Women who quit smoking during pregnancy and relapse in the first two years after pregnancy.

A Thesis

by

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List of Abbreviations

FPL   Federal Poverty Level

IPV   Intimate Partner Violence

HCW   Health Care Worker

OR   Odds Ratio

WIC   Special Supplementary Nutrition Program for Women, Infants, and

                Children

PRAMS   Pregnancy Risk Assessment Monitoring System

CI   Confidence Interval

CDC   Centers for Disease Control and Prevention

SIDS   Sudden Infant Death Syndrome

NICU   Neonatal Intensive Care Unit

SLE   Stressful Life Event

SHS   Second-hand Smoke

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Abstract

Background

The health consequences of smoking during pregnancy, both to the prospective mother and to the infant, have long been recognized. However, very little is known about why some women avoid detrimental behaviors and engage in beneficial ones, while others do not. It is encouraging to note that approximately 40-44% of women who smoke at the start of pregnancy quit smoking for the duration of the pregnancy. Unfortunately, more than half of these women return to smoking within 6 months postpartum. While trends in smoking prevalence during pregnancy are known, little is known about trends in quitting during pregnancy and staying quit, postpartum.

This project aims to identify and differentiate between characteristics of those women who quit smoking during pregnancy and managed to stay quit, 2 years postpartum. Women who smoked during pregnancy and those who quit smoking during pregnancy will be compared to identify characteristics of women who quit smoking during pregnancy. In addition, we aim to identify characteristics of those women who stayed quit, 2 years postpartum compared to those women who relapsed into smoking, 2 years postpartum.

Methods

This study used data from the 2004 Oregon Pregnancy Risk Assessment Monitoring System (PRAMS) and its 2006 longitudinal follow-up, PRAMS-2. 1,968 women were surveyed with the 2004 Oregon PRAMS and 865 of these women responded to the 2-year follow-up survey in 2006.

In the PRAMS questionnaire, women were asked: "Have you smoked 100 cigarettes in the past 2 years? (A pack has 20 cigarettes.)" Only those who reported smoking at least 100 cigarettes in the past 2 years were included in this analysis. Smoking intensity was measured at three time points in PRAMS – 3 months before pregnancy (T1), last 3 months of pregnancy (T2) and 2-6 months postpartum (T3) with the question: "In the (time point), how many cigarettes did you smoke on an average day? (A pack has 20 cigarettes.)" PRAMS-2 measured smoking intensity at a fourth time point – 2 years postpartum (T4) – only to those who answered 'Yes' to the question: "Have you smoked 100 cigarettes in your entire life? (A pack has 20 cigarettes.)" Possible responses were *None, Less than 1 cigarette, 1 to 5 cigarettes, 6 to 10 cigarettes, 11 to 20 cigarettes, 21 to 40 cigarettes, 41 cigarettes or more.*

The respondents were classified into the following categories: (i) Smoked during pregnancy, (ii) Quit smoking during pregnancy, (iii) Stayed quit 2 years postpartum, (iv) Relapsed into smoking, 2 years postpartum, and, (v) Persistent smokers – Women who smoked at all the 4 time points.

Women who smoked during pregnancy were compared with women who quit smoking during pregnancy to identify characteristics of those women who quit smoking during pregnancy. Women who stayed quit 2 years postpartum were compared with women who relapsed into smoking 2 years postpartum to explore characteristics of women who stayed quit 2 years postpartum.

Logistic regression was used to highlight characteristics of women who quit smoking during pregnancy and identify potential correlates of staying quit, 2 years postpartum. Hosmer & Lemeshow's model building techniques were used to build a

multivariable logistic regression model to determine the characteristics of women who quit smoking during pregnancy and of women who stayed quit, 2 years postpartum. All analyses used weighted data to account for the complex sampling design utilized by PRAMS and PRAMS-2.

Results - Quit smoking during pregnancy

In logistic regression analyses, marginally significant factors associated with quitting smoking during pregnancy were. Even though these results were only marginally significant, the magnitude of the Odds Ratios warrants discussion of these results for public health implications.

Annual household income during pregnancy: Women who had higher annual household incomes (>=185% FPL category) were more likely to quit smoking than those who had lower annual household incomes (0-184% FPL category) (Unadjusted OR 3.68; 95% CI 0.98, 13.79).

WIC during pregnancy: Women who did not use WIC during pregnancy were more likely to quit smoking during pregnancy than women who used WIC (Unadjusted OR 2.84; 95% CI 0.87, 9.21).

Results - Stayed quit, 2 years postpartum

Significant factors associated with women staying quit, 2 years postpartum, were:

Maternal Education: Women who had greater than a high school education were more likely to stay quit, 2 years postpartum, than women who had a high school education or less (Unadjusted OR 20.33; 95% CI 4, 103.52).

Depressive Symptoms in 13-24 months after delivery: This was perhaps the most striking finding of this study. Women who reported *experiencing* depressive symptoms 13-24 months after delivery were more likely to stay quit than women who reported *not*

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experiencing any depressive symptoms in the past 12 months (Unadjusted OR: 6.73, 95% CI 1.33, 34.08).

Maternal age: Women who were greater than or equal to 25 years old were more likely to stay quit than women who were less than 25 years old (Unadjusted OR: 8.92, 95% CI 1.35, 59.03).

Discussion

We were able to identify marginally significant associations between annual household income during pregnancy and use of WIC during pregnancy with women who quit smoking during pregnancy. Significant risk factors for staying quit, identified in this preliminary analysis, included maternal education, maternal age and postpartum depressive symptoms. Because of the limited sample size that was available (68 women who quit smoking during pregnancy compared to 85 women who smoked during pregnancy), this study only had adequate power to detect Odds Ratios of 4.0 or higher for quitting smoking during pregnancy and 5.0 or higher for staying quit, 2 years postpartum (24 women who stayed quit 2 year postpartum compared to 34 women who relapsed into smoking 2 years postpartum). Further research is warranted to re-examine some additional well-known risk factors such as stressful life events, social support and people in household who smoke in conjunction with staying quit. This research could be useful in highlighting characteristics of women who quit smoking during pregnancy and providing some exploratory insight into characteristics of women who managed to stay quit, 2 years postpartum in order to be able to account for those characteristics while implementing smoking cessation interventions and ensuring efficient distribution of limited resources.

Introduction

Smoking during Pregnancy: Maternal smoking during pregnancy has been causally associated with a multitude of adverse health outcomes such as fetal growth restriction, premature rupture of the membranes, placenta previa, placental abruption, pre-term delivery, and low birth weight babies. Babies born to women who smoke during pregnancy have about a 30% odds of being born prematurely, are more likely to be born with low birth weight (less than 2500 grams or 5.5 pounds) - increasing their risk for illness or death, weight an average of 200 grams or less than infants born to women who do not smoke and are 1.4 to 3 times more likely to die of Sudden Infant Death Syndrome (SIDS). In addition, in utero exposure to cigarette smoke can have negative long-term effects on the growth, development, and behaviors of offspring.[39]

Hospital and NICU costs for infants associated with maternal smoking during pregnancy are also a huge economic burden. A 2002 study done on 1997 PRAMS data collected from 13 states estimated the prevalence of smoking during pregnancy at 18%. This study examined an association of smoking during pregnancy with infant admission to the Neonatal Intensive Care Unit (NICU) and found that estimated average cost per night of stay, in the hospital, for a non-NICU infant was $748, whereas for a NICU infant, a night of stay in the NICU nursery led to an average cost of $2500.[1]

Adding to the evidence of harmful effects of smoking is an association between smoking status and food insecurity. Those who live in smoking households are more likely to be food insecure. Not only does spending on cigarettes divert resources away from investing in healthy foods, but the lost productivity resulting from diseases caused by smoking can lower income and raise the likelihood of food insecurity.[11]

Another factor of interest is pregnancy intention. Women's behavior during pregnancy may be influenced by their attitude towards pregnancy. Women with intended pregnancies are somewhat more likely to quit smoking during pregnancy than similar women with unintended pregnancies, but this varies according to the mother's social and demographic characteristics.[22]

A study in Maine conducted with 10 years of PRAMS data (1988-1997) found smoking prevalence to remain high in the last 3 months of pregnancy even though there was an overall decline in smoking prevalence. One of the characteristics of women who smoked through pregnancy, identified by this study, was WIC participation. Over the 10-year study period, even though there was a slight dip in smoking prevalence, women participating in WIC had consistently higher prevalence of smoking in the last 3 months of pregnancy compared to those women who did not participate in WIC.[12]

Furthermore, one of the adverse outcomes that are linked to high prevalence of depression among pregnant women and mental and physical health problems during pregnancy is continuation of high-risk behaviors, such as cigarette smoking.[2]

According to 2004 PRAMS data from 26 states the prevalence of smoking during pregnancy is estimated at 13%, which is lower than the 1997 numbers but still higher than national estimates of 10% and still far above the Healthy People 2010 goal of 1%. Younger, less educated, non-Hispanic, white women and American Indian women are more likely to smoke during pregnancy compared to their older, more educated counterparts.[10]

Staying Quit, postpartum: The past 15 years have seen a steady decrease in the number of women who smoke while pregnant, partly because of an overall decline in smoking rates among all women of childbearing age and partly, due to interventions targeting women during the prenatal period [34.] Smoking cessation during pregnancy significantly reduces the risks of fetal death, low birth weight, and other complications of pregnancy.

Continued abstinence postpartum also reduces children's exposure to environmental tobacco smoke and its associated health risks. According to a recent study by the Harvard School of Public Health, subjects first exposed to second hand smoke (SHS) between the ages of 0-25 have higher odds of developing lung cancer than those who were exposed to SHS after the age of 25 [6.] Exposure to second hand smoke is also an important contributor to the future risks of impaired pulmonary function [38.] Moreover, sustained abstinence postpartum reduces women's lifetime risk for smoking-related diseases [27.]

In spite of overall decline of smoking prevalence, relapse into smoking postpartum remains high. According to a presentation on "Risk Factors for Smoking Cessation Relapse After Pregnancy" at the 9th Annual Maternal & Child Health Epidemiology Workshop in 2003, 50% of the PRAMS respondents successfully quit smoking during pregnancy. Among those who successfully quit smoking during pregnancy, almost 40% of them relapsed into smoking 2-6 months postpartum.[13]

There is evidence that suggests that the strategies used by women who quit smoking during pregnancy differ from those used by non-pregnant quitters, and thus, the resumption of smoking postpartum represents the end of a temporary suspension of smoking rather than a failure to maintain a long-term behavior change.[25]

A recent study findings published by researchers at University of North Carolina at Chapel Hill state: Women who remained smoke-free postpartum were bolstered by strong social support, strong internal belief systems, strong beliefs in postpartum health benefits of not smoking, negative experiences with a return to smoking and concrete strategies for dealing with temptations. Women who relapsed postpartum were undermined by easy access to cigarettes, reliance on cigarettes to deal with stress, lack of financial resources, lack of resources for childbearing and, low self-esteem.[34]

Prior studies have consistently reported the prevalence of relapse into smoking, postpartum at 50% or higher[13, 23, 24, 25, 27, 35]. More needs to be done to encourage women who quit smoking pregnancy, to continue to remain smoke-free, postpartum.

<u>Specific Aims</u>

The data used in this study comes from the 2004 Oregon Pregnancy Risk Assessment Monitoring System (PRAMS) and from its 2006 longitudinal follow-up survey – PRAMS-2 – administered in 2006. This study aims to:

1) Establish prevalence of smoking at four different time points: 3 months before pregnancy (T1), last 3 months of pregnancy (T2), 2-6 months postpartum (T3), and, 2 years postpartum (T4).

2) Establish prevalence of staying quit among those who women who quit smoking during pregnancy at two time points: 2-6 months postpartum (T3) and 2 years postpartum (T4).

3) Identify characteristics of women who quit smoking during pregnancy compared to those women who continued to smoke through pregnancy.

4) Preliminary exploration into possible characteristics of women who stayed quit, 2 years postpartum, compared to those women who quit smoking during pregnancy but relapsed into smoking, two years postpartum.

Smoking still remains a serious problem that affects the health and welfare of the general population not only through the main effects of smoking but also through the exposure to second hand smoke (SHS). Limited information exists regarding correlates of those women who manage to remain smoke-free, postpartum. Information provided by this study could prove useful in examining factors associated with quitting smoking during pregnancy and staying quit, 2 years postpartum in order to target groups of women who may need to receive more effective and timely smoking cessation interventions.

Methods

PRAMS

This project uses data collected through the 2004 Oregon Pregnancy Risk Assessment Monitoring System (PRAMS) and its longitudinal follow-up – PRAMS-2 – administered in 2006. PRAMS is an epidemiologic surveillance program maintained by the Centers for Disease Control and Prevention (CDC) and implemented by participating state health departments. Research has indicated that maternal behaviors during pregnancy may influence infant birth weight and mortality rates. The goal of the PRAMS project is to improve the health of mothers and infants by reducing adverse outcomes such as low birth weight, infant mortality and morbidity, and maternal morbidity. PRAMS combines two modes of data collection; a survey conducted by mailed questionnaire with multiple follow-up attempts, and a survey by telephone.   Here is the sequence of contacts for PRAMS surveillance:

- **Preletter.** This letter introduces PRAMS to the mother and informs her that a questionnaire will soon arrive.
- **Initial Mail Questionnaire Packet**. This packet is sent to all sampled mothers 3 to 7 days after the preletter. Its contents are described below.
- **Tickler.** The tickler serves as a thank you and a reminder note. It is sent 7 to 10 days after the initial mail packet.
- **Second Mail Questionnaire Packet.** This packet is sent to all sampled mothers who have not yet responded 7 to 14 days after the tickler has been sent.
- **Third Mail Questionnaire Packet.** This third packet is sent to all remaining nonrespondents 7 to 14 days after the second questionnaire.
- **Telephone Follow-up.** Telephone follow-up is initiated for all mail nonrespondents 7 to 14 days after mailing the last questionnaire.

The 2004 Oregon PRAMS survey was designed as an eighty-item self-administered questionnaire. Both the written survey and the interview ask the same questions. Oregon

PRAMS questionnaires and interviews were completed in either English or Spanish. A complete copy of the 2004 Oregon PRAMS survey is included in Appendix A.

PRAMS-2

In January 2006 the Oregon Office of Family Health PRAMS team began re-surveying PRAMS respondents whose children had turned 24 months old. This new survey includes questions on health insurance, chronic diseases, oral health, well child-care, medical home, breastfeeding, smoking, domestic violence, family planning, child nutrition, immunization, early intervention, childcare, and reading to child.

PRAMS-2 was administered to all mothers who responded to the PRAMS Survey, with the exception of:
- Those who indicated "Do not contact me again" on the contact/information card included with PRAMS survey.
- Those whose babies were deceased.

From Jan06 to Aug06, the PRAMS-2 survey was only administered by mail. From Sep06 to present, the PRAMS-2 survey is administered by both mail and phone. PRAMS-2 mailing materials are sent in English language to mothers who returned the PRAMS survey in English, and in Spanish language to mothers who returned the PRAMS survey in Spanish.

A complete copy of the 2006 Oregon PRAMS-2 survey is included in Appendix B. The PRAMS-2 survey format is similar to the PRAMS format with up to two mailings of the PRAMS-2 surveys to each mother and telephone follow-up with mothers who do not respond by mail.

PRAMS employs several complex weighting mechanisms in order to adjust for aspects of the subject selection methods. Because PRAMS oversamples for maternal race and ethnicity, a sampling weight is applied to the data. In the 2004 Oregon PRAMS, the

sampling weight was calculated to also account for oversampling based on low birth weight.   The 2006 longitudinal follow-up, PRAMS-2, was re-weighted to account for loss to follow-up of the PRAMS respondents.

PRAMS/PRAMS-2 Weighting Methodology

The population of interest for PRAMS is all mothers who are residents of Oregon who delivered within Oregon a live-born infant during the surveillance period. For PRAMS surveillance, there is often a particular interest from a public health perspective in certain subpopulations. These subpopulations may not represent a large portion of a state's overall population. To make inferences about specific subpopulations and make comparisons among several subpopulations, infants in those subpopulations (commonly called *strata*) will need to be oversampled (i.e., sampled at a higher rate than other subpopulations). The main advantage of *stratified sampling* is that it permits separate estimates of subgroups of interest and permits comparisons across these subgroups. Oregon chose to stratify by race/ethnicity (of mother) as defined by CDC: African American, American Indian/Alaskan Native, Asian/Pacific Islander, Hispanic, and White. This will enable Oregon to obtain accurate data about small minority race/ethnicity groups. Oversampling these groups should provide robust estimates of overall responses. In addition to the race/ethnicity stratification, a low birth weight white stratum was added, thus making the total number of strata for Oregon, six. Because of the recent reported increase in Oregon infant mortality deaths due to low birth weight and based on Oregon's birth population composition, it is feasible to over sample low birth weight babies only from the "White" strata.

Participation in Oregon PRAMS may vary based on additional maternal characteristics. That is, some women who share common traits may be less likely to respond to the survey than others. Because of this, a nonresponse weight is used to compensate for non-participation. Nonresponse weights are typically based on common demographic characteristics within each sampling stratum that are identified after the data has been collected and non-respondents have been compared to respondents.

Finally, participation in the Oregon PRAMS can also be affected by characteristics of the sampling scheme. That is, some women may be less likely than others to participate because they were not covered by the sampling frame. This situation can occur when there are accidental duplications in the birth certificate records. Duplicate records can lead to missing files in the group of selected participants. To adjust for women who may have been omitted in this fashion, a non-coverage weight is calculated and applied to the data. Factors that are related to non-coverage are identified by the CDC once all of the PRAMS data has been collected.

The longitudinal follow-up – PRAMS-2 – used the same three classification of weights that PRAMS uses, i.e., weighting for maternal race/ethnicity, non-response and, non-coverage. Only the non-response weight was re-calculated to account for those women that were lost to follow-up. All those women who also indicated "Do not contact me again" on the PRAMS information card were also included in the non-response weight category. For a detailed description of PRAMS weighting methodology, please refer to http://www.cdc.gov/prams/methodology.htm.

Variable Coding

Outcome

     Only those women who reported smoking at least 100 cigarettes in the past 2 years were included in this analysis. There are two outcomes being examined in this analysis: (i) Quitting smoking during pregnancy – will be referred to as 'Quit' from now on, and, (ii) Staying quit, 2 years postpartum – will be referred to as 'Staying quit' from now on. All women who smoked 3 months before pregnancy and quit smoking during pregnancy were included in the quit outcome variable (Table 1). All those women who smoked 3 months before pregnancy, quit smoking during pregnancy and stayed quit, 2 years postpartum were included in the staying quit outcome variable (Table 2). For crosstab analysis, the "event" was coded as 1, else 0.

Table 1: Coding of quitting smoking during pregnancy outcome variable (Among those who reported smoking at least 100 cigarettes in the past 2 years)

Presence of Smoking (Yes/No)		Number of Women	
3 months before becoming pregnant	**Last 3 months of pregnancy**		
Yes	Yes	85	Smoked during pregnancy
Yes	No	68	Quit smoking during pregnancy

(Data source: 2004 PRAMS/2006 PRAMS-2)

Table 2: Patterns of smoking among women who reported smoking at least 100 cigarettes in the past 2 years.

3 months before pregnancy (T1)	Last 3 months of pregnancy (T2)	2-4 months postpartum (T3)	2 years postpartum (T4)	Number of Women	
Presence of Smoking (Yes/No)					
Yes	Yes	Yes	Yes	69	Persistent Smokers
Yes	Yes	Yes	No	5	Excluded
Yes	Yes	No	Yes	2	Excluded
Yes	Yes	No	No	5	Excluded
Yes	No	Yes	Yes	15	Quit/Relapsed
Yes	No	Yes	No	6	Excluded
Yes	No	No	Yes	19	Quit/Relapsed
Yes	No	No	No	24	Stayed Quit
No	Yes	Yes	Yes	0	Excluded
No	Yes	Yes	No	0	Excluded
No	Yes	No	Yes	0	Excluded
No	Yes	No	No	0	Excluded
No	No	Yes	Yes	3	Excluded
No	No	Yes	No	0	Excluded
No	No	No	Yes	2	Excluded
No	No	No	No	3	Excluded
Reported not smoking 100 cigarettes in the past 2 years				689	Excluded
Smoking information missing				23	Excluded
Total				**865**	

(Data source: 2004 PRAMS/2006 PRAMS-2)

Independent Variables

The 2004 Oregon PRAMS assessed respondents for numerous experiences and behaviors related to pregnancy and birth outcomes. The 2004 PRAMS was also linked to birth certificates in order to access maternal demographic characteristics such as race/ethnicity, maternal education and maternal age. The 2006 longitudinal follow up

assessed respondents' behavioral outcomes, 2 years postpartum, and outcomes related to their now two-year old child. This analysis used information from both the PRAMS and PRAMS-2 surveys to attempt to profile women who quit smoking during pregnancy and explore potential correlates of women who stayed quit 2 years postpartum.

For the outcome of Quitting smoking during pregnancy (Quit)

Variables Derived from Birth Certificate Information

Variables drawn from birth certificate information used in this study, for analysis of quitting smoking during pregnancy, included maternal age, maternal race/ethnicity, education and marital status

Maternal race/ethnicity was separated into five categories: Hispanic, non-Hispanic White, non-Hispanic African American, non-Hispanic Asian/Pacific Islander, and non-Hispanic American Indian/Alaska Native. To ensure sufficient sample size in each category and because of the race/ethnicity distribution in Oregon[40], the maternal race/ethnicity variable was dichotomized into Whites and non-Whites.

Information regarding maternal age (in years) was originally available as a continuous variable in the dataset. However, initial analysis revealed a nonlinear trend between age and the log odds of women quitting smoking during pregnancy. To improve the ease of analysis, this information was re-coded as a categorical variable. To ensure sufficient sample size in each category, maternal age was dichotomized into <25 years and >=25 years.

Maternal education for the PRAMS variable analysis was coded as a categorical variable with 2 categories to be consistent with the maternal education variable in the PRAMS-2 dataset. The categories are <12th grade/12th grade or GED and >12th grade.

Table 3 includes a complete list of birth certificate variables used in this analysis, along with their original response options and recoded categories.

Table 3. Independent variables derived from birth certificate
(Used for the outcome of quitting smoking during pregnancy)

Birth Certificate Measure	Possible Responses	Coding for Analysis
Maternal Age	Continuous	0 = <25 years 1 = 25 years or greater
Marital Status	Married Divorced/Separated/ Widowed	1 = All Else 2 = Married
Maternal Race/Ethnicity	-White - Hispanic - African American - Asian/Pacific Islander - American Indian/ Alaskan Native	0 = Whites 1 = non-Whites
Maternal Education	- Less than 12th grade - 12th grade - Greater than 12th grade	0 = <12th/12th grade 1 = Greater than 12th grade

(Linked with 2004 Oregon PRAMS data)

For the outcome of Quitting smoking during pregnancy (Quit)

Variables derived from Oregon PRAMS

The variables measured on the 2004 Oregon PRAMS used in this analysis, for the outcome of quitting smoking during pregnancy, included food insecurity during pregnancy, physician counseling for smoking during pregnancy, annual household income during pregnancy, pre-pregnancy smoking intensity, maternal age, intimate partner violence (IPV), stressful life events (SLE) during pregnancy, pregnancy intention, depressive symptoms during pregnancy and physical activity assessed 2-6 months postpartum.

According to a study by Frank Chaloupka, smoking households tend to experience higher levels of food insecurity [11]. Food insecurity during pregnancy was

measured using the question, "During the 12 months before your new baby was born, did you ever eat less than you felt you should because there wasn't enough money to buy food?" Possible responses are "No" or "Yes".

Some prior studies have assessed physical counseling for smoking during pregnancy [9, 14]. Physician counseling for smoking during pregnancy was assessed with the question, "During any of your prenatal care visits, did a doctor, nurse or other health care worker talk with you about – How smoking during pregnancy could affect my baby (Please count only discussion, not reading materials or videos)" Possible responses were "No" or "Yes".

Annual household income during pregnancy was divided into categories based upon percentage of the federal poverty threshold (% FPL), which is published by the Department of Health and Human Services. Because the 2004 Oregon PRAMS asks respondents about income in the year prior to giving birth, percentages of the FPL were based upon guidelines for 2003. All participants who reported an annual income were classified as earning either 0%—99 % FPL, 100%—184% FPL, or 185% FPL and greater. Cutoff points for each category were based upon their significance to public programs. In particular the Oregon WIC program requires that participants have incomes less than 185% FPL. The Oregon Food Stamp program now has an extended categorical elibility which allows Oregon households to qualify for food stamps if they have incomes of upto 185% of FPL [44]. To account for the limited sample size in this study and since both WIC and the food stamps program use less than 185% FPL as the eligibility cut-off, this variable was further dichotomized into 0-184% FPL and >=185% FPL.

Pre-pregnancy smoking intensity was measured with the question, "In the 3 months before you got pregnant, how many cigarettes did you smoke on an average day?" The question also included information on how many cigarettes constitute a pack – "(A pack has 20 cigarettes)." Smokers were classified as "light" or "heavy" based on the number of cigarettes smoked on an average day. Those who smoked <=10 cigarettes a day were classified as light smokers and those who smoked >10 cigarettes a day were classified as heavy smokers [26].

Intimate Partner Violence (IPV) during pregnancy was measured using 2 items on the PRAMS questionnaire. They are, "During your most recent pregnancy, did an ex-husband or ex-partner push, hit, slap, kick, choke, or physically hurt you in any other way" – and – "During your most recent pregnancy, were you physically hurt in any way by your husband or partner?" Possible responses to either question were "No" or "Yes". Respondents who answered "Yes" to either question were classified as having experienced IPV and only those who answered "No" to both questions were classified as not having experienced IPV during pregnancy.

Stressful life events have been examined as a risk factor associated with returning to smoking postpartum [9], so this factor should also warrant examination in association with quitting smoking during pregnancy. Stressful life events were measured using a series of questions that assessed thirteen events that may have occurred during the 12 months prior to giving birth. Some of the events included on the survey were serious illness of a close family member, separation or divorce, homelessness, increased arguments with a husband or partner, and the loss of a job by either the mother or her husband or partner. All of the stressful life event measures included "Yes" or "No" as

possible responses. For this analysis, because of the limited sample size, these events were dichotomized into those women experiencing '0 events' and those women experiencing 1 or more events in the year preceding delivery. Table 4 describes all the Stressful life events measured in PRAMS.

Table 4. Stressful Life Event Measures, 2004 Oregon PRAMS
(Used for the outcome of quitting smoking during pregnancy)

Event
A close family member was very sick and had to go to the hospital
I got separated or divorced from my husband or partner
I moved to a new address
I was homeless
My husband or partner lost his job
I lost my job even though I wanted to go on working
I argued with my husband or partner more than usual
My husband or partner said that he didn't want me to be pregnant
I had a lot of bills I couldn't pay
I was in a physical fight
My husband or partner or I went to jail
Someone very close to me a bad problem with drinking or drugs
Someone very close to me died

Based on data from the 1988 NMIHS (National Maternal and Infant Health Survey) and and 1988 NSFG (National Survey of Family Growth), women's behavior during pregnancy may be influenced by whether the pregnancy was planned or unplanned [22]. Pregnancy intention was measured using responses to the question, "Thinking back to just before you got pregnant with your new baby, how did you feel about becoming pregnant?" Women who reported either "I wanted to be pregnant sooner" or "I wanted to be pregnant then" were considered to have intended pregnancies. Women who reported

either "I wanted to be pregnant later" or "I didn't want to be pregnant then or at any time in the future" were considered to have unintended pregnancies.

Depressive symptoms during pregnancy were measured using two items on the PRAMS questionnaire. The first question asked, "While you were pregnant, how often did you feel down, depressed, or hopeless?" The second question asked, "While you were pregnant, how often did you have little interest or pleasure in doing things?" Possible responses for both questions included "Always," "Often," "Sometimes," "Rarely," or "Never." For this analysis, answers of "Always" or "Often" were considered a positive report of depressive symptoms. Answers of "Sometimes," "Rarely," and "Never" were considered a negative report of depressive symptoms. All respondents who provided a positive answer to either one or both of the questions were considered to have experienced depressive symptoms during pregnancy. All respondents who provided negative answers to both of the questions were considered to have been free of depressive symptoms during pregnancy. Table 5 includes a complete list of PRAMS variables used in this analysis (for the outcome of quitting smoking during pregnancy), along with their original response options and recoded categories.

Table 5. (Independent variables derived from 2004 Oregon PRAMS (Used for the outcome of quitting smoking during pregnancy)

PRAMS Measure	Possible Responses	Coding for Analysis
Food Insecurity during pregnancy	- No - Yes	1 = No 2 = Yes
Physician counseling for smoking during prenatal care visits	- No - Yes	0 = Yes 1 = No
Annual Household Income—during pregnancy	-Less than $10,000 -$10,000—$14,999 -$15,000—$19,999 -$20,000—$24,999 -$25,000—$34,999 -$35,000—$49,999 -$50,000 or more	0 = 0%—184% FPL 1 = 185% FPL or greater

Pre-Pregnancy Smoking Intensity	- 41 cigarettes or more - 21 to 40 cigarettes - 11 to 20 cigarettes - 6 to 10 cigarettes - 1 to 5 cigarettes - Less than 1 cigarette - None (0 cigarette)	1 = Heavy (>10 cigarettes) 2 = Light (<= 10 cigarettes)
Intimate Partner Violence—During Pregnancy, Current Husband or Partner/Ex-husband or Ex-Partner	-No -Yes	1 = Yes 2 = No
Stressful Life Events during pregnancy (13 events)	-No -Yes	1 = 1 Event or greater 2 = 0 Events
Pregnancy Intention	-I wanted to be pregnant sooner -I wanted to be pregnant later -I wanted to be pregnant then -I didn't want to be pregnant then or at any time in the future	1 = Unintended 2 = Intended

Depressive Symptoms during Pregnancy
    -Depressed Mood
    - Little Interest or pleasure
	-Always
	-Often
	-Sometimes
	-Rarely
	-Never
		Always/Often = Yes
		Sometimes/Rarely/Never = No

WIC Participation	-No -Yes	0 = Yes 1 = No

<u>For the outcome of staying quit 2 years postpartum (Staying Quit)</u>

Variables derived from Oregon PRAMS

Since, the outcome of staying quit assesses smoking status among PRAMS-2 respondents, 2 years after delivery; most variables used in this analysis were from PRAMS-2. But, there were a few variables from PRAMS that were meaningful to examine for inclusion in this analysis. Those variables include current physical activity and antenatal depressive symptoms, assessed 2-6 months postpartum.

Current physical activity was assessed with the following question, "In the past month, how many days a week did you get at least 30 minutes of physical activity of exercise? (For example, walking, dancing, yard work or sweeping)." Possible response choices included "Less than 1 day per week", "1 to 4 days per week" and "5 or more days per week." To account for the limited sample size, this variable was dichotomized into <=4 days per week and >=5 days per week. Table 4 includes a complete list of PRAMS variables used in this study, along with their original response options and recoded categories.

Antenatal depressive symptoms were assessed with two items on the PRAMS questionnaire. The first question asked, "Since your new baby was born, how often did you feel down, depressed, or hopeless?" The second question asked, "Since your new baby was born, how often did you have little interest or pleasure in doing things?" Possible responses for both questions included "Always," "Often," "Sometimes," "Rarely," or "Never." For this analysis, answers of "Always" or "Often" were considered a positive report of depressive symptoms. Answers of "Sometimes," "Rarely," and "Never" were considered a negative report of depressive symptoms. All respondents who provided a positive answer to either one or both of the questions were considered to have experienced depressive symptoms after delivery. All respondents who provided negative answers to both of the questions were considered to have been free of depressive symptoms 2-6 months after delivery. Table 6 includes the list of PRAMS variables used in this analysis (for the outcome of staying quit), along with their original response options and recoded categories.

Table 6. Independent variables derived from 2004 Oregon PRAMS
(Used for the outcome of staying quit, 2 years postpartum)

Physical Activity in the past month	- Less than 1 day per week - 1 to 4 days per week - 5 or more days per week	1 = 5 or more days per week 2 = 4 or less days per week

Antenatal Depressive Symptoms
  - Depressed Mood
  - Little Interest
	- Always
	- Often
	- Sometimes
	- Rarely
	- Never
		Always/Often = Yes
		Sometimes/Rarely/Never = No

For the outcome of staying quit, 2 years postpartum (Staying Quit)

Variables derived from Oregon PRAMS-2

The variables measured on the 2006 Oregon PRAMS-2 used in this analysis included food insecurity (13-24 months after delivery), people in the household who smoke, social support, marital status, maternal education, postpartum stressful life events (SLE), depressive symptoms in the first 12 months after delivery, depressive symptoms 13-24 months after delivery, current annual household income, maternal age, maternal physical activity and smoking cessation counseling from physician or health care worker (HCW).

Armour et al. found that families with income near the federal poverty level spend a large share of their income on cigarettes. This suggests an interaction between food insecurity and household income levels on smoking behavior [5]. With our limited sample size (n=58), we were unable to examine any interactions and so income and food insecurity were examined as individual risk factors for staying quit. Food Insecurity in PRAMS-2 was measured with the question, "In the past 12 months, did you ever eat less than you felt you should because there wasn't enough money to buy food?" Possible responses to this question were "No" or "Yes".

People in the household who smoked were measured with the question, "Not including yourself, is there anyone in your household who smokes cigarettes, cigars, or pipes?" Possible responses are "No" or "Yes".

Carmichael et al. cited the lack of information on social support as a limitation in their study examining correlates of postpartum smoking relapse [9]. Social support was measured using a series of questions which measured five events listed in Table 7. All of the social support questions had possible responses of "Yes" or "No". Questions 2-5 were considered more relevant to the outcomes of this analysis and so only those questions were used in this analysis. To account for the limited sample size of this study, these questions were collapsed and dichotomized. Those who answered "No" to all four of the questions were considered as not having any social support and those who answered "Yes" to any one or more of the 4 questions were considered as having social support.

Table 7. Social Support Measures, 2006 Oregon PRAMS-2

Measures
You have someone who would load you money for food or bills if you needed it (**not used for purposes of this analysis**).
You have someone who would help you if you were sick and needed to be in bed.
You have someone who would take you to the clinic or doctor's office if you needed a ride.
You have someone you can count on to listen to you when you need to talk.
You have someone who shows you love and affection.

The PRAMS-2 survey includes questions regarding demographics such as marital status, maternal education and maternal age, assessed 2 year postpartum. These variables

were used for the analyses of staying quit rather than demographics from the birth certificate.

Marital status was measured with the question, "What is your current marital status?" Possible responses were "Never married", "Married", "Widowed", "Divorced", "Separated". This variable was dichotomized into those who were married and all else to ascertain effect of being married on the outcome of interest.

Maternal education was measured with the question, "What is the highest level of school you have completed?" Possible responses were "Less than 12th grade", "12th grade or GED" and "More than 12th grade". This variable was dichotomized into all those who had a high school education or less and all those who had greater than a high school education.

Maternal age was dichotomized based on the most commonly used cut-off point among prior literature reviews for ease of interpretation. Thus, maternal age was dichotomized into <25 years and >=25 years.

Stressful life events in the year preceding delivery were found to be significantly associated with return to smoking, 2-6 months postpartum [9]. Hence, stressful life events between 13-24 months after delivery would warrant examination in association with staying quit, 2 years postpartum. Stressful life events were measured using a series of questions that assessed thirteen events that may have occurred during the past 12 months. It is the same series of questions that is reported in Table 3. This variable was dichotomized, because of the small sample size and cell counts, into those who experienced no SLEs'- "None" and those who experienced at least one SLE – ">=1 event".

Allen et al. , using 2004 PRAMS data from 16 states, found that smokers with

depressive symptoms are more likely to relapse after attempting to quit than those

without depressive symptoms [3]. Maternal depressive symptoms 2 years after delivery

were measured using 2 items on the PRAMS-2 questionnaire. The first item examines

depressive symptoms in the first 12 months after delivery with the question, "During the

FIRST 12 months of your two-year-old's life, was there a period of two or more weeks

when almost every day you: (a) Felt sad, blue or depressed for most of the day, (b) Lost

interest or pleasure in most things that you usually cared about or enjoyed." Possible

responses for both (a) and (b) are "No" or "Yes". The second item examines depressive

symptoms in the past 12 months with the question, "In the PAST 12 months, has there

been a period of two or more weeks when almost every day you: (a) Felt sad, blue or

depressed for most of the day, (b) Lost interest or pleasure in most things you usually

cared about or enjoyed." Possible responses for both (a) and (b) are "No" or "Yes". If

the respondent answered "Yes" to either part (a) or (b) for the first 12 months, then they

were classified as having depressive symptoms during that time period. If they answered

"No" to both parts (a) and (b), then they were classified as not having depressive

symptoms during that time period. Assessing depressive symptoms in the respondents

during the past 12 months was done similarly.

Current annual household income was divided into categories based upon

percentage of the federal poverty threshold (% FPL). All participants who reported an

annual income were classified as earning either 0%—184 % FPL or >=185%.

Levine et al. published an article assessing concerns about weight and its

association with smoking behavior in women[24]. Current physical activity was assessed

using the question, "In the past month, how many days a week did you get at least 30 minutes of physical activity or exercise? (For example, walking, dancing, yard work or sweeping)." Possible responses were "Less than 1 day per week", "1 to 4 days per week" and "5 or more days per week". To account for the small sample size, this variable was further dichotomized into <=4 days per week and >=5 days per week.

Postpartum smoking cessation counseling by physician or HCW was assessed with the following two questions – "During any of your healthcare visits in the last 12 months, did a doctor, nurse, or other health care worker talk with you about any of the things listed below? (i) Advise you to quit smoking, (ii) Offer you help on how to quit smoking" Possible responses were "Yes" or "No". Both these items were examined separately for the outcome of interest. Table 8 includes a complete list of PRAMS-2 variables used in this analysis, along with their original response options and recoded categories.

Table 8. Independent variables derived from 2006 Oregon PRAMS-2
(Used for the outcome of staying quit, 2 years postpartum)

PRAMS-2 Measure	Possible Responses	Coding for Analysis
Food Insecurity in the past 12 months	- No - Yes	1 = No 2 = Yes
HCW advise to quit smoking	- No - Yes	0 = Yes 1 = No
HCW offer help to quit smoking	- No - Yes	0 = Yes 1 = No
Current Annual Household Income—	-Less than $10,000 -$10,000—$14,999 -$15,000—$19,999 -$20,000—$24,999 -$25,000—$34,999 -$35,000—$49,999 -$50,000 or more	1 = 0%—184% FPL 2 = 185% FPL and greater
People in household who smoke	- No - Yes	1 = No 2 = Yes
Social Support (4 out of 5 questions)	- No - Yes	1 = No 2 = Yes
Marital Status	- Never Married	0 = Married

	- Married - Widowed - Divorced - Separated	1 = All else
Maternal Education	- Less than 12th grade - 12th grade or GED - More than 12th grade	0 = Less than 12th/12th 1 = More than 12th grade
Stressful Life Events (13 events)	-No -Yes	0 = 0 Events 1 = 1 or more events
Postpartum depressive symptoms in first 12 months	- No - Yes	0 = No 1 = Yes
Postpartum depressive symptoms in past 12 months	- No - Yes	0 = No 1 = Yes
Maternal Age	- Continuous	0 = <25 years 1 = 25 years or greater
Current physical Activity	- Less than 1 day per week - 1 to 4 days per week - 5 or more days per week	1 = 5 or more days per week 2 = 1 to 4 days per week

Data Management

Tasks related to cleaning and editing of PRAMS data files, including the correction of errors and inconsistencies, are the responsibility of state health departments. For the 2004 Oregon PRAMS and the 2006 Oregon PRAMS-2, the Department of Human Services (DHS) performed all data entry verification and telephone interview monitoring (as all telephone interviews were performed by a hired contractor). The data files were then checked for consistency through an automated process at the CDC. Finally, the CDC created the Oregon PRAMS analysis file, complete with analysis weights. This file was then provided to Oregon DHS. Re-weighting for the PRAMS-2 data set was done at DHS with instructions from the CDC.

For this project, I acquired the PRAMS merged with the PRAMS-2 follow up data file in STATA format. All analyses for this project were performed using STATA Version 10 (STATA Corporation) software package. Because Oregon PRAMS and

PRAMS-2 responses are de-identified and do not contain personal identifying information, the Institutional Review Board (IRB) of Oregon Health and Science University exempted this project from review.

Statistical Analysis

Descriptive Analysis

Weighted data was used for all parts of the statistical analysis. The prevalence of smoking at the four different time points was examined. The prevalence of staying quit, 2 years postpartum, was also determined among the PRAMS-2 respondents. Cross tabulations were then generated to determine the number of women who quit smoking during pregnancy and the number of women who stayed quit, within each of the covariates. These cross tabulations were examined to determine if there were sufficient cell counts within each of the variable categories to be eligible for inclusion in a multivariable model.

Univariate Analysis

Simple logistic regression models were constructed to determine unadjusted odds ratios (ORs) to examine significant risk factors between those women who quit smoking during pregnancy compared to those who continued to smoke during pregnancy. The same was done for the women who stayed quit, 2 years postpartum, compared to those who relapsed into smoking, 2 years postpartum.

All correlates with a p-value of ≤ 0.25 were eligible for inclusion in the multivariable logistic regression model. A large number of prior studies that have assessed smoking behaviors during pregnancy and 2-6 months postpartum have included demographics in their analyses [3, 9, 13, 21, 26, 27, 28, 43] and so, demographics such as maternal

age, maternal education, marital status, annual household income (% FPL) and maternal race/ethnicity were included in the model, to adjust for, even if the p-value was greater than 0.25.

Multivariate analysis

Multivariate analysis was conducted using Hosmer & Lemeshow's applied logistic regression technique for model building [46]. Expected counts for each variable were examined to ensure adequate sample sizes in each group. Some of the variables were further collapsed into dichotomized formats if cell sizes were too small to obtain accurate inferences. Continuous variables such as maternal age were categorized if the relationship between the log odds of the outcome and associated covariate showed departure from linearity. All examined independent covariates with sufficient cell counts and with a p-value of ≤ 0.25 was eligible for inclusion into the multivariable logistic regression model.

Forward stepwise model building

STATA does not allow for automated model selection processes such as backwards, forwards, stepwise processes or best subset selection using weighted data. Hence, forward manual stepwise was performed by adding the variables to the model by the level of significance in univariate analysis. The variable that was most significant was added first to the model and additional variables added, one at a time, based on the significance of the association with the outcome of quitting smoking during pregnancy.

Similarly, a forward manual stepwise model building process was performed for the outcome of staying quit, 2 years postpartum.

Results

Summary

Response Rates

The 2004 Oregon PRAMS sampled 1,968 women. The weighted response rate for PRAMS was 74.8%. The PRAMS-2 survey was sent to 1,935 of these 1,968 women. 865 women responded to the PRAMS-2 survey with an un-weighted response rate of 44%. The weighted response rate, or more appropriately, the percent of the Oregon population that this represents, is 51.1%. The overall combined response rate for both PRAMS and PRAMS-2 was 38%. The weighted response rate for PRAMS-2 was calculated using the formula defined by the CDC. For detailed information on calculation of the PRAMS-2 response rate and the overall response rate, please refer to Appendix C.

Demographics of PRAMS-2 respondents

All of the percentages reported here are weighted. The majority of the PRAMS-2 respondents in this study were greater than or equal to 25 years old (78.3%), had more than a high school education (62.6%) and were married (76.4%). Annual household income was split right down the middle with half the respondents earning an annual income of less than 185% of the federal poverty level (49.4%) and the other half earning an annual income of greater than or equal to 185% of the federal poverty level (50.6%). Most respondents also reported not smoking at least 100 cigarettes in their entire life (64.6%) and were non-Hispanic Whites (71%)

Smoking Prevalence

20.9% of the PRAMS-2 respondents smoked at least 100 cigarettes in the past two years (N=167).   The PRAMS survey was able to establish smoking prevalence during three time points – 3 months before pregnancy (T1), last 3 months of pregnancy (T2) and 6 months postpartum (T3) Information about smoking 3 months before pregnancy was available for 853 respondents. Those who reported smoking less than 100 cigarettes in the past 2 years, were coded as non-smoking for each of those time points. 19% of all PRAMS-2 respondents reported smoking less than one or more cigarettes on an average day in the 3 months before pregnancy (N=154). Information about smoking in the last 3 months of pregnancy was available for 854 respondents. In the last 3 months of pregnancy, 11% of the respondents (N=87) smoked less than one or more cigarettes on an average day. Information about smoking 6 months postpartum was available for 855 respondents. At 6 months postpartum, 14% of the respondents (N=104) reported smoking less than one or more cigarettes on an average day.

35.4% of the PRAMS-2 respondents smoked at least 100 cigarettes in their entire life (N=284). The PRAMS-2 survey was able to establish smoking prevalence at a fourth time point (T4) – 2 years postpartum. Information about smoking 2 years postpartum was available for 853 respondents. At 2 years postpartum, 15% of the respondents (N=135) smoked less than one or more cigarettes on an average day.

Persistent Smokers

Those PRAMS-2 respondents who reported smoking less than one or more cigarettes on an average day at all the four time points – 3 months before pregnancy (T1), last 3 months of pregnancy (T2), 6 months postpartum (T3) and 2 years postpartum (T4) – were classified as persistent smokers. Smoking information at all the four time points

were available for 830 respondents. 8.7% of the respondents (N=69) reported smoking at all the four time points.

Stayed Quit

For purposes of this analysis, those respondents who reported smoking before pregnancy (T1), quit smoking during pregnancy (T2) and continued to remain smoke-free at 6 months postpartum (T3) and 2 years postpartum (T4) were classified as staying quit. 3.7% of the respondents (N=24) were classified as staying quit.

Relapsers

Those respondents who reported smoking before pregnancy (T1), quit during pregnancy (T2) and relapsed into smoking, 2 years postpartum (T4) were classified as relapsers. 2.6% of the respondents (N=34) were classified as relapsers.

Quit smoking during pregnancy

Among those PRAMS-2 respondents who reported smoking 3 months before pregnancy (T1), prevalence of quitting smoking during pregnancy was 44.5% (N=85).

Stayed quit, 2-6 months postpartum

Among those PRAMS-2 respondents who reported smoking 3 months before pregnancy (T1) and reported quitting smoking during pregnancy (T2), prevalence of staying quit 2-6 months postpartum (T3) was 65% (N=47).

Stayed quit, 2 years postpartum

Among those PRAMS-2 respondents who reported smoking 3 months before pregnancy (T1) and reported quitting smoking during pregnancy (T2), prevalence of those who stayed quit 2-6 months postpartum (T3) and continued to stay quit 2 years postpartum (T4) was 59% (N=24).

Non-Smokers

Those respondents who did not smoke at any of the four time points were classified as non-smokers. This category also included those who reported not smoking at least 100 cigarettes in the past 2 years or in their entire life. 82% of the respondents (703) were classified as non-smokers. Figure 1 is a flowchart of the four time points under consideration.

Figure 1
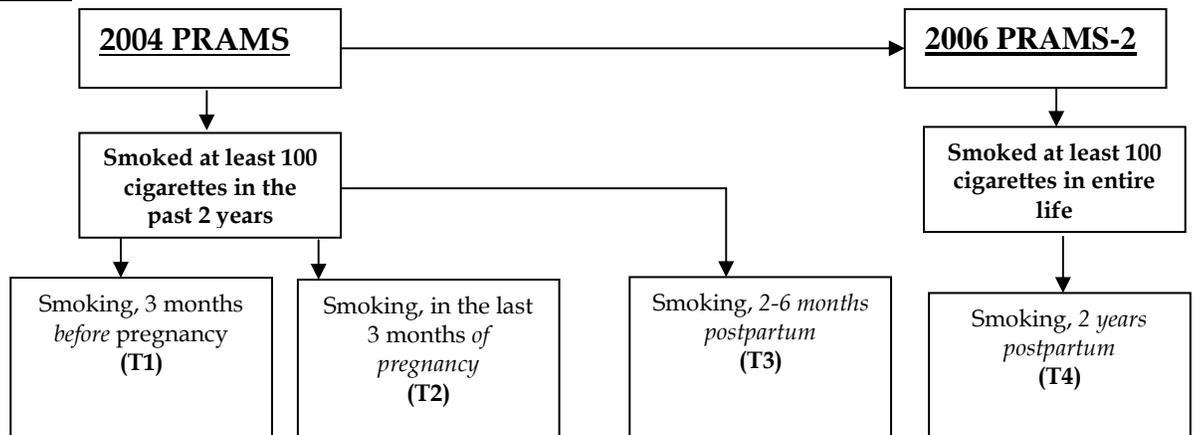
Outcome: Quit smoking during pregnancy

68 women reported quitting smoking during pregnancy while 85 women reported smoking during pregnancy with a 44.5% prevalence of quitting smoking during pregnancy.

Maternal Education

Information regarding maternal education was available for 83 women who smoked during pregnancy and all 68 women who quit smoking during pregnancy. 40% of those who had a high school education or less (38) and 58% of those who had greater than a high school education (30) quit smoking during pregnancy.

Marital Status

Information regarding maternal marital status was available for all 85 women who smoked during pregnancy and all 68 women who quit smoking during pregnancy. 52% of those who were married (36) and 39% of those who were not married (includes never married, divorced and separated) (32) quit smoking during pregnancy.

Maternal Age

Information regarding maternal age was available for all 85 women who smoking during pregnancy and all 68 women who quit smoking during pregnancy. 38% of women aged less than 25 years (33) and 55% of women 25 years old or greater (35) quit smoking during pregnancy.

Maternal race/ethnicity

Information regarding maternal race/ethnicity was available for all 85 women who smoked during pregnancy and all 68 women who quit smoking during pregnancy. 45% of non-Hispanic Whites (37) and 44% of non-Whites (includes American Indian/Alaskan Native, African American, Asian/Pacific Islander and Hispanic) (31) quit smoking during pregnancy.

Food insecurity during pregnancy

Information regarding food insecurity during pregnancy was available for all 85 women who smoked during pregnancy and 67 women who quit smoking during pregnancy. 42% of those who didn't report food insecurity (52) and 50% of those who reported food insecurity (15) quit smoking during pregnancy.

HCW talk about smoking during prenatal visits

Information regarding doctor, nurse of health care worker (HCW) talking about smoking was available for 84 women who smoked during pregnancy and 67 women who

quit smoking during pregnancy. 40% of those who reported that a doctor, nurse or other HCW spoke with them about how smoking during pregnancy could affect the baby (57) and 66% of those who didn't report any HCW talking about smoking, quit smoking during pregnancy (10).

Annual household income during pregnancy (% FPL)

Information regarding annual pre-pregnancy household income was available for 80 women who smoked during pregnancy and 65 women who quit smoking during pregnancy. 37% of those who had annual household income during pregnancy of 0-184% FPL (37) and 68% of those who had annual household income during pregnancy of >=185% FPL (28) quit smoking during pregnancy.

Pre-pregnancy smoking intensity

Information regarding pre-pregnancy smoking intensity was available for 85 women who smoked during pregnancy and 68 women who quit smoking during pregnancy. 35% of heavy smokers (20) and 52% of light smokers (48) quit smoking during pregnancy.

Intimate Partner Violence (IPV) during pregnancy

Information regarding IPV was available for all 85 women who smoked during pregnancy and all 68 women who quit smoking during pregnancy. 37% of those who reported experiencing IPV during pregnancy (7) and 46% of those who reported not experiencing any IPV during pregnancy (61) and quit smoking during pregnancy.

Stressful Life Events (SLE) during pregnancy

Information regarding SLE during pregnancy was available for all 85 women who smoked during pregnancy and all 68 women who quit smoking during pregnancy. 43%

of those who reported experiencing 1 or more SLE's during pregnancy (54) and 56% of those who reported experiencing no SLE's (14) quit smoking during pregnancy.

Pregnancy Intention

Information regarding pregnancy intention was available for 82 women who smoked during pregnancy and 67 women who quit smoking during pregnancy. 40% of those who reported unintended pregnancies (35) and 54% of those who reported intended pregnancies (32) quit smoking during pregnancy.

Depressive symptoms during pregnancy

Information regarding depressive symptoms during pregnancy was available for 83 women who smoked during pregnancy and 67 women who quit smoking during pregnancy. 47% of women who reported experiencing depressive symptoms during pregnancy (5) and 44% of women who reported experiencing no depressive symptoms during pregnancy (63) quit smoking during pregnancy.

WIC during pregnancy

Information regarding WIC use during pregnancy was available for all 85 women who smoked during pregnancy and all 68 women who quit smoking during pregnancy. 37% of women who reported using WIC during pregnancy (39) and 63% of women who reported not using WIC during pregnancy (29), quit smoking during pregnancy.

Pre-pregnancy BMI

Information regarding pre-pregnancy weight was available for 81 women who smoked during pregnancy and all 68 women who quit smoking during pregnancy. 58% of women who were considered normal (40) based on BMI classification and 36% of

those who were classified as all else (included underweight, obese and overweight) (28),

quit smoking during pregnancy.

Other variables

Other variables that were assessed but were not included for analysis due to

insufficient cell counts were alcohol consumption during pregnancy.

Univariate Analysis

The proportion of women, who quit smoking during pregnancy, did not vary by

most of the correlates examined in this analysis. In univariate logistic analyses annual

household income during pregnancy and WIC participation during pregnancy were of

marginal significance as risk factors for women quitting smoking during pregnancy.

Table 9 describes the associations between women who quit smoking during pregnancy

and possible correlates, including Unadjusted ORs and 95% CIs.

Women who quit smoking during pregnancy were more likely to have higher

annual household incomes during pregnancy (OR: 3.68, 95% CI: 0.98, 13.79) and were

also more likely to have not used WIC during pregnancy compared to women who

smoked during pregnancy (OR: 2.84, 95% CI: 0.84, 9.21).

Table 9:Risk Factors for Quitting smoking during pregnancy (n=68)
Compared to women who smoked through pregnancy (n=85)

Maternal characteristic	Numerator (un-weighted)	Denominator (un-weighted)	Quit (weighted)	Unadjusted OR (95% CI)
Total	68	153	44.5%	
Maternal Education				
<12th/12th grade	38	99	40%	Referent
>12th grade	30	52	58%	2.10 (0.70, 6.30)
Missing		2		
Marital Status				
All else	32	84	39%	Referent
Married	36	69	52%	1.68 (0.59, 4.82)
Maternal Age				
<25 years	33	81	38%	Referent
>= 25 years	35	72	55%	2.02 (0.70, 5.80)
Maternal Race/Ethnicity				
Non-Whites	31	68	44%	Referent
Non-Hispanic Whites	37	85	45%	1.02 (0.39, 2.66)
Food insecurity during pregnancy				
No	52	115	42%	Referent
Yes	15	37	50%	1.39 (0.45, 4.25)
Missing	1	1		
HCW talk about smoking during prenatal visits				
Yes	57	132	40%	Referent
No	10	19	66%	2.85 (0.68, 11.93)
Missing	1	2		
Annual Household Income during Pregnancy				
0-184% FPL	37	101	37%	Referent
>= 185% FPL	28	44	68%	3.68 (0.98, 13.79)
Missing	3	8		
Pre-pregnancy Smoking Intensity				
Heavy	20	64	35%	Referent
Light	48	89	52%	2.08 (0.71, 6.06)
Intimate Partner Violence during pregnancy				
Yes	7	26	37%	Referent
No	61	127	46%	1.47 (0.33, 6.48)
Stressful Life Events during pregnancy				
>=1 Event(s)	54	132	43%	Referent
0 Events	14	21	56%	1.70 (0.37, 7.77)
Pregnancy Intention				
Unintended	35	86	40%	Referent
Intended	32	63	54%	1.77 (0.61, 5.16)
Missing	1	4		
Depressive Symptoms				

during Pregnancy				
Yes	22	55	47%	Referent
No	45	95	44%	0.90 (0.29, 2.78)
Missing	1	3		
WIC during pregnancy				
Yes	39	104	37%	Referent
No	29	49	63%	2.84 (0.87, 9.21)
Maternal Pre-pregnancy BMI				
All Else	28	74	36%	Referent
Normal (18.5<= BMI < 25.0)	40	75	58%	2.49 (0.84, 7.40)
Missing		4		

(Data source: 2004 PRAMS/2006 PRAMS-2)

Multivariate Logistic Analysis

For the outcome of quitting smoking during pregnancy, all covariates that were had a p-value of ≤ 0.25 were included in the multivariable model. Demographic factors such as maternal race/ethnicity, maternal age and maternal education were included in the model to adjust for.

The final model for women who quit smoking during pregnancy included the variables of maternal education, marital status, maternal age, maternal race/ethnicity, HCW talk about smoking during prenatal visit, pre-pregnancy smoking intensity, annual household income during pregnancy, the use of WIC during pregnancy and pre-pregnancy BMI. Table 10 describes the associations from the multivariable model between women who quit smoking during pregnancy and possible correlates, including Adjusted ORs and 95% CIs.

Table 10: Multivariable Model - Risk Factors for Quitting smoking during pregnancy (n=68)

Compared to women who smoked through pregnancy (n=85)

Maternal characteristic	Numerator (un-weighted)	Denominator (un-weighted)	Quit (weighted)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Total	68	153	44.5%		
Maternal Education					
<12th/12th grade	38	99	40%	Referent	Referent
>12th grade	30	52	58%	2.10 (0.70, 6.30)	1.64 (0.35, 7.66)
Missing		2			
Marital Status					
All else	32	84	39%	Referent	Referent
Married	36	69	52%	1.68 (0.59, 4.82)	0.89 (0.25, 3.14)
Maternal Age					
<25 years	33	81	38%	Referent	Referent
>= 25 years	35	72	55%	2.02 (0.70, 5.80)	1.60 (0.44, 5.76)
Maternal Race/Ethnicity					
Non-Whites	31	68	44%	Referent	Referent
Non-Hispanic Whites	37	85	45%	1.02 (0.39, 2.66)	0.82 (0.25, 2.72)
Food insecurity during pregnancy					
No	52	115	42%	Referent	Excluded from model
Yes	15	37	50%	1.39 (0.45, 4.25)	
Missing	1	1			
HCW talk about smoking during prenatal visits					
Yes	57	132	40%	Referent	Referent
No	10	19	66%	2.85 (0.68, 11.93)	2.31 (0.41, 12.83)
Missing	1	2			
Annual Household Income during Pregnancy					
0-184% FPL	37	101	37%	Referent	Referent
>= 185% FPL	28	44	68%	3.68 (0.98, 13.79)	2.17 (0.50, 9.42)
Missing	3	8			
Pre-pregnancy Smoking Intensity					
Heavy	20	64	35%	Referent	Referent
Light	48	89	52%	2.08 (0.71, 6.06)	1.84 (0.54, 6.31)
Intimate Partner Violence during pregnancy					
Yes	7	26	37%	Referent	Excluded from model
No	61	127	46%	1.47 (0.33, 6.48)	
Stressful Life Events during pregnancy					
>=1 Event(s)	54	132	43%	Referent	Excluded from model
0 Events	14	21	56%	1.70 (0.37, 7.77)	
Pregnancy Intention					
Unintended	35	86	40%	Referent	Excluded from model
Intended	32	63	54%	1.77 (0.61, 5.16)	

Missing	1	4			
Depressive Symptoms during Pregnancy					
Yes	22	55	47%	Referent	Excluded from model
No	45	95	44%	0.90 (0.29, 2.78)	
Missing	1	3			
WIC during pregnancy					
Yes	39	104	37%	Referent	Referent
No	29	49	63%	2.84 (0.87, 9.21)	1.08 (0.29, 4.03)
Maternal Pre-pregnancy BMI					
All Else	28	74	36%	Referent	Referent
Normal (18.5 <= BMI < 25)	40	75	58%	2.49 (0.84, 7.40)	1.71 (0.54, 5.35)
Missing		4			

(Data source: 2004 PRAMS/2006 PRAMS-2)

Forward Manual Stepwise Model Building

The variable that was first added to the manual stepwise model was annual

household income during pregnancy with the highest level of significance in univariate

analysis (p=0.05). The next variable to be added was use of WIC during pregnancy

(p=0.08). Even though there was moderate correlation between household income and

WIC participation, inclusion or exclusion of either variable did not change the overall

results and significance of the remaining variables in the final model. Pre-pregnancy

BMI, HCW talk about smoking, maternal education, pre-pregnancy smoking intensity,

maternal age, marital status and maternal race/ethnicity were added in the order listed.

Table 11 includes results of manual stepwise selection and its corresponding ORs and p-

values.

Table 11. Forward Manual Stepwise - Multivariable Logistic Regression Model, Odds Ratios and p-values for quitting smoking during pregnancy

Characteristic	Stage 1 OR, (p-value)	Stage 2 OR, (p-value)	Stage 3 OR, (p-value)	Stage 4 OR, (p-value)	Stage 5 OR, (p-value)	Stage 6 OR, (p-value)	Stage 7 OR, (p-value)	Stage 8 OR, (p-value)	Stage 9 OR, (p-value)
Annual household income during pregnancy	3.68 (0.05)	2.98 (0.15)	2.44 (0.21)	2.17 (0.26)	2.14 (0.28)	2.18 (0.27)	2.08 (0.30)	2.13 (0.31)	**2.17 (0.30)**
WIC during pregnancy		1.64 (0.48)	1.34 (0.64)	1.40 (0.60)	1.22 (0.75)	1.14 (0.84)	1.06 (0.92)	1.07 (0.92)	**1.08 (0.91)**
Pre-pregnancy BMI			1.93 (0.27)	1.93 (0.25)	1.72 (0.34)	1.63 (0.40)	1.69 (0.36)	1.69 (0.36)	**1.70 (0.36)**
HCW talk about smoking				2.28 (0.30)	2.40 (0.30)	2.44 (0.30)	2.23 (0.35)	2.24 (0.34)	**2.31 (0.34)**
Maternal education					1.67 (0.45)	1.98 (0.34)	1.66 (0.51)	1.66 (0.51)	**1.64 (0.53)**
Pre-pregnancy smoking intensity						1.92 (0.29)	1.86 (0.32)	1.86 (0.31)	**1.84 (0.33)**
Maternal age							1.56 (0.49)	1.61 (0.46)	**1.60 (0.47)**
Marital status								0.90 (0.87)	**0.89 (0.86)**
Maternal race/ethnicity									**0.82 (0.74)**

(Data source: 2004 PRAMS/2006 PRAMS-2)

Outcome: Stayed Quit, 2 years postpartum

Among the 68 women who quit smoking during pregnancy, 6 were excluded because they reported smoking at 2-6 months postpartum. 4 women had missing information regarding smoking status at 2 years postpartum. Among the remaining 58 women, 24 stayed quit at 2 years postpartum while 34 relapsed into smoking 2 years postpartum.

Maternal Education

Information regarding maternal education was available for all 24 who stayed quit and 34 relapsers. 14.6% of those who had a high school education or less (7) and 77.7% of those who had more than a high school education stayed quit, 2 years postpartum (17).

Marital Status

Information regarding marital status was available for all 24 who stayed quit and all 34 relapsers. 60.3% of those who were married (17) and 54.1% of those who were not married (includes never married, divorced and separated) (7) stayed quit, 2 years postpartum.

Maternal race/ethnicity

Information regarding maternal race/ethnicity was available for all 24 who stayed quit and all 34 relapsers. 62.1% of non-Hispanic Whites (12) and 40.1% of non-Whites (12) stayed quit, 2 years postpartum.

Current annual household income (% FPL)

Information regarding current annual household income was available for all 24 who stayed quit and all 34 relapsers. 53.8% of those who were in the 0-184% FPL (11) and 63.8% of those who were in the >=185% FPL (13) stayed quit, 2 years postpartum.

Maternal age

Information regarding maternal age was available for all 24 who stayed quit and all 34 relapsers. 53.7% of those who were less than 31 years old (15) and 72.3% of those who were greater than or equal to 31 years old (9) stayed quit, 2 years postpartum.

Food Insecurity in the past 12 months

Information regarding food insecurity in the past 12 months was available for all 24 who stayed quit and all 34 relapsers. 57.3% of those who reported experiencing food insecurity in the past 12 months (5) and 64.3% of those who reported experiencing no food insecurity (19) stayed quit, 2 years postpartum.

People in household who smoke

Information regarding people in household who smoke was available for all 24 who stayed quit and all 34 relapsers. 63.3% of those who reported not having any one in the household that smokes (17) and 50.1% of those who reported having someone in the household who smokes (7) stayed quit, 2 years postpartum.

Pre-pregnancy smoking intensity

Information regarding pre-pregnancy smoking intensity was available for all 24 who stayed quit and all 34 relapsers. 55.3% of heavy smokers (7) and 60.9% of light smokers (17) stayed quit, 2 years postpartum.

Stressful Life Events (SLEs) in the past 12 months

Information regarding SLEs in the past 12 months was available for all 24 who stayed quit and all 34 relapsers. 37.3% of those who experienced 1 or more SLEs in the past 12 months (18) and 62.7% of those who experienced no SLEs in the past 12 months stayed quit, 2 years postpartum (6).

Depressive symptoms in the first 12 months after delivery

Information regarding depressive symptoms in the first 12 months after delivery was available for all 24 who stayed quit and all 34 relapsers. 49.7% of those who reported experiencing no depressive symptoms for 2 or more weeks in the first 12 months after delivery (13) and 63.5% of those who reported experiencing depressive symptoms for 2 or more weeks in the first 12 months after delivery (10) stayed quit, 2 years postpartum.

Depressive symptoms 13-24 months after delivery

Information regarding depressive symptoms 13-24 months after delivery was available for 22 who stayed quit and all 34 relapsers. 46.1% of those who reported

experiencing depressive symptoms for 2 or more weeks in the past 12 months (15) and 84% of those who reported experiencing depressive symptoms almost every day for a period of two or more weeks in the past 12 months (7) stayed quit, 2 years postpartum.

Physical activity in the past month (at 6 months postpartum)

Information regarding physical activity in the past month (at 6 months postpartum) was available for 23 who stayed quit and 32 relapsers. 33.3% of those who reported having 30 minutes of physical activity, in the last month, for 5 or more days in a week (4) and 44.2% of those who reported having 30 minutes of physical activity, in the last month, for 4 or less days in a week (19) stayed quit, 2 years postpartum.

Health Care Worker (HCW) advice to quit smoking

Information regarding HCW advice to quit smoking was available for 21 who stayed quit and 33 relapsers. 36.6% of those who received advice on quitting smoking from a HCW in the last 12 months (7) and 68% of those who did not receive advice on quitting smoking from a HCW in the last 12 months (14) stayed quit, 2 years postpartum.

Health Care Worker (HCW) offer help to quit smoking

Information regarding HCW offer help to quit smoking was available for 22 who stayed quit and 32 relapsers. 41.1% of those who were offered help to quit smoking by a HCW in the last 12 months (7) and 67.1% of those who were not offered help to quit smoking
by a HCW in the last 12 months (15) stayed quit, 2 years postpartum.

Current BMI

Information regarding current BMI was available for all 24 who stayed quit and for all 34 relapsers. 62% of those who were normal (8) according to BMI classification

and 57% of those who were underweight, overweight or obese (16) stayed quit, 2 years postpartum.

Other Variables

Other variables that were examined but not included for analysis due to insufficient sample sizes were antenatal depressive symptoms, assessed 2-6 months postpartum, social support, physical activity in the past month at 2 years postpartum and alcohol consumption in an average week in the past 12 months (assessed 2 years postpartum).

Univariate Analysis

In simple logistic analyses maternal education, maternal age and depressive symptoms 13-24 months after delivery were significantly associated with women staying quit, 2 years postpartum.

Women who quit smoking during pregnancy and continued to stay quit, 2 years postpartum were more likely to have greater than a high school education (Unadjusted OR: 20.33, 95% CI: 4, 103.54) and were more likely to be 25 years old or greater (Unadjusted OR: 8.92, 95% CI: 1.35, 59.03). Women who stayed quit were also more likely to report experiencing depressive symptoms in the second year following pregnancy (Unadjusted OR: 6.15, 95% CI: 1.15, 32.79).

Table 12 describes the associations between women who stayed quit and possible correlates, including Unadjusted ORs and 95% CIs.

Table 12:Risk Factors for Staying Quit, 2 years postpartum (n=24)
Compared to women who relapsed into smoking, 2 years postpartum (n=34)

Maternal characteristic	Numerator (un-weighted)	Denominator (un-weighted)	Stayed Quit (weighted)	Unadjusted OR (95% CI)
Total	24	58	59%	
Maternal Education				
<12th/12th grade	7	25	15%	Referent
>12th grade	17	33	78%	20.33 (3.99, 103.54)
Marital Status				
All Else	7	21	54%	Referent
Married	17	37	60%	1.29 (0.18, 9.05)
Maternal Race/Ethnicity				
non-Whites	12	27	40%	Referent
Whites	12	31	62%	2.44 (0.49, 12.19)
Annual Household Income				
0-184% FPL	11	33	54%	Referent
>= 185% FPL	13	25	64%	1.51 (0.25, 9.22)
Maternal Age				
<25 years	15	37	54%	Referent
>=25 years	9	20	72%	8.92 (1.35, 59.03)
Missing		1		
Food Insecurity (past 12 months)				
Yes	5	11	57%	Referent
No	19	47	64%	1.34 (0.12, 14.57)
People in household who smoke				
Yes	7	23	50%	Referent
No	17	35	63%	1.72 (0.27, 11.07)
Pre-pregnancy Smoking Intensity				
Heavy (>10 cigs)	7	18	55%	Referent
Light (<=10 cigs)	17	40	61%	1.25 (0.2, 7.8)
Stressful Life Events in the past 12 months				
>=1 Event	18	46	37%	Referent
0 Events	6	12	63%	3.03 (0.34, 27.07)
Depressive symptoms first year after delivery				
No	13	35	50%	Referent
Yes	10	22	64%	1.76 (0.27, 11.30)
Missing	1	1		
Depressive symptoms 2nd year after delivery				
No	15	41	46%	Referent
Yes	8	16	85%	6.73 (1.33, 34.08)
Missing	1	1		
Physical Activity (6 months postpartum)				
>=5 days a week	4	12	33%	Referent

<= 4 days a week	19	43	44%	1.98 (0.17, 23.15)
Missing	1	3		
HCW advised to quit smoking				
Yes	7	33	37%	Referent
No	14	21	68%	3.68 (0.49, 27.89)
Missing	3	4		
HCW offer help to quit smoking				
Yes	7	24	41%	Referent
No	15	30	67%	2.92 (0.40, 21.4)
Missing	2	4		
Current BMI				
All Else	16	36	57%	Referent
Normal	8	22	62%	1.24 (0.20, 7.70)

(Data source: 2004 PRAMS/2006 PRAMS-2)

Multivariate Analysis

For the outcome of staying quit 2 years postpartum, all covariates that had a p-value of ≤ 0.25 were included in the multivariable logistic regression model. Demographic factors such as maternal race/ethnicity, maternal age, maternal education and annual household income (% FPL) were included in the model to adjust for.

The final model for staying quit included the variables of maternal education, marital status, maternal age, maternal race/ethnicity, depressive symptoms 13-24 months after delivery and HCW advice to quit smoking. Maternal education and annual household income were moderately correlated and annual household income was not significant in univariate analysis, hence, annual household income was dropped from the final model to avoid collinearity. Table 13 describes the multivariate associations between women who stayed quit, 2 years postpartum, and the covariates, including Adjusted ORs and 95% CIs.

Table 13: Multivariable Model - Risk Factors for Staying Quit, 2 years postpartum (n=24)

Compared to women who relapsed into smoking, 2 years postpartum (n=34)

Maternal characteristic	Numerator (un-weighted)	Denominator (un-weighted)	Stayed Quit (weighted)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Total	24	58	58.7%		
Maternal Education <12th/12th grade	7	25	14.6%	Referent	Referent
>12th grade	17	33	77.7%	20.33 (3.99, 103.54)	13.30 (2.36, 74.87)
Marital Status All Else	7	21	54.1%	Referent	Referent
Married	17	37	60.3%	1.29 (0.18, 9.05)	0.35 (0.02, 5.04)
Maternal Race/Ethnicity non-Whites	12	27	40.1%	Referent	Referent
Whites	12	31	62.1%	2.44 (0.49, 12.19)	3.00 (0.23, 38.34)
Annual Household Income 0-184% FPL	11	33	53.8%	Referent	Excluded because of collinearity with maternal education
>= 185% FPL	13	25	63.8%	1.51 (0.25, 9.22)	
Maternal Age <25 years	4	16	30%	Referent	Referent
>=25 years	20	41	80%	8.92 (1.35, 59.03)	3.92 (0.27, 57)
Missing		1			
Food Insecurity (past 12 months) Yes	5	11	57.3%	Referent	Excluded from model
No	19	47	64.3%	1.34 (0.12, 14.57)	
People in household who smoke No	17	35	63.3%	Referent	Excluded from model
Yes	7	23	50.1%	1.72 (0.27, 11.07)	
Pre-pregnancy Smoking Intensity Heavy (>10 cigs)	7	18	55.3%	Referent	Excluded from model
Light (<=10 cigs)	17	40	60.9%	1.25 (0.2, 7.8)	
Stressful Life Events in the past 12 months >=1 Event	18	46	37.3%	Referent	Excluded from model
0 Events	6	12	62.7%	3.03 (0.34, 27.07)	
Postpartum Depressive Symptoms (first 12 months) No	13	35	49.7%	Referent	Excluded from model
Yes	10	22	63.5%	1.76 (0.27, 11.30)	
Missing	1	1			
Postpartum					

Depressive Symptoms (past 12 months)					
No	15	41	46.1%	Referent	Referent
Yes	7	15	84%	6.73 (1.33, 34.08)	11.27 (1.83, 69.52)
Missing	2	2			
Physical Activity (6 months postpartum)					
>=5 days a week	4	12	33.3%	Referent	Excluded from model
<= 4 days a week	19	43	44.2%	1.98 (0.17, 23.15)	
Missing	1	3			
HCW advised to quit smoking					
Yes	7	33	36.6%	Referent	Referent
No	14	21	68%	3.68 (0.49, 27.89)	6.53 (0.99, 43.01)
Missing	3	4			
HCW offer help to quit smoking					Excluded from the model
Yes	7	24	41.1%	Referent	
No	15	30	67.1%	2.92 (0.40, 21.4)	
Missing	2	4			
Current BMI					
All Else	16	36	57%	Referent	Excluded from the model
Normal	8	22	62%	1.24 (0.20, 7.70)	

(Data source: 2004 PRAMS/2006 PRAMS-2)

Forward Manual Stepwise Model Building

The variable that was first added to the manual stepwise model was maternal
education (p=0.0005). Maternal age was next; addition of maternal age to a model that
already contained the variable of maternal education rendered the age/staying quit
association not statistically significant. Depressive symptoms in 13-24 months after
delivery, HCW talk about quitting smoking, maternal race/ethnicity and marital status
were added to the model in the order listed. The variables of maternal education and
depressive symptoms 13-24 months after delivery remained significant after inclusion of
all other covariates. Table 14 includes results of manual stepwise selection and
corresponding ORs and 95% CIs.

Table 14. Forward Manual Stepwise - Multivariable Logistic Regression Model, Odds Ratios and p-values

Characteristic	Stage 1 OR, (p-value)	Stage 2 OR, (p-value)	Stage 3 OR, (p-value)	Stage 4 OR, (p-value)	Stage 5 OR, (p-value)	Stage 6 OR, (p-value)
Maternal Education	20.33 (0.0005)	11.46 (0.006)	15.25 (0.001)	14.49 (0.003)	12.02 (0.01)	**13.30 (0.004)**
Maternal age		4.33 (0.17)	3.51 (0.25)	2.90 (0.37)	3.27 (0.33)	**3.92 (0.31)**
Depressive symptoms in the past 12 months			8.39 (0.015)	17.86 (0.002)	18.29 (0.003)	**11.27 (0.01)**
HCW talk about quitting smoking				5.94 (0.04)	5.63 (0.06)	**6.53 (0.05)**
Maternal race/ethnicity					2.29 (0.49)	**2.99 (0.39)**
Marital status						**0.35 (0.43)**

(Data source: 2004 PRAMS/2006 PRAMS-2)

Discussion

Summary

Prevalence of quitting smoking during pregnancy among the PRAMS-2 respondents was 44.5%. Prior studies have found a range of quitting rates during pregnancy – from 35% to 56% - [35, 23, 21] because the definition of quitting smoking during pregnancy varied among the different studies. Prevalence of staying quit among PRAMS-2 respondents was 59%. This measure has been assessed, by prior studies, consistently at 5-6 months postpartum and staying quit rates at that time have been estimated to be about 50% or lower [13, 23, 24, 25, 27, 35.] This study is one of the first studies examining prevalence of staying quit, 2 years postpartum. This may be an over-estimation partly because a higher percentage of women, who were lost to follow-up reported smoking at 2-6 months postpartum, compared to PRAMS-2 respondents and also because women may under-report smoking due to the social stigma attached to it.

This study of Oregon women found that annual household income during pregnancy and using WIC during pregnancy were of marginal significance in conjunction with quitting smoking while pregnant. After adjusting for maternal age, maternal race/ethnicity, maternal marital status, pre-pregnancy BMI and HCW talk about smoking during pregnancy, women with higher household incomes and women who did not participate in WIC during pregnancy were more likely to quit smoking, but these associations did not remain statistically significant.

This study also found that maternal education, maternal age and self-reported maternal depressive symptoms 13-24 months after delivery were significantly associated with staying quit, 2 years postpartum. After adjusting for other factors such as maternal

marital status, maternal race/ethnicity and HCW advice to quit smoking, the associations

between maternal education and self-reported maternal depressive symptoms 13-24

months after delivery with the outcome of staying quit still remained statistically

significant.

Comparison with previous findings

Prevalence of smoking at all 4 time points: before pregnancy (T1), during pregnancy (T2), 6 months postpartum (T3) and 2 years postpartum (T4)

10.5% of the PRAMS-2 respondents reported smoking at all the four time points. Since

this was one of the first studies assessing smoking prevalence, 2 years postpartum and the

first study using PRAMS-2 data, this finding cannot be validated at the current time for

external consistency.

Prevalence of staying quit

Among those who quit smoking during pregnancy, 58.7% stayed quit, 2 years

postpartum, while 41.3% relapsed into smoking, postpartum. According to 1996

PRAMS data, prevalence of relapse into smoking, postpartum, was 50.9% at 2-6 months

postpartum.[9] The prevalence of relapse at 2 years, which our study found, is lower than

these estimates. Other studies have consistently measured prevalence of relapse into

smoking, postpartum, at about 50%. Our estimates are close to that. Also, these

estimates are from the longitudinal follow-up and those lost to follow-up in the PRAMS-

2 may have been more likely to be smokers. Thus, this number may be an overestimation

of the true prevalence of staying quit in the underlying population.

Risk Factors for quitting smoking during pregnancy

        The results of this study found that annual household income during pregnancy

and the use of WIC during pregnancy were of marginal significance in association with

quitting smoking during pregnancy. Women who do not participate in WIC during pregnancy are more likely to quit smoking during pregnancy. This is consistent with prior studies [12.] This study also found positive associations between maternal education, marital status, maternal age, pre-pregnancy smoking intensity, IPV, SLEs during pregnancy and pregnancy intention as risk factors for quitting smoking during pregnancy, albeit, not statistically significant.

The association between food insecurity during pregnancy and quitting smoking during pregnancy differed from existing literature. Our study found that those who reported experiencing food insecurity during pregnancy were more likely to quit smoking during pregnancy compared to those who reported not experiencing food insecurity, though this was not statistically significant. Prior studies found that smoking households tend to experience higher levels of food insecurity [11.] Prior studies also suggest the possibility of food insecurity being an effect modifier in the association between household income levels and smoking status. Smoking prevalence seems to be higher among low income families who were food insecure than it was for low income families who were food secure [5]. Our data did not have enough sample size to investigate any possible effect modifiers. This could be one possible explanation for our counter-intuitive findings. Un-weighted numbers result in higher rates of quitting smoking among women who are food secure while weighted numbers flip the association around. This could also be due to the complex weighting mechanism used by PRAMS to represent the ethnic distribution of the populated represented by PRAMS.

Risk Factors for staying quit, 2 years postpartum

This study found significant associations between the variables of maternal education and self-reported maternal depressive symptoms 13-24 months after delivery with women staying quit, 2 years postpartum. Our findings regarding maternal education is consistent with prior studies that measured postpartum smoking prevalence at 2-6 months postpartum.[10, 14, 21, 41] Women with greater than a high school education are more likely to stay quit than those with a high school education or less. There is very limited information available on staying quit, 2 years postpartum to further validate these results.

Our study also found that women who reported experiencing depressive symptoms 13-24 months after delivery are more likely to stay quit. A 2004 PRAMS study examined data from 16 states that had elected to include the optional question of postpartum depressive symptoms on the survey. This study found that women who reported experiencing postpartum depressive symptoms (2-6 months postpartum) were less likely to stay quit and more likely to relapse into smoking, postpartum [3]. Our findings are counter-intuitive to this study. These results may be due to the fact that women reporting depressive symptoms 13-24 months after delivery may be chronic depressives and not typical postpartum depressives. There have been studies done examining the use of anti-depressants as an aid for smoking cessation [45], which may have been the cause of our findings. Also, this is preliminary exploration of the first year of PRAMS-2 data; combining a few years of data is needed to further stratify this purported association by factors such as race/ethnicity and annual household income. Prior research has also found that nicotine dependence and depression often occur together in the same patient. But, very little research has been done to find out whether depressed

patients who quit smoking attain long-lasting abstinence and what the effects of quitting are on their depressive symptoms. It is uncertain whether smokers with a history of depression run an increased risk of a new depressive episode once they quit smoking [32].

Strengths and Limitations

This analysis used data from the 2004 Oregon Pregnancy Risk Assessment Monitoring System and its two-year longitudinal follow-up, the 2006 Oregon PRAMS-2. The greatest strength of using PRAMS data is its population-based nature. A representative sample of the state's population is surveyed thus making the results generalizable to the women throughout the state. The PRAMS-2 data were further re-weighted, not only, using the same weighting scheme for PRAMS, but also to account for those women that were lost to follow-up. Thus, PRAMS-2 also enjoys the generalizibility that PRAMS provides.

Both PRAMS and the PRAMS-2 surveys evaluate a variety of measures that could affect maternal smoking status before, during and after pregnancy, such as stressful life events, social support and depressive symptoms during pregnancy and postpartum. This allowed for examination of a multitude of factors, in multivariate analysis, that could possibly influence maternal smoking behavior.

A third strength is the first-time use of 2006 PRAMS-2 data. The 2006 Oregon PRAMS-2 dataset is a longitudinal survey following the 2004 PRAMS respondents in time. Thus temporality of data was maintained as well as being able to shed some light on the demographic distribution of the PRAMS-2 respondents.

This study also had several limitations, the foremost being the lost to follow-up. As evidenced by the response rate, a sizeable number of women who were lost to follow-

up with the PRAMS-2 survey. In examining the characteristics of the PRAMS-2

respondents compared to those lost to follow-up, some differences were found. A higher

proportion of women reported smoking at least 100 cigarettes in the past 2 years among

those lost to follow-up (30%) compared to the PRAMS-2 respondents (21%). Smoking

prevalence at the 3 time points measured in PRAMS, i.e. 3 months before pregnancy

(T1), last 3 months of pregnancy (T2) and 2-6 months postpartum (T3) were higher in

those lost to follow-up than among the PRAMS-2 respondents. Among those lost to

follow-up, more women participated in WIC during pregnancy (58.2%), had unintended

pregnancies (43.7%), experienced depressive symptoms during pregnancy (25.9) and 2-6

months postpartum (7.3%) compared to the PRAMS-2 respondents. Finally, women lost

to follow-up were more likely to have been of lower income (57.4% in 0-184% FPL)

compared to the PRAMS-2 respondents (38.2% in 0-184% FPL) and more likely to be

less than 25 years of age. But, as stated before, the PRAMS-2 data were re-weighted

again to account for the loss to follow-up and so our results may not have been highly

influenced by those lost to follow-up. Table 15 provides a list of maternal characteristics

and weighted distributions of PRAMS-2 respondents in comparison with those lost to

follow-up.

Table 15: Characteristics of PRAMS-2 respondents versus those lost to follow-up

Maternal Characteristic	PRAMS-2 respondents		Lost to follow-up	
	Un-weighted count (%)	Weighted %	Un-weighted count (%)	Weighted %
Reported smoking 100 cigarettes in the past 2 years	167 (19.5)	21	282 (27)	30
Smoking 3 months before pregnancy	154 (18)	19	259 (25)	28.5
Smoking in the last 3 months of pregnancy	87 (10.2)	10.2	148 (14)	17.4
Smoking 2-6 months postpartum	104 (12.2)	13.6	200 (19)	22.3
Pre-pregnancy smoking intensity (Heavy smokers)	64 (41.6)	47.3	95 (36.7)	50.4
BC Maternal marital status (Married)	633 (75.6)	72.4	620 (56.2)	57
Food insecurity during pregnancy (Yes)	93 (12.8)	13	149 (14.2)	14.5
IPV during pregnancy (Yes)	28 (3.5)	2.3	41 (4.4)	2.4
Unintended pregnancies	300 (35.2)	31.2	498 (45.9)	43.7
Depressive symptoms during pregnancy (Yes)	163(19.4)	14.1	311 (29.8)	25.9
Depressive symptoms 2-6 months postpartum (Yes)	46 (5.4)	4.2	88 (8.3)	7.3
Used WIC during pregnancy	351 (41.1)	34.8	643 (60.6)	58.2
Physical Activity, 6 months postpartum (<=4 days a week)	660 (77.9)	77.3	802 (76.1)	72.4
Annual household income during pregnancy (0-184% FPL)	359 (43.8)	38.2	611 (63.2)	57.4
Maternal race/ethnicity (Whites)	389 (45.1)	79.8	311 (28.2)	62.2
Maternal age (<25)	220 (25.4)	25.4	417 (46.9)	52.2

(Data source: 2004 Oregon PRAMS)

Yet another limitation is the cross-sectional nature of PRAMS. Only PRAMS variables were used for the outcome of quitting smoking during pregnancy. Thus one cannot infer causation from the results of this analysis. It would not be possible to state whether smoking during pregnancy causes one to use WIC or whether using WIC during pregnancy causes one to continue smoking during pregnancy.

In examining the outcome of staying quit at 2 years postpartum, variables from PRAMS were either not meaningful to use or were not used due to insufficient sample sizes, thus, this study lacked the ability to use the temporality of data to its advantage.

A third limitation of this study is the small sample sizes. Thus the study did not have adequate power to detect meaningful shifts nor did the study have the ability to examine any effect modification.

The fourth limitation is that smoking status was self-reported and was not verified by any biological tests (like cotinine levels).[9] This combined with the fact that maternal smoking during pregnancy/postpartum has a social stigma attached to it may lead to under-reporting of the actual smoking prevalence in the PRAMS/PRAMS-2 population. There is also a possibility of reporting bias of sensitive topics such as IPV and alcohol consumption during pregnancy, thus, under-estimating the true Odds Ratios.

<u>Public Health Implications</u>

This study finding lends further credibility to the assertion that annual household income is associated with quitting smoking during pregnancy and that maternal education levels are associated with continued abstinence, postpartum.

For the outcome of quitting smoking during pregnancy:

Among the PRAMS-2 respondents 25.9% of those eligible for WIC participation during pregnancy (had annual household income during pregnancy of 0-184% FPL) did not use WIC. Oregon is one of just a handful of states to implement a federal food stamp policy option that allows Oregon households to qualify for food stamps if they have incomes of up to 185% of the FPL. WIC also uses the 185% FPL as cut-off for eligibility. Encouraging more eligible women to use WIC through continued awareness would be advantageous. Because WIC is a prenatal nutrition and health education program serving low-income women and children, WIC can provide opportunities for intervention and follow-up of women who are pregnant and smoke [11].

The participants of the Oregon Food Stamp program, WIC program or TANF would also have lower annual household incomes and this would aid in focusing the limited resources available to those group of women who need more help to quit smoking during pregnancy.

For the outcome of staying quit, 2 years postpartum

Women with greater than a high school education were more likely to stay smoke-free, 2 years postpartum. Smoking cessation interventions for quitting during pregnancy and staying quit, postpartum, should be targeted more towards women with lower levels of education. Since education levels and annual household income exhibit a

positive correlation, this would also mean targeting those women who report lower annual household incomes, akin to quitting smoking during pregnancy.

Women who reported experiencing depressive symptoms 13-24 months after delivery were also more likely to stay quit, postpartum. Depression and smoking are co-morbidities and should not be treated in isolation from each other [40]. Nicotine withdrawal may produce depressive symptoms or precipitate a major depressive episode, and thus, there may be some anti-depressants that might also be used as an aid for smoking cessation [45]. There is very little research done on how postpartum depressive symptoms can affect smoking behaviors in new mothers, especially those with a history of depressive symptoms. It is not clear whether remaining abstinent can cause an episode of experiencing depressive symptoms in smokers with a history of depression [32]. Health care workers need to be aware of this co-morbidity and the fact that women who report depressive symptoms 13-24 months after live birth may be chronic depressives, not typical postpartum depressives. Continued screening of depressive symptoms would be important to learn more about this health condition and how it can affect smoking behavior in women.

<u>Future Studies</u>

This study lacked the required sample size to study the effect of certain well known correlates such as pre-pregnancy smoking intensity, depressive symptoms during pregnancy, people in household who smoke, stressful life events during pregnancy and postpartum and social support, for the outcomes of quitting smoking during pregnancy or staying quit, 2 years postpartum. Combining multiple years of PRAMS-2 data will render adequate sample size to study the effect of these variables on quitting smoking and staying quit. Enhanced understanding of behavioral differences by race/ethnicity of the survey population will be necessary to apply population-based interventions.

In this study, non-Hispanic Whites were more likely to quit smoking during pregnancy and more likely to stay quit, 2 years postpartum, though not statistically significant. Since, the Oregon population is predominantly non-Hispanic White [39], minority race/ethnicity categories such as African Americans make up small target populations that may be amenable to culturally sensitive smoking cessation interventions.

It would be worth examining whether those mothers who reported experiencing depressive symptoms 13-24 months after delivery were diagnosed as having depression and whether they were on any anti-depressants. It would also be very insightful to examine patterns of self-reported depressive symptoms at all the different time points that this information is available for: during pregnancy, 2-6 months postpartum, in the first 12 months after delivery and 13-24 months after delivery.

<u>Summary and Conclusion</u>

This was the first and foremost study to explore year one of the Oregon PRAMS-2 dataset.

Exploring risk factors for quitting smoking during pregnancy, we found marginally significant associations between annual household income during pregnancy and WIC participation during pregnancy with the outcome of quitting smoking during pregnancy. Although similar associations were observed in multivariate analysis, they were not statistically significant.

In our preliminary analysis of staying quit, 2 years postpartum, women who had higher levels of education and those who reported experiencing depressive symptoms in 13-24 months after delivery were more likely to stay quit, both in univariate and multivariate analysis.

We lacked the capability of using the temporality of the longitudinal PRAMS-2 dataset to our advantage. Hence, the cross-sectional nature of our analysis prohibited us from determining direction and causality of the associations.

The findings of this study suggest that additional well-known risk factors be re-examined with multiple years' of data to validate current preliminary findings. There is also a need for improved understanding of self-reported maternal depressive symptoms in the first two years after delivery and its effect on smoking behaviors of mothers.

Appendix A

2004 Oregon Pregnancy Risk Assessment Monitoring System
Questionnaire

Appendix B

2006 Oregon PRAMS-2

(longitudinal follow-up survey of 2004 PRAMS)

Appendix C

Calculation of un-weighted response rate for PRAMS-2:
No. of PRAMS-2 respondents/No. of women who responded to PRAMS
= 865/1,968 = 44%

Calculation of weighted response rate according to the formula identified by the CDC:
∑ PRAMS weights (of PRAMS-2 responders) / ∑ PRAMS weights (total)
= 22535.71/44131 = 51.1%

Calculation of overall response rate for both PRAMS & PRAMS-2 combined:
Response rate for PRAMS * Response rate for PRAMS-2
= 0.748 * 0.511 = 38.2%

Verification of response rate calculations with TOTS
Since 1994, the state of Oklahoma's Maternal & Child Health department has a survey called TOTS (The Oklahoma Toddler Survey), which is a 2-year longitudinal follow-up of Oklahoma PRAMS respondents. Thus, calculation of weighted response rates for PRAMS-2 and overall response rates for PRAMS & PRAMS-2 were verified with the Oklahoma state department of Maternal & Child Health.

Verification of response rate calculation with MEPS (Medical Expenditure Panel Survey)
The Medical Expenditure Panel Survey (MEPS) is a set of large-scale surveys of families and individuals, their medical providers, and employers across the United States. MEPS is the most complete source of data on the cost and use of health care and health insurance coverage. The panel design of the survey, which features several rounds of interviewing covering two full calendar years, makes it possible to examine changes in different health care related variables over time.

MEPS uses a multiplicative function of the wave or round-specific response rates to calculate the overall response rate. Detailed methodology on how overall response rates for MEPS are calculated is given in the document titled 'Medical Expenditure Panel Survey Household Component' [47].

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