management of self-identity and social relations as well as the work of coping with stress"; cotinine levels less than 50 ng/mL	Clear intentions about staying quit; protective anti-smoking messages (verbal and nonverbal) from a range of sources (HC provider, partner, parents, coworkers)	Risk for PP relapse; desire to quit before child is old enough to imitate or recognize behavior; increased energy and breath for parenting requirements.	Large city in southwestern United States	Maintenaning abstinence; sustained cessation; quitter	Smoking relapse; smoking norms; moral identity shifts; smoking trajectories; harm reduction; smoking identity; intentions to quit
Ockene et al. (2002)	Self-report of not smoking in previous 7 days	Higher SES; less addicted to nicotine; perceived risk	Clinician vigilance about multiple supportive interventions;	Community health centers; WIC offices	Spontaneously stop; spontaneous cessation	Attitudes and perceptions;

Pletsch (2002)	Related concepts well-defined but not smoking cessation	Current stage of change	None identified	Not identified	Non-smoker	Lifestyle changes; second hand smoke exposure; self-efficacy; teachable moments; fetal awareness
Scheibmeir, O'Connell, and Aaronson (2005)	Negative urine cotinine test	High motivation to quit; personal control; high self-image; use of experiential and behavioral strategies	Remain smoke free; relapse PP	Pre-natal care clinics	Ex-smoker	Temporary abstinence; type of motivation; delayed relapse; intention; self-perception
Solomon, Secker-Walker, Skelly, and Flynn (1996)	Currently not smoking	Action stage of change	Relapse or staying quit	Obstetric group practice	Staying quit; quit smoking	Behavior change; motivations to quit/remain quit; relapse prevention

APPENDIX C. CHAPTER TWO TABLES AND FIGURES

Table C1.

Exemplar Show-case of Concept Analysis Findings

Concept Analysis Findings	Supportive Exemplar Statements
Antecedents	
Demographics	First pregnancy; In treatment for mental health; 22 years old
Biopsychosocial	Increased motivation for a healthy baby; Intensive ongoing treatment
Financial incentives	N/A: not reported in exemplar
Support systems	Interpersonal level of support = none identified Community level support = Nurse; OB Healthcare provider; Nicotine Anonymous; State-quit line
Attributes	
Biochemical	CO breath test result: 13ppm
Intrapersonal	N/A: Self-report not identified as a measure in exemplar
Physical	Spontaneous reduction of smoking upon learning of pregnancy
Consequences	
Empowerment	Increased knowledge on the negative effects to her and child from smoking; Able to address education, self-sufficiency, and housing
Longer duration before relapse	Remained smoke free after quitting during pregnancy;
Holistic care	Holistic nursing care; Support for GED completion, job attainment, and stable housing

Notes. See Lundquist et al. (2012) for complete exemplar; N/A = not applicable; CO = carbon monoxide; ppm=parts per million.

APPENDIX D. DATA CODEBOOK

Table D1.

Data Codebook

Original Variable in Excel file from NSO	Renamed Variable in Excel file from NSO	Question/ Description	Response Options	Recoding Number	Recoded and New SAS Variables
CLID CL_EN_GEN_ID Client	**CLID**	N/A	Continuous; Unique	N/A	N/A
SiteID	**SiteID**	N/A	Numeric	N/A	N/A
ProgramStartDate	**ProgramStartDate**	N/A	Date	N/A	N/A
EndDate	**EndDate**	N/A	Date	N/A	N/A
SurveyDate	**SurveyDate**	N/A	Date	N/A	N/A
CLIENT_HEALTH_BELIEF_0_LITTLE_CONTROL	littlecontrol	I have little control over the things that happen to me.	Strongly Agree Agree Disagree Strongly Disagree	1 2 3 4	littlecontroln
CLIENT_HEALTH_BELIEF_0_CANT_SOLVE	nosolveprob	There is really no way I can solve some of the problems I have.	Strongly Agree Agree Disagree Strongly Disagree	1 2 3 4	nosolveprobn
CLIENT_HEALTH_BELIEF_0_LITTLE_CAN_DO	littlecando	There is little I can do to change many of the important things in	Strongly Agree Agree Disagree Strongly Disagree	1 2 3 4	littlecandon
CLIENT_HEALTH_BELIEF_0_FEEL_HELPLESS	feelhelpless	I often feel helpless in dealing with the problems of life.	Strongly Agree Agree Disagree Strongly Disagree	1 2 3 4	feelhelplessn

CLIENT_HEALTH_BELIEF_0_FEEL_PUSHED_AROUND	pushedaround	Sometimes I feel that I'm being pushed around in life.	Strongly Agree Agree Disagree Strongly Disagree	1 2 3 4	pushedaroundn
CLIENT_HEALTH_BELIEF_0_FUTURE_CONTROL	futuredependson	What happens to me in the future mostly depends on me.	Strongly Agree Agree Disagree Strongly Disagree	4 3 2 1	futuredependsonn
CLIENT_HEALTH_BELIEF_ 0_DO_ANYTHING	candoanything	I can do just about anything I really set my mind to do	Strongly Agree Agree Disagree Strongly Disagree	4 3 2 1	candoanythingn
Age at Intake	**age**	N/A	Numeric	N/A	N/A
Race	race	Race (check all that apply)	American Indian or Alaska Native Asian Black or African American Native Hawaiian or other Pacific Islander White Declined to Self-identify Unrecorded *more than one selection* NULL	3 3 2 3 1 3 3 3 .	racen
Ethnicity	ethnicity	Ethnicity (check one)	Not Hispanic or Latina Hispanic or Latina Declined to self-identify Null	1 2 0 .	ethnicityn
CLIENT_MARITAL_0_STATUS	maritalstatus	Marital Status:	Single, never married Not Married - living with partner Married (legal or common law) Separated Divorced Widowed Null	1 1 2 3 3 3 .	maritalstatusn

CLIENT_LIVING_0_WITH	livingstatus	With whom do you live? (check only one from option 1-5)	Homeless	3	livingstatusn
			Confined to an institutional facility (residential treatment facility, incarcerated)	3	
			Live in a group home/shelter	3	
			Live alone (or with infant/child)	2	
			Live with Others	1	
			Null	.	
CLIENT_EDUCATION_0_HS_GED	completedhigh	Have you completed high school or a GED or vocational/ certification program?	Yes - completed high school	1	completedhighn
			Yes - completed GED	2	
			Yes - completed vocational/certification program	2	
			Did not complete school	0	
			Null	.	
CLIENT_EDUCATION_1_HIGHER_EDUC_COMP	currented	Have you completed education other than high school/GED (mark the highest level)?	Some college (no degree)	1	currentedn
			Vocational/certification/technical training program (not related to High School)	2	
			Vocational/certification/technical training program (beyond High School)	2	
			Associate's degree	3	
			Bachelor's degree	3	
			Master's degree	4	
			Doctorate degree (for example: PhD - EdD)	4	
			Professional degree (for example: LLB - LD - MD - DDS)	4	
			No	0	
			Null	.	

CLIENT_INCOME_AMOUNT	income	Which of the following categories best describes your total yearly household income?	Less than or equal to $6,000	1	incomen
			$6,001 - $9,000	1	
			$9,001 - $12,000	1	
			$12,001 - $16,000	1	
			$16,001 - $20,000	2	
			$20,001 - $30,000	2	
			Over $30,000	3	
			Client is dependent on parent/guardian	4	
			Null	.	
CLIENT_SUBSTANCE_CIG_1_PRE_PREG	cigpriorpreg	During the 3 months before you became pregnant, how many cigarettes did you usually smoke in a day?	Numeric	N/A	N/A
CLIENT_SUBSTANCE_CIG_0_DURING_PREG	cigusepreg	Did you smoke cigarettes at all during your pregnancy, including before you found out you were pregnant?	Yes	1	cigusepregn
			No	0	
			Null	.	
CLIENT_SUBSTANCE_CIG_1_LAST_48	intakerecentcig	In the last 48 hours, HOW MANY cigarettes have you smoked? By 48 hours, I mean from (TIME AND DAY OF WEEK) to (TODAY AND TIME).	Numeric	N/A	N/A
CLIENT_SUBSTANCE_CIG_1_LAST_48	eoprecentcig	In the last 48 hours, HOW MANY cigarettes have you smoked? By 48 hours, I mean from (TIME AND DAY OF WEEK) to (TODAY AND TIME).	Numeric	N/A	N/A
CLIENT_SUBSTANCE_CIG_1_LAST_48	infancyrecentcig	In the last 48 hours, HOW MANY cigarettes have you smoked? By 48 hours, I mean from (TIME AND DAY OF WEEK) to (TODAY AND TIME).	Numeric	N/A	N/A

CLIENT_EPDS_1_ABLE_TO_LAUGH	intakelaugh	I have been able to laugh and see the funny side of things.	As much as I always could	0	intakelaughn
			Not quite so much now	1	
			Definitely not so much now	2	
			Not at all	3	
CLIENT_EPDS_1_ENJOY_THINGS	intakeenjoyment	I have looked forward with enjoyment to things.	As much as I ever did	0	intakeenjoymentn
			Rather less than I used to	1	
			Definitely less than I used to	2	
			Hardly at all	3	
CLIENT_EPDS_1_BLAME_SELF	intakeblamedself	I have blamed myself unnecessarily when things went wrong.	Yes - most of the time	3	intakeblamedselfn
			Yes - some of the time	2	
			Not very often	1	
			No - never	0	
CLIENT_EPDS_1_ANXIOUS_WORRIED	intakeanxious	I have been anxious or worried for no good reason.	Yes - very often	3	intakeanxiousn
			Yes - sometimes	2	
			Hardly ever	1	
			No - not at all	0	
CLIENT_EPDS_1_SCARED_PANICKY	intakefeltscared	I have felt scared or panicky for no very good reason.	Yes - quite a lot	3	intakefeltscaredn
			Yes - sometimes	2	
			No - not much	1	
			No - not at all	0	
CLIENT_EPDS_1_THINGS_GETTING_ON_TOP	intakeontop	Things have been getting on top of me.	No - I have been coping as well as ever	0	intakeontopn
			No - most of the time I have coped quite well	1	
			Yes - sometimes I haven't been coping as well as usual	2	
			Yes - most of the time I haven't been able to cope at all	3	
CLIENT_EPDS_1_DIFFICULTY_SLEEPING	intakesleeping	I have been so unhappy that I have had difficulty sleeping.	Yes - most of the time	3	intakesleepingn
			Yes - sometimes	2	
			Not very often	1	
			No - not at all	0	

CLIENT_EPDS_1_SAD_MISERABLE	intakefeltsad	I have felt sad or miserable	Yes - most of the time Yes - quite often Not very often No - not at all	3 2 1 0	intakefeltsadn
CLIENT_EPDS_1_BEEN_CRYING	intakecry	I have been so unhappy that I have been crying.	No - never Only occasionally Yes - quite often Yes - most of the time	0 1 2 3	intakecryn
CLIENT_EPDS_1_HARMING_SELF	intakesi	The thought of harming myself has occurred to me	Never Hardly ever Sometimes Yes - quite often	0 1 2 3	intakesin
CLIENT_EPS_TOTAL_SCORE	intakeepdsscore	N/A	Numeric	N/A	N/A
CLIENT_EPDS_1_ABLE_TO_LAUGH	eoplaugh	I have been able to laugh and see the funny side of things.	As much as I always could Not quite so much now Definitely not so much now Not at all	0 1 2 3	eoplaughn
CLIENT_EPDS_1_ENJOY_THINGS	eopenjoyment	I have looked forward with enjoyment to things.	As much as I ever did Rather less than I used to Definitely less than I used to Hardly at all	0 1 2 3	eopenjoymentn
CLIENT_EPDS_1_BLAME_SELF	eopblamedself	I have blamed myself unnecessarily when things went wrong.	Yes - most of the time Yes - some of the time Not very often No - never	3 2 1 0	eopblamedselfn
CLIENT_EPDS_1_ANXIOUS_WORRIED	eopanxious	I have been anxious or worried for no good reason.	Yes - very often Yes - sometimes Hardly ever No - not at all	3 2 1 0	eopanxiousn

CLIENT_EPDS_1_SCARED_PANICKY	eopfeltscared	I have felt scared or panicky for no very good reason.	Yes - quite a lot	3	eopfeltscaredn
			Yes - sometimes	2	
			No - not much	1	
			No - not at all	0	
CLIENT_EPDS_1_THINGS_GETTING_ON_TOP	eopontop	Things have been getting on top of me.	No - I have been coping as well as ever	0	eopontopn
			No - most of the time I have coped quite well	1	
			Yes - sometimes I haven't been coping as well as usual	2	
			Yes - most of the time I haven't been able to cope at all	3	
CLIENT_EPDS_1_DIFFICULTY_SLEEPING	eopsleeping	I have been so unhappy that I have had difficulty sleeping.	Yes - most of the time	3	eopsleepingn
			Yes - sometimes	2	
			Not very often	1	
			No - not at all	0	
CLIENT_EPDS_1_SAD_MISERABLE	eopfeltsad	I have felt sad or miserable	Yes - most of the time	3	eopfeltsadn
			Yes - quite often	2	
			Not very often	1	
			No - not at all	0	
CLIENT_EPDS_1_BEEN_CRYING	eopcry	I have been so unhappy that I have been crying.	No - never	0	eopcryn
			Only occasionally	1	
			Yes - quite often	2	
			Yes - most of the time	3	
CLIENT_EPDS_1_HARMING_SELF	eopsi	The thought of harming myself has occurred to me	Never	0	eopsin
			Hardly ever	1	
			Sometimes	2	
			Yes - quite often	3	
CLIENT_EPS_TOTAL_SCORE	eopepdsscore	N/A	Numeric	N/A	N/A
CLIENT_EPDS_1_ABLE_TO_LAUGH	infancylaugh	I have been able to laugh and see the funny side of things.	As much as I always could	0	infancylaughn
			Not quite so much now	1	
			Definitely not so much now	2	
			Not at all	3	

CLIENT_EPDS_1_ENJOY_THINGS	infancyenjoyment	I have looked forward with enjoyment to things.	As much as I ever did	0	infancyenjoymentn
			Rather less than I used to	1	
			Definitely less than I used to	2	
			Hardly at all	3	
CLIENT_EPDS_1_BLAME_SELF	infancyblamedself	I have blamed myself unnecessarily when things went wrong.	Yes - most of the time	3	infancyblamedselfn
			Yes - some of the time	2	
			Not very often	1	
			No - never	0	
CLIENT_EPDS_1_ANXIOUS_WORRIED	infancyanxious	I have been anxious or worried for no good reason.	Yes - very often	3	infancyanxiousn
			Yes - sometimes	2	
			Hardly ever	1	
			No - not at all	0	
CLIENT_EPDS_1_SCARED_PANICKY	infancyfeltscared	I have felt scared or panicky for no very good reason.	Yes - quite a lot	3	infancyfeltscaredn
			Yes - sometimes	2	
			No - not much	1	
			No - not at all	0	
CLIENT_EPDS_1_THINGS_GETTING_ON_TOP	infancyontop	Things have been getting on top of me.	No - I have been coping as well as ever	0	infancyontopn
			No - most of the time I have coped quite well	1	
			Yes - sometimes I haven't been coping as well as usual	2	
			Yes - most of the time I haven't been able to cope at all	3	
CLIENT_EPDS_1_DIFFICULTY_SLEEPING	infancysleeping	I have been so unhappy that I have had difficulty sleeping.	Yes - most of the time	3	infancysleepingn
			Yes - sometimes	2	
			Not very often	1	
			No - not at all	0	
CLIENT_EPDS_1_SAD_MISERABLE	infancyfeltsad	I have felt sad or miserable	Yes - most of the time	3	infancyfeltsadn
			Yes - quite often	2	
			Not very often	1	
			No - not at all	0	

CLIENT_EPDS_1_BEEN_CRYING	infancycry	I have been so unhappy that I have been crying.	No - never Only occasionally Yes - quite often Yes - most of the time	0 1 2 3	infancycryn
CLIENT_EPDS_1_HARMING_SELF	infancysi	The thought of harming myself has occurred to me	Never Hardly ever Sometimes Yes - quite often	0 1 2 3	infancysin
CLIENT_EPS_TOTAL_SCORE	infancyepdsscore	N/A	Numeric	N/A	N/A
***	***	# of days enrolled in the program prior to discharge. <365 DELETE	Date	Number	enrolltime
***	***	sum score of Pearlin Mastery Scale	Numeric	N/A	pmscore
***	***	sum score for EPDS at Intake	Numeric	N/A	epdst1
***	***	sum score for EPDS at 36w	Numeric	N/A	epdst2
***	***	sum score for EPDS at 12m	Numeric	N/A	epdst3
***	***	cigarettes smoked in the previous 48 hours greater than 0 for a positive smoking status	intakerecentcig>0 intakerecentcig=0	1 0	ssT1
***	***	cigarettes smoked in the previous 48 hours greater than 0 for a positive smoking status	eoprecentcig>0 eoprecentcig=0	1 0	ssT2
***	***	cigarettes smoked in the previous 48 hours greater than 0 for a positive smoking status	infancyrecentcig>0 infancyrecentcig=0	1 0	ssT3

***	***	pathways based on patterns of smoking status	ssT1=1 and ssT2=1 and ssT3=1	1	smokingpathway
			ssT1=1 and ssT2=1 and ssT3=0	2	
			ssT1=1 and ssT2=0 and ssT3=1	3	
			ssT1=1 and ssT2=0 and ssT3=0	4	
			ssT1=0 and ssT2=1 and ssT3=1	5	
			ssT1=0 and ssT2=1 and ssT3=0	6	
			ssT1=0 and ssT2=0 and ssT3=1	7	
			ssT1=0 and ssT2=0 and ssT3=0	8	
***	***	smoking relapse during pregnancy	smokingpathway=1	0	relapsepreg
			smokingpathway=2	0	
			smokingpathway=3	0	
			smokingpathway=4	0	
			smokingpathway=5	1	
			smokingpathway=6	1	
			smokingpathway=7	0	
			smokingpathway=8	0	
***	***	smoking relapse during infancy	smokingpathway=1	0	relapseinfancy
			smokingpathway=2	0	
			smokingpathway=3	1	
			smokingpathway=4	0	
			smokingpathway=5	0	
			smokingpathway=6	0	
			smokingpathway=7	1	
			smokingpathway=8	0	
***	***	pathways at the end of pregnancy, based on patterns of smoking status	ssT1=1 and ssT2=1	1	eopsmokepath
			ssT1=1 and ssT2=0	2	
			ssT1=0 and ssT2=1	3	
			ssT1=0 and ssT2=0	4	

***	***	cut-off score of 10 or higher for possible depression	epdst1>=10 epdst1<10	1 0	possdepressionT1
***	***	cut-off score of 10 or higher for possible depression	epdst2>=10 epdst2<10	1 0	possdepressionT2
***	***	cut-off score of 10 or higher for possible depression	epdst3>=10 epdst3<10	1 0	possdepressionT3
*****	*****	pathways based on patterns of possible depression	possdepressionT1=1 and possdepressionT2=1 and possdepressionT3=1 possdepressionT1=1 and possdepressionT2=1 and possdepressionT3=0 possdepressionT1=1 and possdepressionT2=0 and possdepressionT3=1 possdepressionT1=1 and possdepressionT2=0 and possdepressionT3=0 possdepressionT1=0 and possdepressionT2=1 and possdepressionT3=1 possdepressionT1=0 and possdepressionT2=1 and possdepressionT3=0 possdepressionT1=0 and possdepressionT2=0 and possdepressionT3=1 possdepressionT1=0 and possdepressionT2=0 and possdepressionT3=0	1 2 3 4 5 6 7 8	depressionpathway

*******	*******	pathways at the end of pregnancy, based on patterns of possible depression	possdepressionT1=1 and possdepressionT2=1	1	eopdeppath
			possdepressionT1=1 and possdepressionT2=0	2	
			possdepressionT1=0 and possdepressionT2=1	3	
			possdepressionT1=0 and possdepressionT2=0	4	
***	***	Pearlin mastery score indicating high or low levels of self-mastery	pmscore <=21	0	mastery
			pmscore >21	1	
			pmscore missing	.	

APPENDIX E. CHAPTER THREE TABLES AND FIGURES

Table E1.

Smoking and Probable Depression Pattern Descriptions

Pattern Label	*Smoking Pattern Descriptions*
1	Continued smoking
2	Post-delivery cessation
3	Variable cessation and relapse
4	Pregnancy quitter
5	Pregnancy relapse
6	Variable relapse and cessation
7	Post-delivery relapse
8	Continued cessation

Pattern Label	*Probable Depression Pattern Descriptions*
1	Persistent probable depression
2	Pregnancy-only probable depression
3	Variable probable depression during pregnancy and post-delivery
4	Remission of probable depression by end of pregnancy
5	Probable depression beginning at end of pregnancy
6	Variable probable depression during pregnancy
7	Post-delivery probable depression
8	No probable depression

Table E2.

Sample Characteristics (N = 1,554)

Variable		M ± *SD*	*N*	%
Age in years		22.44 ± 4.67	1,550	
Ethnicity				
	Not Hispanic or Latina		1,164	77.60%
	Hispanic or Latina		313	20.87%
	Declined to self-identify		23	1.53%
Race				
	Caucasian		960	64.21%
	African American		290	19.40%
	Other*		245	16.39%
Marital Status				
	Single		1.339	86.39%
	Married		155	10.00%
	Separated, Divorced, Widowed		56	3.61%
Living Situation				
	Live alone (or with infant/child)		109	7.03%
	Lives with others		1,408	90.84%
	Other**		33	2.13%
High School Education				
	Completed High School		878	56.65%
	Completed GED or vocational training		156	10.06%
	Did not Complete High School		516	33.29%
Post-Secondary Education				
	Some college-no degree		326	26.83%
	Vocational training after High School		167	13.74%
	Undergraduate degree		101	8.31%
	Graduate/Professional degree		7	0.58%
Yearly Household*** Income				
	Less than $16,000		667	65.91%
	$16,001 - $30,000		135	13.34%
	Over $30,000		16	1.58%
	Client is dependent on parent/guardian		194	19.17%
Cigarette use during pregnancy, even prior to finding out				
	Yes		1,306	84.31%
	No		243	15.69%

*Notes: *Other= American Indiana or Alaska Native, Asian, Native Hawaiian or Pacific Islander, more than one race, or declined to self-identify; **Other=living in group shelter/home, confined to an institutional facility, or homeless; ***household defined as mom and baby*

Table E3.

Smoking and Depression Screen Characteristics (N = 1,554)

Variable	M $\pm$ *SD*	*N*	%
Smoking point-prevalence			
Intake		468	30.12%
End of pregnancy		379	24.39%
12 Months post-delivery		786	50.58%
Mean cigarettes smoked in the previous 48 hours			
Intake	2.65 $\pm$ 6.94	1,550	
End of pregnancy	2.10 $\pm$ 5.42	1,550	
12 Months Post-Delivery	5.74 $\pm$ 8.89	1,550	
Smoking relapse rates			
Intake to end of pregnancy		38	2.45%
End of pregnancy to 12 months post-delivery		433	27.86%
Probable depression point-prevalence			
Intake		471	30.31%
End of pregnancy		318	20.46%
12 Months post-delivery		281	18.08%
Mean EPDS scores			
Intake	7.51 $\pm$ 5.10	1,550	
End of pregnancy	5.88 $\pm$ 4.76	1,550	
12 Months post-delivery	5.47 $\pm$ 5.10	1,550	

Notes: Outliers removed for means calculation (n = 4); EPDS = Edinburgh Postnatal Depression Scale; Probable depression = positive depression screen (EPDS $\geq$ 10)

APPENDIX F. CHAPTER FOUR TABLES AND FIGURES

Table F1.

Covariates and Sample Size Used in Unadjusted Logistic Regression Models

Covariate at Intake	Response Option(s)	Number of complete cases (*N*) used for logistic modeling (unadjusted models)*	
		End of pregnancy	12 months post-delivery
Age	Age in number of years	59,115	45,627
Race		55,651	43,171
	Caucasian		
	African-American		
	Other**/Declined to Self-Identify		
Marital Status		58,330	44,341
	Single		
	Married		
	Separated, Divorced, Widowed		
Completion of high school education		58,317	44,343
	Yes-H.S. Diploma		
	Yes- GED/Certification program		
	No		
Post-secondary education		42,630	33,060
	Some college-no degree		
	Vocational training after High School		
	Undergraduate degree		
	Graduate/Professional degree		
Income		30,973	23,671
	Less than or equal to $16,000		
	$16,001 - $30,000		
	Over $30,000		
	Client is dependent on parent/guardian		
Cigarette use in the 3 months prior to pregnancy		44,456	34,217
	Yes		
	No		
Smoking status at intake		57,008	43,244
	Smoker		
	Non-smoker		
Probable depression		20,309	15,923
	Yes (EPDS $\geq$ 10)		
	No (EPDS < 10)		
Level of self-mastery		57,196	43,776
	High self-mastery (PMS > 21)		
	Low self-mastery (PMS $\leq$ 21)		

*Notes: EPDS=Edinburgh Postnatal Depression Scale; PMS = Pearlin Mastery Scale; HS = High school; GED=General Education Development; *sample sizes differ for end of pregnancy and 12 months post-delivery due to missing outcome variable data;**other = American Indiana or Alaska Native, Asian, Native Hawaiian or Pacific Islander, more than one race.*

Table F2.

Intercorrelations for Covariates Included in Final Predictive Models

End of Pregnancy and Baseline Predictor Variables

Covariate	1	2	3	4
1. Completion of High School	--	--	--	--
2. Cigarette use during pregnancy, even prior to finding out	0.05**	--	--	--
3. Number of cigarettes smoked in the previous 48 hours at intake	0.04**	0.56**	--	--
4. EPDS score at intake	-0.03**	0.14**	0.09**	--
5. Pearlin Mastery Scale score	0.16**	-0.01*	-0.02**	-0.33**

12 months post-delivery and Baseline Predictor Variables

Covariate	1	2	3	4	5	6	7
1. Completion of High School	--	--	--	--	--	--	--
2. Cigarette use during pregnancy, even prior to finding out	0.05**	--	--	--	--	--	--
3. Number of cigarettes smoked in the previous 48 hours at intake	0.04**	0.56**	--	--	--	--	--
4. EPDS score at intake	-0.03**	0.14**	0.09**	--	--	--	--
5. Pearlin Mastery Scale score	0.16**	-0.01*	-0.02**	-0.33**	--	--	--
6. Post-secondary education	0.36**	-0.04**	-0.04**	-0.02**	0.12**	--	--
7. Race	-0.03**	-0.14**	-0.13**	-0.00**	-0.02**	0.02**	--
8. Marital status	-0.21**	-0.07**	-0.03**	-0.07**	-0.02**	0.22**	-0.02**

*Note: Test=Spearman's rank correlation; EPDS=Edinburgh Postnatal Depression Scale; Smoking status coded as 1 = smoker, 0= non-smoker; Completion of High School coded as 1 = yes, 0 = no; Cigarette use during pregnancy, even prior to finding out coded as 1 = yes, 0 = no. *p<.01. **p<.0001.*

Table F3.

Total Sample Characteristics. (Total sample N=71,944)

Variable		M ± SD	N	%
Age in years		21.60 ± 4.94	71,944	
Ethnicity [a]			69,265	
	Not Hispanic or Latina		44,753	64.61%
	Hispanic or Latina		23,179	33.46%
	Declined to self-identify		1,333	1.92%
Race [b]			67,268	
	Caucasian		32,891	48.90%
	African American		19,715	29.31%
	Other/Declined to Self-Identify*		14,662	21.80%
Marital Status [c]			68,563	
	Single		56,324	82.15%
	Married		10,667	15.56%
	Separated, Divorced, Widowed		1,572	2.29%
High School Education [d]			68,570	
	Yes-H.S. Diploma		37,409	54.56%
	Yes- GED/Certification program		3,568	5.20%
	No		27,593	40.24%
Post-Secondary Education [e]			24,106	
	Some college-no degree		12,923	53.61%
	Vocational training after High School		5,487	22.76%
	Undergraduate degree		5,034	20.88%
	Graduate/Professional degree		662	2.75%
Yearly Household** Income [f]			36,714	
	Less than or equal to $16,000		21,148	57.60%
	$16,001 - $30,000		5,068	13.80%
	Over $30,000		1,039	2.83%
	Client is dependent on parent/guardian		9,459	25.76%
Cigarette use within the 3 months prior to pregnancy [g]			52,353	
	Yes		13,036	24.90%
	No		39,317	75.10%
Pearlin Mastery Scale score [h]		22.41 ± 3.32	67,412	
High self-mastery (>21)			37,813	56.09%
Low self-mastery (≤ 21)			29,599	43.91%
EPDS score: intake [i]		6.51 ± 4.97	23,435	
Probable depression (EPDS ≥ 10)			5,737	24.48%
No probable depression (EPDS < 10)			17,698	75.52%

*Notes: Missing data: [a] n=2,679; [b] n=4,676; [c] n=3,381; [d] n=3,374; [e] n=21,858; [f] n=35,230; [g] n=19,591; [h] n=4,532; [i] n=48,529; *Other race= American Indiana or Alaska Native, Asian, Native Hawaiian or Pacific Islander, more than one race, or declined to self-identify; ** household defined as mom and baby; EPDS=Edinburgh Postnatal Depression Scale*

Table F4.

End of Pregnancy Modeling

Covariate	Unadjusted OR					Adjusted OR				
	B	SE	OR	95% CI	p	B	SE	OR	95% CI	p
Completion of High School*										
Did not complete H.S. (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
H.S. Diploma	-0.128	0.034	0.88	[0.82, 0.94]	0.0002	-0.060	0.094	0.94	[0.68, 0.97]	0.5228
GED/Certification program	1.068	0.054	2.91	[2.62, 3.23]	<.0001					
Cigarette use in the 3 months prior to pregnancy										
No (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
Yes	5.031	0.110	153.15	[123.44, 190.01]	<.0001	3.378	0.208	29.32	[19.50, 44.08]	<.0001
Smoking Status at Intake										
Non-Smoker (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
Smoker	5.454	0.053	233.58	[210.71, 258.93]	<.0001	3.902	0.098	49.49	[40.83, 59.98]	<.0001
Depression Screening										
EPDS < 10 (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
EPDS $\geq$ 10	0.503	0.060	1.65	[1.47, 1.86]	<.0001	-0.026	0.010	0.98	[0.80, 1.19]	0.7978
Self-mastery										
Low self-mastery (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
High self-mastery	-0.086	0.032	0.92	[0.86, 0.98]	0.0077	-0.144	0.095	0.87	[0.72, 1.04]	0.1308
Marital status**										
Single (reference category)	-	-	1.0	-	-	-	-	-	-	-
Married	-0.635	0.050	0.53	[0.48, 0.59]	<.0001	-	-	-	-	-
Separated/ Divorced/ Widowed	0.773	0.078	2.17	[1.86, 2.53]	<.0001	-	-	-	-	-
Post-secondary education**						-	-	-	-	-
No post-secondary education (reference category)	-	-	1.0	-	-	-	-	-	-	-
Some college, no degree	-0.219	0.045	0.80	[0.74, 0.88]	<.0001	-	-	-	-	-
Vocational certificate	0.130	0.057	1.14	[1.02, 1.27]	0.0242	-	-	-	-	-
Undergraduate degree	-0.829	0.084	0.44	[0.37, 0.51]	<.0001	-	-	-	-	-
Graduate/Professional degree	-1.780	0.657	0.17	[0.08. 0.34]	<.0001	-	-	-	-	-
Race**						-	-	-	-	-
Caucasian (reference category)	-	-	1.0	-	-	-	-	-	-	-
African-American	-1.190	0.046	0.30	[0.28, 0.33]	<.0001	-	-	-	-	-
Other/Declined to self-identify	-0.808	0.046	0.45	[0.41, 0.49]	<.0001	-	-	-	-	-
Income**										
<$16,000 (reference category)	-	-	1.0	-	-	-	-	-	-	-
$16,001-$30,000	-0.493	0.073	0.61	[0.53, 0.70]	<.0001	-	-	-	-	-
Over $30,000	-0.413	0.147	0.66	[0.50, 0.88]	0.0049	-	-	-	-	-
Dependent on Parent/Guardian	-0.685	0.061	0.50	[0.45, 0.57]	<.0001	-	-	-	-	-
Age**	0.037	0.003	1.04	[1.03, 1.04]	<.0001	-	-	-	-	-

*Notes. OR= odds ratio; CI = confidence interval; *CLASS levels were combined to prevent quasi-complete separation of data points in the final model (0=No high school education, 1=Diploma/GED/Certification program); **Not included in the final multiple logistic regression modeling*

Table F5.

12 Month Post-Delivery Modeling

Covariate	Unadjusted OR					Adjusted OR				
	B	SE	OR	95% CI	p	B	SE	OR	95% CI	p
Completion of High School*										
Did not complete H.S. (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
H.S. Diploma	-0.166	0.028	0.85	[0.80, 0.90]	<.0001	-0.210	0.115	0.81	[0.65, 1.02]	0.0686
GED/Certification program	0.967	0.050	2.63	[2.39, 2.90]	<.0001					
Cigarette use in the 3 months prior to pregnancy										
No (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
Yes	3.936	0.048	51.22	[46.65, 56.25]	<.0001	3.405	0.097	30.11	[24.92, 36.39]	<.0001
Smoking Status at Intake										
Non-smoker (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
Smoker	4.076	0.049	58.89	[53.56, 64.77]	<.0001	2.323	0.108	10.21	[8.27, 12.61]	<.0001
Depression Screening										
EPDS < 10 (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
EPDS ≥ 10	0.560	0.050	1.75	[1.59, 1.93]	<.0001	0.235	0.088	1.27	[1.07, 1.50]	0.0075
Self-mastery										
Low self-mastery	-	-	1.0	-	-	-	-	1.0	-	-
High self-mastery	-0.061	0.027	0.94	[0.89, 0.99]	0.0232	-0.076	0.082	0.93	[0.79, 1.09]	0.3545
Marital status										
Single (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
Married	-0.801	0.045	0.45	[0.41, 0.49]	<.0001	-0.326	0.122	0.75	[0.57, 0.92]	0.0076
Separated/ Divorced/ Widowed	0.529	0.073	1.70	[1.47, 1.96]	<.0001	0.178	0.206	1.20	[0.80, 1.79]	0.3865
Post-secondary education								-	-	-
No post-secondary education (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
Some college, no degree	-0.235	0.038	0.79	[0.74, 0.85]	<.0001	-0.244	0.097	0.78	[0.65, 0.95]	0.0120
Vocational certificate	0.114	0.048	1.12	[1.02, 1.23]	0.0163	0.064	0.123	1.07	[0.84, 1.36]	0.6022
Undergraduate degree	-0.820	0.065	0.44	[0.39, 0.50]	<.0001	-0.614	0.156	0.54	[0.40, 0.74]	<.0001
Graduate/Professional degree	-1.536	0.235	0.22	[0.14, 0.34]	<.0001	-0.491	0.496	0.61	[0.23, 1.62]	0.3223
Race								-	-	-
Caucasian (reference category)	-	-	1.0	-	-	-	-	1.0	-	-
African-American	-0.675	0.034	0.51	[0.48, 0.54]	<.0001	0.250	0.096	1.28	[1.06, 1.55]	0.0092
Other/Declined to self-identify	-0.706	0.038	0.49	[0.46, 0.53]	<.0001	-0.069	0.110	0.93	[0.75, 1.16]	0.5298
Income**										
<$16,000 (reference category)	-	-	1.0	-	-	-	-	-	-	-
$16,001-$30,000	-0.425	0.059	0.65	[0.58, 0.73]	<.0001	-	-	-	-	-
Over $30,000	-0.542	0.126	0.58	[0.45. 0.75]	<.0001	-	-	-	-	-
Dependent on Parent/Guardian	-0.431	0.049	0.65	[0.59, 0.72]	<.0001	-	-	-	-	-
Age**	0.006	0.003	1.01	[1.00,1.01]	0.0106	-	-	-	-	-

*Notes. OR= odds ratio; CI = confidence interval; *CLASS levels were combined to prevent quasi-complete separation of data points in the final model (0=No high school education, 1=Diploma/GED/Certification program); **Not included in the final multiple logistic regression modeling*

Figure F1. Predicted Probability Equation

$$P(Y=1) = \frac{e^{\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k}}{1 + e^{\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k}}$$

Note. where, P(Y=1) is the predicted probability of smoking, e is the natural logarithm, α and β_i are the model parameters, X_i is the covariate, and k is the number of covariates for the model (e.g. 6 for end of pregnancy and 8 for 12 months infancy)

REFERENCES

1. U.S. Department of Health and Human Services [USDHHS] (2014). *The Health Consequences of Smoking: 50 Years of Progress: A Report of the Surgeon General.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. Retrieved from: https://www.surgeongeneral.gov/library/reports/50-years-of-progress/full-report.pdf
2. Centers for Disease Control and Prevention [CDC]. (2004, October 8). *Smoking during Pregnancy --- United States, 1990--2002*. Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5339a1.htm.
3. Centers for Disease Control and Prevention [CDC]. (29 September, 2017). *Tobacco use during pregnancy*. Retrieved from https://www.cdc.gov/reproductivehealth/maternalinfanthealth/tobaccousepregnancy/index.htm
4. Office of Disease Prevention and Health Promotion [ODPHP] (2014). *2020 Topics and objectives: Maternal, infant, and child health.* Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives
5. Gyllstrom, M., Hellerstedt, W., & Hennrikus, D. (2012). The association of maternal mental health with prenatal smoking cessation and postpartum relapse in a population-based sample. *Maternal & Child Health Journal, 16*(3), 685-693. doi:10.1007/s10995-011-0764-2
6. Yasuda, T., Ojima, T., Nakamura, M., Nagai, A., Tanaka, T., Kondo, N., . . . Yamagata, Z. (2013). Postpartum smoking relapse among women who quit during pregnancy: Cross-sectional study in Japan. *Journal of Obstetrics & Gynaecology Research, 39*(11), 1505-1512. doi:10.1111/jog.12098
7. Rockhill, K.M., Tong, V.T., Farr, S.L., Robbins, C.L., D'Angelo, D.V., & England, L.J. (2016). Postpartum smoking relapse after quitting during pregnancy: Pregnancy Risk Assessment Monitoring System, 2000-2011. *Journal of Women's Health, 25*(5), 480-488.
8. Gadomski, A., Adams, L., Tallman, N., Krupa, N., & Jenkins, P. (2011). Effectiveness of a combined prenatal and postpartum smoking cessation program. *Maternal & Child Health Journal, 15*(2), 188-197 110p.
9. Hennrikus, D., Pirie, P., Hellerstedt, W., Lando, H. A., Steele, J., & Dunn, C. (2010). Increasing support for smoking cessation during pregnancy and postpartum: Results of a randomized controlled pilot study. *Preventive Medicine, 50*(3), 134-137
10. Jiménez-Muro, A., Nerín, I., Samper, P., Marqueta, A., Beamonte, A., Gargallo, P., . . . Rodríguez, G. (2013). A proactive smoking cessation intervention in postpartum women. *Midwifery, 29*(3), 240-245.
11. Reitzel, L. R., Vidrine, J. I., Businelle, M. S., Kendzor, D. E., Costello, T. J., Li, Y., . . . Wetter, D. W. (2010). Preventing postpartum smoking relapse among diverse low-income women: A randomized clinical trial. *Nicotine & Tobacco Research, 12*(4), 326-335.

12. Chamberlain, C., O'Mara-Eves, A., Porter, J., Coleman, T., Perlen, S.M., Thomas, J., & McKenzie, J.E. (2017). Psychosocial interventions for supporting women to stop smoking in pregnancy. *Cochrane Database of Systematic Reviews, 2,* DOI: 10.1002/14651858.CD001055.pub5
13. Brown-Johnson, C.G., England, L.J., Glantz, S.A., & Ling, P.M. (2014). Tobacco industry marketing to low socioeconomic status women in the U.S.A. *Tobacco Control, 23*(e2), 139-146.
14. Curtin, S.C., & Mathews, T.J. (2016). Smoking prevalence and cessation before and during pregnancy: Data from the birth certificate, 2014. *National Vital Statistics Report, 65*(1), 1-14. Retrieved from https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65_01.pdf
15. Lipari, R.N. & Van Horn, S.L. (30 March, 2017). Smoking and mental illness among adults in the United States. *The CBHSQ Report: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration*: Rockville, MD.
16. Centers for Disease Control and Prevention [CDC] (8 February, 2013). Current cigarette smoking among adults aged $\geq$ 18 years with mental illness-United States, 2009-2011. *Morbidity and Mortality Weekly Report, 62*(5), 81-87
17. National Institute of Mental Health [NIMH] (November, 2017). *Major depression.* Retrieved from https://www.nimh.nih.gov/health/statistics/major-depression.shtml#part_155029
18. Mendelsohn, C. (2012). Smoking and depression: A review. *Australian Family Physician, 41*(5), 304-307.
19. Caputo, R.K. (2003). The effects of socioeconomic status, perceived discrimination and mastery on health status in a youth cohort. *Social Work in Health Care, 37*(2), 17-42.
20. Pearlin L.I., Menaghan E.G., Lieberman M.A., Mullan J.T. (1981). The stress process. *Journal of Health and Social Behavior, 22(*4), 337-356.
21. Bonfils, K.A., Firmin, R.L., Salyers, M., & Wright, E.R. (2015). Sexuality and intimacy among people living with serious mental illness: Factors contributing to sexual activity. *Psychiatric Rehabilitation Journal, 38*(3), 249-255.
22. Carlson, M.B., Britt, S.L., & Goff, B.N. (2015). Factors associated with a composite measure of financial behavior among soldiers. *Journal of Financial Counseling and Planning, 26*(1), 30-42.
23. Raaijmakers, L.G.M., Martens, M.K., Hesselink, A.E., de Weerdt, I., de Vries, N.K., & Kremers, S.P.J. (2014). Mastery and perceived autonomy support are correlates of Dutch diabetes patients' self-management and quality of life. *Patient Education and Counseling, 97,* 75-81.
24. Kendler, K.S., & Myers, J. (2015). Addiction resistance: Definition, validation, and association with mastery. *Drug and Alcohol Dependence, 154*, 236-242.
25. de Waal, M.W.M., Hegeman, J.M., Gussekloo, J., Verhaak, P.F.M., van der Mast, R.C., & Comijs, H.C. (2016). The effect of pain on presence and severity if depressive disorders in older persons: the role of perceived control as mediator. *Journal of Affective Disorders, 197,* 239-244.

26. Marshall, G.N., & Lang, E.L. (1990). Optimism, self-mastery, and symptoms of depression in women professionals. *Journal of Personality and Social Psychology, 59*(1), 132-139.
27. Gallagher, M.W., Schoemann, A.M., & Pressman, S.D. (2011). Mastery beliefs and intraindividual variability of anxiety. *Cognitive Therapy Research,* 35, 227-231.
28. Mengesha, Z.B., Worku, A.G., & Feleke, S.A. (2015). Contraceptive adoption in the extended postpartum period is low in Northwest Ethiopia. *BMC Pregnancy and Childbirth, 15*:160 doi: 10.1186/s12884-015-0598-9.
29. Levis, D.M., Stone-Wiggins, B., O'Hegarty, M., Tong, V.T., Polen, K.N.D., Cassell, C.H….Council, M. (2014). Women's perspectives on smoking and pregnancy and graphic warning labels. *American Journal of Health Behavior, 38*(5), 755-764. doi:10.5993/AJHB.38.5.13.
30. Marks D.F., Murray M., Evans B., Estacio E.V. (2015) *Health psychology: Theory, research and practice.* (4th ed.). Thousand Oaks, CA: SAGE Publications Inc.
31. U.S. Department of Health, Education, and Welfare. (1964). *Smoking and health: Report of the advisory committee to the Surgeon General of the Public Health Service* (PHS Publication No. 1103). Washington, D.C.: Government Printing Office. Retrieved from https://profiles.nlm.nih.gov/ps/access/NNBBMQ.pdf
32. O'Connell, K. A. (2009). Theories used in nursing research on smoking cessation. *Annual Review of Nursing Research, 27,* 33-62. doi:10.1891/0739-6686.27.33
33. Fishbein, M., & Azjen, I. (1974). Attitudes towards objects as predictors of single and multiple behavioral criteria. *Psychological Review, 81*(1), 59-74.
34. Azjen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.
35. Montaño, D.E., Kasprzyk, D. (2015). Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. In K. Glanz, B.K. Rimer, & K. Viswanath, (Eds.). *Health behavior: Theory, research, and practice (5th ed).* San Francisco, CA: John Wiley & Sons, Inc., 95-124.
36. Simmons, V. N., Sutton, S. K., Quinn, G. P., Meade, C. D., & Brandon, T. H. (2014). Prepartum and postpartum predictors of smoking. *Nicotine & Tobacco Research, 16*(4), 461-468
37. Correa, J., Simmons, V., Sutton, S., Meltzer, L., & Brandon, T. (2015). A Content analysis of attributions for resuming smoking or maintaining abstinence in the post-partum period. *Maternal & Child Health Journal, 19*(3), 664-674
38. Polanska, K., Hanke, W., Sobala, W., Lowe, J., & Jaakkola, J. (2011). Predictors of smoking relapse after delivery: Prospective study in Central Poland. *Maternal & Child Health Journal, 15*(5), 579-586.
39. Holtrop, J. S., Meghea, C., Raffo, J. E., Biery, L., Chartkoff, S. B., & Roman, L. (2010). Smoking among pregnant women with Medicaid insurance: are mental health factors related? *Maternal & Child Health Journal, 14*(6), 971-977. doi: 10.1007/s10995-009-0530-x
40. Merzel, C., English, K., & Moon-Howard, J. (2010). Identifying women at-risk for smoking resumption after pregnancy. *Maternal & Child Health Journal, 14*(4), 600-611. doi: 10.1007/s10995-009-0502-1

41. Heppner, W. L., Ji, L., Lorraine, R. R., Castro, Y., Correa-Fernandez, V., Vidrine, J. I., . . . Wetter, D. W. (2011). The Role of Prepartum Motivation in the Maintenance of Postpartum Smoking Abstinence. *Health Psychology*.
42. Jang, Y., Borenstein-Graves, A., Haley, W.E., Small, B.J., & Mortimer, J.A. (2003). Determinants of a sense of mastery in African American and White older adults. *Journal of Gereontology: Social Sciences, 58B*(4), S221-S224.
43. Salimi, S., Terplan, M., Cheng, D., & Chisolm, M.S. (2015). The relationship between postpartum depression and perinatal cigarette smoking: An analysis of PRAMS Data. *Journal of Substance Abuse Treatment, 56*, 34-38.
44. Tong, V.T., Farr, S.L., Bombard, J., D'Angelo, D., Ko, J.Y. & England, L. (2016). Smoking before and during pregnancy among women reporting depression or anxiety. *Obstetrics and Gynecology, 128*(3), 562-570.
45. Kolko, R.P., Emery R.L., Cheng, Y., & Levine, M.D. (2017). Do psychiatric disorders or measures of distress moderate response to postpartum relapse prevention interventions? *Nicotine & Tobacco Research, 19*(5), 615-622. https://doi.org/10.1093/ntr/ntw385
46. Nurse-Family Partnership (2011). Proven results. Retrieved from http://www.nursefamilypartnership.org/proven-results.
47. Nurse-Family Partnership (2017). *Nurse-Family Partnership Snapshot*. Retrieved from https://www.nursefamilypartnership.org/wp-content/uploads/2017/02/NFP_Snapshot_Dec2017.pdf
48. SAS Institute Inc. SAS software, Copyright © 2002-2012. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.
49. Bergink, V., Kooistra, L., Lambregtse-van den Berg, M.P., Winjnen, H., Bunevicius, R., van Baar, A....Pop, V. (2011). Validation of the Edinburgh Depression Scale during pregnancy. *Journal of Psychosomatic Research, 70*, 385-389.
50. Cox, J.L., Holden, J.M., & Sagovsky, R. (1987). Detection of postnatal depression: Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry, 150*, 782-786.
51. Pearlin, L., & Schooler, C. (1978). The structure of coping. *Journal of Health and Social Behavior, 19*, 2-21.
52. DeSocio, J., Kitzman, H., & Cole, R. (2003). Testing the relationship between self-agency and enactment of health behaviors. *Research in Nursing & Health, 26*, 20-29.
53. Centers for Disease Control and Prevention. (2016). *Smoking and tobacco use: Fast facts*. Retrieved from https://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/index.htm
54. Curtin, S.C., & Mathews, T.J. (2016). Smoking prevalence and cessation before and during pregnancy: Data from the birth certificate, 2014. *National Vital Statistics Report, 65*(1), 1-14. Retrieved from https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65_01.pdf
55. Boonn, A. (2008). Smoking and Pregnancy: The harms of continued smoking and the benefits of quitting. Campaign for Tobacco-Free Kids. Retrieved from https://www.tobaccofreekids.org/research/factsheets/pdf/0288.pdf

56. Chamberlain, C., O'Mara-Eves, A., Oliver, S., Caird, J., Perlen, S., Eades, S., & Thomas, J. (2013). Psychosocial interventions to help women stop smoking in pregnancy (Review). *The Cochrane Library* (10).
57. Severson, H. H., Andrews, J. A., Lichtenstein, E., Wall, M., & Zoref, L. (1995). Predictors of smoking during and after pregnancy: A survey of mothers and newborns. *Preventative Medicine, 24*, 23-28.
58. U.S. Department of Health, Education, and Welfare. (1964). *Smoking and health: Report of the advisory committee to the Surgeon General of the Public Health Service* (PHS Publication No. 1103). Washington, D.C.: Government Printing Office. Retrieved from https://profiles.nlm.nih.gov/ps/access/NNBBMQ.pdf
59. U.S Department of Health and Human Services. (1980). *The health consequences of smoking for women: A report of the Surgeon General*. Retrieved from https://profiles.nlm.nih.gov/ps/access/NNBBRT.pdf
60. University of California, San Francisco. (2016). Smoking cessation leadership center: Other vulnerable populations. Retrieved from https://smokingcessationleadership.ucsf.edu/other-vulnerable-populations
61. Office of Disease Prevention and Health Promotion. (21 July, 2017). *Disparities overview by income*. Retrieved from https://www.healthypeople.gov/2020/data/disparities/summary/Chart/5287/6.1
62. Rodgers, B. (2000). Concept analysis: An evolutionary view. In B. Rodgers & K. Knafl. (Eds.), *Concept Development in Nursing: Foundations, Techniques and Applications.* (2nd ed) Philadelphia: Saunders, 77-102.
63. Cluss, P. A., Levine, M. D., & Landsittel, D. (2011). The Pittsburgh STOP program: disseminating an evidence-informed intervention for low-income pregnant smokers. *American Journal of Health Promotion, 25*(5 Suppl), S75-81. doi: 10.4278/ajhp.100616-QUAN-197
64. Ma, Y., Goins, K. V., Pbert, L., & Ockene, J. K. (2005). Predictors of smoking cessation in pregnancy and maintenance postpartum in low-income women. *Maternal and Child Health Journal, 9*(4), 393-402.
65. Ockene, J. K., Ma, Y., Zapka, J. G., Pbert, L. A., Valentine Goins, K., & Stoddard, A. M. (2002). Spontaneous cessation of smoking and alcohol use among low-income pregnant women. *American Journal of Preventive Medicine, 23*(3), 150-159. doi: http://dx.doi.org/10.1016/S0749-3797(02)00492-0
66. Ward, K. D., Vander Weg, M. W., Sell, M. A., Scarinci, I. C., & Read, M. C. (2006). Characteristics and correlates of quitting among black and white low-income pregnant smokers. *American Journal of Health Behavior, 30*(6), 651-662.
67. Browne, A. J., Shultis, J. D., & Thio-Watts, M. (1999). Solution-focused approaches to tobacco reduction with disadvantaged prenatal clients. *Journal of Community Health Nursing, 16*(3), 165-177.
68. Hayes, C. B., Collins, C., O'Carroll, H., Wyse, E., Gunning, M., Geary, M., & Kelleher, C. C. (2013). Effectiveness of motivational interviewing in influencing smoking cessation in pregnant and postpartum disadvantaged women. *Nicotine & Tobacco Research, 15*(5), 969-977. doi: 10.1093/ntr/nts225
69. Nichter, M., Nichter, M., Adrian, S., Goldade, K., Tesler, L., & Muramoto, M. (2008). Smoking and harm-reduction efforts among postpartum women. *Qualitative Health Research, 18(*9), 1184-1194. doi: 10.1177/1049732308321738

70. Higgins, S. T., Washio, Y., Heil, S. H., Solomon, L. J., Gaalema, D. E., Higgins, T. M., & Bernstein, I. M. (2012). Financial incentives for smoking cessation among pregnant and newly postpartum women. *Preventive Medicine, 55*, Supplement, S33-S40. doi: http://dx.doi.org/10.1016/j.ypmed.2011.12.016
71. Scheibmeir, M. S., O'Connell, K. A., & Aaronson, L. S. (2005). Smoking cessation strategy use among pregnant ex-smokers. *Western Journal of Nursing Research, 27*(4), 411-427.
72. Solomon, L., Secker-Walker, R., Skelly, J., & Flynn, B. (1996). Stages of change in smoking during pregnancy in low-income women. *Journal of Behavioral Medicine, 19*(4), 333-344. doi: 10.1007/BF01904760
73. Eiden, R. D., Homish, G. G., Colder, C. R., Schuetze, P., Gray, T. R., & Huestis, M. A. (2013). Changes in smoking patterns during pregnancy. *Substance Use & Misuse, 48*(7), 513-522. doi: 10.3109/10826084.2013.787091
74. Holtrop, J. S., Meghea, C., Raffo, J. E., Biery, L., Chartkoff, S. B., & Roman, L. (2010). Smoking among pregnant women with Medicaid insurance: are mental health factors related? *Maternal and Child Health Journal, 14*(6), 971-977. doi: 10.1007/s10995-009-0530-x
75. Lundquist, R. S., Seward, G., Byatt, N., Tonelli, M. E., & Kolodziej, M. E. (2012). Using a multidisciplinary approach for pregnant women with nicotine dependence and co-occurring disorders. *Journal of Dual Diagnosis, 8*(2), 158-167. doi: 10.1080/15504263.2012.671119
76. Borland, T., Babayan, A., Irfan, S., & Schwartz, R. (2013). Exploring the adequacy of smoking cessation support for pregnant and postpartum women. *BMC Public Health, 13*(1), 1-11. doi: 10.1186/1471-2458-13-472
77. Pletsch, P. K. (2002). Reduction of primary and secondary smoke exposure for low-income black pregnant women. *The Nursing Clinics of North America, 37*, 315-329.
78. Wen, K.-Y. P., Miller, S. M. P., Lazev, A. P., Fang, Z. P., & Hernandez, E. M. D. (2012). Predictors of smoking cessation counseling adherence in a socioeconomically disadvantaged sample of pregnant women. *Journal of Health Care for the Poor and Underserved, 23*(3), 1222-1238.
79. Herbert, R. J., Gagnon, A. J., O'Loughlin, J. L., & Rennick, J. E. (2011). Testing an empowerment intervention to help parents make homes smoke-free: a randomized controlled trial. *Journal of Community Health, 36*(4), 650-657. doi: 10.1007/s10900-011-9356-8
80. Merzel, C., English, K., & Moon-Howard, J. (2010). Identifying women at-risk for smoking resumption after pregnancy. *Maternal and Child Health Journal, 14*(4), 600-611. doi: 10.1007/s10995-009-0502-1
81. Pletsch, P. K., Morgan, S., & Pieper, A. F. (2003). Context and beliefs about smoking cessation. *The American Journal of Maternal/Child Nursing, 28*(5), 320-325.
82. Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & the PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA Statement. *PLoS Med, 6*(7), e1000097. doi:10.1371/journal.pmed.1000097

83. Drake, P., Driscoll, A.K., & Mathews, T.J. (2018). *Cigarette smoking during pregnancy: United States, 2016.* NCHS Data Brief, no 305. Hyattsville, MD: National Center for Health Statistics. Retrieved from https://www.cdc.gov/nchs/data/databriefs/db305.pdf
84. Curtin, S.C., & Mathews, T.J. (2016). Smoking prevalence and cessation before and during pregnancy: Data from the birth certificate, 2014. *National Vital Statistics Report, 65*(1), 1-14. Retrieved from https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65_01.pdf
85. Centers for Disease Control and Prevention [CDC] b. (29 September, 2017). *Tobacco use during pregnancy*. Retrieved from https://www.cdc.gov/reproductivehealth/maternalinfanthealth/tobaccousepregnancy/index.htm
86. Chamberlain, C., O'Mara-Eves, A., Porter, J., Coleman, T., Perlen, S.M., Thomas, J., & McKenzie, J.E. (2017). Psychosocial interventions for supporting women to stop smoking in pregnancy. *Cochrane Database of Systematic Reviews, 2,* DOI: 10.1002/14651858.CD001055.pub5
87. U.S. Department of Health and Human Services [USDHHS] (2014). *The Health Consequences of Smoking: 50 Years of Progress: A Report of the Surgeon General.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. Retrieved from: https://www.surgeongeneral.gov/library/reports/50-years-of-progress/full-report.pdf
88. Paradis, A.D., Shenassa, E.D., Papandonatos, G.D., Rogers, M.L., & Buka, S.L. (2017). Maternal smoking during pregnancy and offspring antisocial behavior: findings from a longitudinal investigation of discordant siblings. *Journal of Epidemiology and Community Health, 71,* 889-896.
89. Biederman, J., Martleon, M., Woodworth, K.Y., Spencer, T.J., & Faraone, S.V. (2017). Is maternal smoking during pregnancy a risk factor for cigarette smoking in offspring? A longitudinal controlled study of ADHD children grown up. *Journal of Attention Disorders, 21*(12), 975-985.
90. Rockhill, K.M., Tong, V.T., Farr, S.L., Robbins, C.L., D'Angelo, D.V., & England, L.J. (2016). Postpartum smoking relapse after quitting during pregnancy: Pregnancy Risk Assessment Monitoring System, 2000-2011. *Journal of Women's Health, 25*(5), 480-488.
91. Fiore, M.C., Jaen, C.R., Baker, T.B., Bailey, W.C., Benowitz, N.L., Curry, S.J.,...Wewers, M.E. (2008). *Treating Tobacco Use and Dependence: 2008 Update.* Rockville, MD: U.S. Department of Health and Human Services. Public Health Service. Retrieved from https://bphc.hrsa.gov/buckets/treatingtobacco.pdf
92. Office on Women's Health. (12 June, 2017*). Depression during and after pregnancy.* Retrieved from https://www.womenshealth.gov/a-z-topics/depression-during-and-after-pregnancy
93. Ko, J.Y., Rockhill, K.M., Tong, V.T., Morrow, B., & Farr, S.L. (2017). Trends in Postpartum Depressive Symptoms: 27 States, 2004, 2008, and 2012. *Morbidity and Mortality Weekly Report, 66,* 153-158.

94. Venkatesh, K.K., Riley, L., Castro, V.M., Perlis, R.H., & Kaimal, A.J. (2016). Association of antenatal depression symptoms and antidepressant treatment with preterm birth. *Obstetrics & Gynecology, 127*(5), 926-933.
95. Tong, V.T., Farr, S.L., Bombard, J., D'Angelo, D., Ko, J.Y. & England, L. (2016). Smoking before and during pregnancy among women reporting depression or anxiety. *Obstetrics and Gynecology, 128*(3), 562-570. DOI: 10.1097/AOG.0000000000001595
96. Centers for Disease Control and Prevention [CDC] a. (30 August, 2017). *PRAMS*. Retrieved from https://www.cdc.gov/prams/index.htm
97. Goodwin, R.D., Cheslack-Postava, K., Nelson, D.B., Smith, P.H., Wall, M.M., Hasin, D.S...Galea, S. (2017). Smoking during pregnancy in the United States, 2005-2014: The role of depression. *Drug and Alcohol Dependence, 179*, 159-166.
98. Linares Scott, T.J., Heil, S.H., Higgins, S.T., Badger, G.J., Bernsetin, I.M. (2009). Depressive symptoms predict smoking status among pregnant women. *Addictive Behaviors, 34*, 705-708.
99. Shuang, J., Long, Q., Newport, D.J., Na, H., Knight, B., Zach, E.B.,...Stowe, Z.N. (2011). Validity of depression rating scales during pregnancy and the postpartum period: Impact of trimester and parity. *Journal of Psychiatric Research, 45(*2), 213-219.
100. Martins, C.S., Motta, J.V., Quevedo, L.A., Matos, M.B., Pinheiro, K.A., Souza, L.D.,...Coelho, F.M. (2015). Comparison of two instruments to track depression symptoms during pregnancy in a sample of pregnant teenagers in Southern Brazil. *Journal of Affective Disorders, 15*, 95-100.
101. McCall-Hosenfeld, J.S., Phiri, K., Schaefer, E., Zhu, J., & Kjerulff, K. (2016). Trajectories of depressive symptoms throughout the peri- and postpartum period: Results from the First Baby Study. *Journal of Women's Health, 25*(11), 1112-1121
102. Fredriksen, E., von Soest, T., Smith, L., & Moe, V. (2017). Patterns of pregnancy and postpartum depressive symptoms: Latent class trajectories and predictors. *Journal of Abnormal Psychology, 126*(2), 173-183
103. Mumford, E.A., Hair, E.C., Yu, T., & Liu, W. (2014). Women's longitudinal smoking patterns from preconception through child's kindergarten entry: Profiles of biological mothers of a 2001 US birth cohort. *Maternal and Child Health Journal, 18*, 810-820.
104. Munafò, M.R., Heron, J., & Araya, R. (2008). Smoking patterns during pregnancy and postnatal period and depressive symptoms. *Nicotine & Tobacco Research, 10*(11), 1609-1620.
105. Nurse-Family Partnership (2011). *Proven results*. Retrieved from http://www.nursefamilypartnership.org/proven-results.
106. Nurse-Family Partnership (2017). *Nurse-Family Partnership Snapshot*. Retrieved from https://www.nursefamilypartnership.org/wp-content/uploads/2017/02/NFP_Snapshot_Dec2017.pdf
107. Nurse-Family Partnership (2014). *Nurses and Mothers*. Retrieved from https://www.nursefamilypartnership.org/wp-content/uploads/2017/07/NFP_Nurses_Mothers.pdf

108. Zhong, Q., Gelaye, B., Rondon, M., Sanchez, S.E., Garcia, P.J. Sanchez, E.,...Williams, M.A. (2014). Comparative performance of Patient Health Questionnaire-9 and Edinburgh Postnatal Depression Scale for screening antepartum depression. *Journal of Affective Disorders, 162*: 1-7.
109. Cox, J.L., Holden, J.M., & Sagovsky, R. (1987). Detection of postnatal depression: Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry, 150*, 782-786. DOI: 10.1192/bjp.150.6.782
110. Kheirabadi, R.G., Maracy, M.R., & Nasrin Masaeli, S.A. (2012). Psychometric properties and diagnostic accuracy of the Edinburgh Postnatal Depression Scale in a sample of Iranian women. *Iranian Journal of Medical Sciences, 37*(1), 32-38.
111. Horowitz, J.A., Murphy, C.A., Gregory, K.E., & Wojcik, J. (2011). A community-based screening initiative to identify mothers at risk for postpartum depression. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, *40*(1), 52-61. doi: https://dx.doi.org/10.1111%2Fj.1552-6909.2010.01199.x
112. Bergink, V., Kooistra, L., Lambregtse-van den Berg, M.P., Wijnen, H., Bunevicius, R., van Baar, A., & Pop, V. (2011). Validation of the Edinburgh Depression Scale during pregnancy. *Journal of Psychosomatic Research, 70*, 385-389 DOI: 10.1016/j.jpsychores.2010.07.008
113. SAS Institute Inc. SAS software, Copyright © 2002-2012. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.
114. Shrive, F.M., Stuart, H., Quan, H., & Ghali, W.A. (2006). Dealing with missing data in a multi-question depression scale: a comparison of imputation methods. *BMC Medical Research Methodology, 6(*57). https://doi.org/10.1186/1471-2288-6-57
115. Salimi, S., Terplan, M., Cheng, D., & Chisolm, M.S. (2015). The relationship between postpartum depression and perinatal cigarette smoking: An analysis of PRAMS Data. *Journal of Substance Abuse Treatment, 56*, 34-38.
116. Dagher, R.K., & Shenassa, E.D. (2012). Prenatal health behaviors and postpartum depression: Is there an association? *Archives of Women's Mental Health, 15*, 31-37.
117. Denckla, C.A., Mancini, A.D., Consedine, N.S., Milanovic, S.M., Basu, A., Seedat, S...Koenen, K.C. (2017). Distinguishing postpartum and antepartum depressive trajectories in a large population based cohort: the impact of exposure to adversity and offspring gender. *Psychological Medicine, 48*, 1139-1147.
118. Holtrop, J. S., Meghea, C., Raffo, J. E., Biery, L., Chartkoff, S. B., & Roman, L. (2010). Smoking among pregnant women with Medicaid insurance: are mental health factors related? *Maternal & Child Health Journal, 14*(6), 971-977. doi: 10.1007/s10995-009-0530-x
119. Tong, V.T., Dietz, P.M., Morrow, B., D'Angelo, D.V>, Farr, S.L., Rockhill, K.M.,...England, L.J. (2013, November 8). Trends in smoking before, during, and after pregnancy-Pregnancy Risk Assessment Monitoring System, United States, 40 sites, 200-2010. *Surveillance Summaries, 64*(SS06), 1-19.
120. Pollak, K.I., Fish, L.J., Lyna, P., Peterson, B.L., Swamy, G.K., & Levine, M.D. (2015). Predictors of pregnant quitters' intention to return to smoking postpartum. *Nicotine & Tobacco Research, 17*(6), 742-745

121. Kessler, T.A., & Alverson, E.M. (2017). Smoking behaviors and abstinence in low-income pregnant women. *Journal of Nursing Education and Practice, 7*(5). 9-16.
122. Schane, R.E., Ling, P.M., & Glantz, S.A. (2010). Health effects of light and intermittent smoking: A review. *Circulation, 121*(13), 1518-1522.
123. Reid, M.S., Jiang, H., Fallon, B., Sonne, S., Rinaldi, P., Turrigiano, E.,...Nunes, E.V. (2011*).* Smoking cessation treatment among patients in community-based substance abuse rehabilitation programs: Exploring predictors of outcome as clues toward treatment improvement. *American Journal of Drug and Alcohol Abuse, 35*(5), 472-478.
124. Grekin, R., Brock. R.L., & O'Hara, M.W. (2017). The effects of trauma on perinatal depression: examining trajectories of depression from pregnancy through 24 months postpartum in an at-risk population. *Journal of Affective Disorders, 218,* 269-276
125. Jones, M., Lewis, S., Parrott, S., Wormall, S. & Coleman, T. (2016). Re-starting smoking in the postpartum period after receiving a smoking cessation intervention: A systematic review. *Addiction, 111,* 981-990.
126. Ashford, K., Wiggins, A., Rayens, E., Assef, S., Fallin, A., & Rayens, M.K. (2017). Perinatal biochemical confirmation of smoking status by trimester. *Nicotine & Tobacco Research, 19*(5), 631-635.
127. US Department of Health and Human Services [USDHHS]. (2001). *Women and Smoking: A report of the surgeon general*. Retrieved from http://profiles.nlm.nih.gov/ps/access/NNBBMQ.pdf
128. Centers for Disease Control and Prevention [CDC]. (2017, May 15). *Health Effects of Cigarette Smoking*. Retrieved from https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/effects_cig_smoking/index.htm
129. National Center for Infants Toddlers and Families. (2014). *FAQ's on the Brain*. Retrieved from http://www.zerotothree.org/child-development/brain-development/faqs-on-the-brain.html?referrer=https://www.google.com/
130. Chastang, J., Baïz, N., Cadwalladder, J. S., Robert, S., Dywer, J., Charpin, D. A., . . . Annesi-Maesano, I. (2015). Postnatal environmental tobacco smoke exposure related to behavioral problems in children. *PLoS ONE, 10*(8), 1-10. doi:10.1371/journal.pone.0133604
131. Hollams, E.M., de Klerk, N.H., Holt, P.G., & Sly, P.D. (2013). Persistent effects of maternal smoking during pregnancy on lung function and asthma in adolescents. *American Journal of Respiratory and Critical Care Medicine, 189(*4), 401-407.
132. Ekblad, M., Korkeila, J., & Lehtonen, L. (2015). Smoking during pregnancy affects foetal brain development. *Acta Paediatrica, 104*(1), 12-18
133. Lee, K.W.K., Richmond, R., Pingzhao, H., French, L., Shin, J., Bourdon, C....Pausova, Z. (2015). Prenatal exposure to maternal cigarette smoking and DNA methylation: Epigenome-wide association in a discovery sample of adolescents and replication in an independent cohort at birth through 17 years of age. *Environmental Health Perspectives, 123*(2), 193-199.

134. Office of Disease Prevention and Health Promotion [ODPHP] (2014). *Disparities by family income (percent poverty threshold).* Retrieved from https://www.healthypeople.gov/2020/data/disparities/summary/Chart/4854/6.1
135. Curtin, S.C., & Mathews, T.J. (2016). Smoking prevalence and cessation before and during pregnancy: Data from the birth certificate, 2014. *National Vital Statistics Report, 65*(1), 1-14. Retrieved from https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65_01.pdf
136. Polanska, K., Hanke, W., Sobala, W., Lowe, J.B., & Jaakkola, J.J.K. (2011). Predictors of smoking relapse after delivery: Prospective study in central Poland. *Maternal and Child Health Journal, 15*, 579-586.
137. Moore, E. Blatt, K., Chen, A., Van Hook, J., & DeFranco, E.A. (2016). Factors associated with smoking cessation in pregnancy. *American Journal of Perinatology, 33*(6), 560-568.
138. Shoff, C., & Yang, T. (2013). Understanding maternal smoking during pregnancy: Does residential context matter? *Social Sciences & Medicine, 78*, 50-60.
139. Ward, K.D., Vander Weg, M.W., Sell, M.A., Sarcinci, I.C., & Read, M.C. (2006). Characteristics and correlates of quitting among black and white low-income pregnant smokers. *American Journal of Health Behavior, 30*(6), 651-662.
140. Heil, S.H., Herrmann, E.S., Badger, G.J., Solomon, L.J., Bernstein, I.M., & Higgins, S.T. (2014). Examining the timing of changes in cigarette smoking upon learning of pregnancy. *Preventative Medicine, 68*, 58-61.
141. Coleman-Cowger, V.H., Koszowski, B., Rosenberry, Z.R., & Terplan, M. (2016). Factors associated with early pregnancy smoking status among low-income smokers. *Maternal and Child Health Journal, 20*, 1054-1060.
142. Linares Scott, T.J., Heil, S.H., Higgins, S.T., Badger, G.J., & Bernstein, I.M. (2009). Depressive symptoms predict smoking status among pregnant women. *Addictive Behavior, 34*(8), 705-708.
143. Pearlin L.I., Menaghan E.G., Lieberman M.A., Mullan J.T. (1981). The stress process. *Journal of Health and Social Behavior, 22(*4), 337-356.
144. Damon, W., & Hart, D. (1982). The development of self-understanding from infancy through adolescence. *Child Development, 53*, 841-864.
145. Bonfils, K.A., Firmin, R.L., Salyers, M., & Wright, E.R. (2015). Sexuality and intimacy among people living with serious mental illness: Factors contributing to sexual activity. *Psychiatric Rehabilitation Journal, 38*(3), 249-255.
146. Raaijmakers, L.G.M., Martens, M.K., Hesselink, A.E., de Weerdt, I., de Vries, N.K., & Kremers, S.P.J. (2014). Mastery and perceived autonomy support are correlates of Dutch diabetes patients' self-management and quality of life. *Patient Education and Counseling, 97*, 75-81.
147. Kuntsche, S., Knibbe, R.A., & Gmel, G. (2010). A step beyond-The relevance of depressed mood and mastery in the interplay between the number of social roles and alcohol use. *Addictive Behaviors, 35*, 1013-1020.
148. Kendler, K.S., & Myers, J. (2015). Addiction resistance: Definition, validation, and association with mastery. *Drug and Alcohol Dependence, 154*, 236-242.

149. Carlson, M.B., Britt, S.L., & Goff, B.N. (2015). Factors associated with a composite measure of financial behavior among soldiers. *Journal of Financial Counseling and Planning, 26*(1), 30-42.
150. de Waal, M.W.M., Hegeman, J.M., Gussekloo, J., Verhaak, P.F.M., van der Mast, R.C., & Comijs, H.C. (2016). The effect of pain on presence and severity if depressive disorders in older persons: the role of perceived control as mediator. *Journal of Affective Disorders, 197,* 239-244.
151. Gallagher, M.W., Schoemann, A.M., & Pressman, S.D. (2011). Mastery beliefs and intraindividual variability of anxiety. *Cognitive Therapy & Research, 35,* 227-231.
152. DeSocio, J., Kitzman, H., & Cole, R. (2003). Testing the relationship between self-agency and enactment of health behaviors. *Research in Nursing & Health, 26,* 20-29.
153. Caputo, R.K. (2003). The effects of socioeconomic status, perceived discrimination and mastery on health status in a youth cohort. *Social Work in Health Care, 37*(2), 17-42.
154. Cox, J.L., Holden, J.M., & Sagovsky, R. (1987). Detection of Postnatal Depression: Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry, 150,* 782-786. DOI: 10.1192/bjp.150.6.782
155. Bergink, V., Kooistra, L., Lambregtse-van den Berg, M.P., Wijnen, H., Bunevicius, R., van Baar, A., ...Pop, V. (2011). Validation of the Edinburgh Depression Scale during pregnancy. *Journal of Psychosomatic Research, 70,* 385-389 DOI: 10.1016/j.jpsychores.2010.07.008
156. Flynn, H.A., Sexton, M., Ratliff, S., Porter, K., & Zivin, K. (2011). Comparative performance of the Edinburgh Postnatal Depression Scale and the Patient Health Questionnaire-9 in pregnant and postpartum women seeking psychiatric services. *Psychiatry Research, 187,* 130-134.
157. Pearlin L.I., Schooler C. (1978). The structure of coping. *Journal of Health and Social Behavior, 19(*1), 2-21.
158. Crowe, L., Butterworth, P., & Leach, L., (2016). Financial hardship, mastery and social support: Explaining poor mental health amongst the inadequately employed using data form the HILDA survey. *SSM-Population health, 2,* 407-415.
159. SAS Institute Inc., Copyright © 2002-2012. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.
160. Bozdogan, H. (1987). Model selection and Akaike's Information Criterion (AIC): The general theory and its analytical extensions. *Psychometrika, 52*(3), 345-370.
161. Shao, J. (1997). An asymptotic theory for linear model selection. *Statistica Sinica, 7,* 221-242.
162. Schroeder, M.A. (1990). Diagnosing and dealing with multicollinearity. *Western Journal of Nursing Research 12*(2), 175-187.
163. Ockene, J. K., Ma, Y., Zapka, J. G., Pbert, L. A., Valentine Goins, K., & Stoddard, A. M. (2002). Spontaneous cessation of smoking and alcohol use among low-income pregnant women. *American Journal of Preventive Medicine, 23*(3), 150-159. doi: http://dx.doi.org/10.1016/S0749-3797(02)00492-0

164. Shisler, S., Hmoish, G.G., Molnar, D.S., Schuetze, P., Colder, C.R., & Eiden, R.D. (2016). Predictors of changes in smoking from third trimester to 9 months postpartum. *Nicotine & Tobacco Research*, 84-87.
165. Ashford, K., Wiggins, A., Rayens, E., Assef, S. Fallin, A., & Rayens, M.K. (2017). Perinatal biochemical confirmation of smoking status by trimester. *Nicotine and Tobacco Research, 19*(5). 631-635.
166. Swamy, G.K., Reddick, K.L.B., Brouwer, R.J.N., Pollak, K.I., & Myers, E.R. (2011). Smoking prevalence in early pregnancy: comparison of self-report and anonymous urine cotinine testing. *Journal of Maternal-Fetal & Neonatal Medicine, 21*(1), 86-90.
167. Substance Abuse and Mental Health Services Administration [SAMHSA] (n.d.). *Screening tools*. Retrieved from https://www.integration.samhsa.gov/clinical-practice/screening-tools
168. The American College of Obstetricians and Gynecologists [ACOG] (2015). Screening for perinatal depression: Committee opinion No. 630. *Obstetrics and Gynecology, 125*, 1268-1271.
169. U.S. Preventive Services Task Force (2017) *Final Recommendation Statement: Tobacco Smoking Cessation in Adults, Including Pregnant Women: Behavioral and Pharmacotherapy Interventions*. Retrieved from https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/tobacco-use-in-adults-and-pregnant-women-counseling-and-interventions1
170. World Health Organization [WHO] (2013). *WHO recommendations for the prevention and management of tobacco use and second-hand smoke exposure in pregnancy.* Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK190304/pdf/Bookshelf_NBK190304.pdf

CURRICULUM VITAE

Ashley Jones

EDUCATION

GRADUATE

10/2018 Doctor of Philosophy in Nursing Science, Minor in Social and Behavioral Sciences, Indiana University, Indianapolis, IN

08/2012 Master of Science in Nursing (MSN), Health Systems Leadership, University of Indianapolis, Indianapolis, IN

UNDERGRADUATE

08/2011 Bachelor of Science in Nursing (BSN), University of Indianapolis, Indianapolis, IN

05/2005 Bachelor of Science in Exercise Science (BS), Minor in Coaching, Miami University, Oxford, OH

CERTIFICATIONS AND LICENSURE

2015 - present Certified Tobacco Treatment Specialist (TTS), Center for Tobacco Treatment Research & Training, University of Massachusetts Medical Center

2012 - present Certified Lactation Consultant (CLC), The Center for Breastfeeding

2011 - present Registered Nurse (RN), Indiana Professional Licensing Agency

PROFESSIONAL ORGANIZATIONS

04/2017 - present	Member, Society for Research on Nicotine and Tobacco (SRNT)
02/2017 - present	Member, Indiana Society for Public Health Education (InSOPHE)
01/2017 - present	Member, American Public Health Association (APHA)
04/2016 - present	Member, Sigma Theta Tau International Honor Society of Nursing, Alpha Chapter
05/2015 - present	Member, Association for the Treatment of Tobacco Use and Dependence (ATTUD)
02/2015 - present	Member, Indiana State Nurse Association
10/2014 - present	Member, Motivational Interviewing Network of Trainers (MINT)

PROFESSIONAL EXPERIENCE

09/2015 - present	Nurse Supervisor, Goodwill Industries of Central & Southern, IN, Indianapolis, IN
10/2013 - 09/2015	Clinical Nurse Educator, Goodwill Industries of Central IN, Indianapolis, IN
03/2012 - 10/2013	Nurse Home Visitor, Goodwill Industries of Central IN, Indianapolis, IN
01/2011 - 04/2011	Capstone Student, Labor and Delivery Unit, Community Hospital North, Indianapolis, IN

RESEARCH AND TRAINING EXPERIENCE

09/2015 - present	Smoking Continuous Quality Improvement (CQI) Leader, Goodwill Industries of Central & Southern, IN, Indianapolis, IN
08/2017 - 12/2017	Teaching Assistant (Jessica Klipsch), Indiana University School of Nursing, Indianapolis, IN
05/2016 - 08/2016	Directed Research Practicum (Dr. Carol Shieh), Indiana University School of Nursing, Indianapolis, IN
08/2015 - 04/2016	Graduate Research Assistant, (Dr. Carol Shieh), Indiana University School of Nursing, Indianapolis, IN
10/2014	Train the Trainer (TNT), Motivational Interviewing Network of Trainers (MINT), Atlanta, GA

HONORS, AWARDS, FELLOWSHIPS, AND GRANTS

05/2015 - 08/2018	Robert Wood Johnson Foundation Future of Nursing Scholars
05/2015 - 08/2018	Ruth Deter Scholarship
04/2018	William M. Plater Civic Engagement Medallion
10/2017	Sigma Theta Tau International Rising Stars of Research
04/2017 - 12/2017	March of Dimes Smoking Cessation Grant, Goodwill Industries of Central & Southern, IN
04/2017	Premier 10 Award and Elite 50 Award, IUPUI Graduate & Professional Student Government
05/2016 - 05/2017	Tri Kappa Scholarship

04/2016	Elite 50 Award, IUPUI Graduate & Professional Student Government
04/2016	Sigma Theta Tau International Nursing Honor Society, Inductee
06/2016	Graduate Student Feature
05/2015 - 05/2016	Florence Nightingale Scholarship

PUBLICATIONS AND PRESENTATIONS

10/2017	**Jones, A.,** Shieh, C., Staten, L., Carter-Harris, L., Stiffler, D., & Macy, J. (2017, October). [Poster presentation]. *Postpartum Smoking and Its Related Factors.* Poster session presentation at the Sigma Theta Tau International 44th Biennial Convention, Indianapolis, IN.
7/2017	**Jones, A.** (2017, July). [Podium presentation]. *Postpartum Smoking and Its Related Factors: Dissertation Update.* Scholar presentation at the RWJF Future of Nursing Scholars Program Summer Institute 2017: Science and Policy, Washington DC.
4/2017	**Jones, A.**, Shieh, C., Staten, L., & Carter-Harris, L., (2017, April). [Poster presentation] *Clinical Inquiry about Smoking Cessation in Pregnant Women Living in Poverty: A Concept Analysis.* Poster session presentation at the IUPUI Research Day, Indianapolis, IN.
11/2016	Crane, L., Gonzalez, J., & **Jones, A**. (2016, November). [Podium presentation] *Defining the Community Health Nursing Workforce:*

	Alignment with a Culture of Health. Conference presentation at the Indiana Nursing Summit, Indianapolis, IN.
9/2016	**Jones, A.** & Gonzalez, J. (2016, September). [Podium presentation] *Using MI to Engage your Clients.* Conference presentation at THE Institute for Strengthening Families, Indianapolis, IN.
7/2016	**Jones, A.** (2016, July). [Podium presentation] *Understanding Postpartum Tobacco Dependency.* Scholar presentation at the RWJF Future of Nursing Scholars Program Summer Institute 2016: Science and Innovation, Colorado Springs, CO.
4/2016	**Jones, A.** & Shieh, C. (2016, April). [Poster presentation] *Maternal Gestational Weight Gain: Perceptions of Overweight and Obese Pregnant Women.* Poster session presentation at the IUPUI Research Day, Indianapolis, IN.
10/2015	**Jones, A.,** Barnes, K., & Gonzalez, J. (2015, October). [Podium presentation] *Innovation in Community Health Nursing Clinical Experiences.* Conference presentation at the Annual Professional Nurse Educators Group Conference, Indianapolis, IN.

COMMUNITY ENGAGEMENT

05/2012 - present	Member, Jr. League of Indianapolis (JLI)
03/2015 - present	Member, Healthy Shelby County Coalition (HSC)
04/2015 - present	Member, Tobacco and Nicotine Action Group, HSC

04/2018	Abstract Reviewer, APHA Annual Meeting & Expo
05/2017	Abstract Reviewer, APHA Annual Meeting & Expo