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THE IMPACT OF MATERNAL SMOKING IN KENTUCKY AND EFFECT OF THE GIVING INFANTS AND FAMILIES TOBACCO-FREE STARTS PILOT PROJECT ON SMOKING CESSATION AND BIRTH OUTCOMES

Joyce Madeline Robl
University of Kentucky, joyce.robl@uky.edu

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Joyce Madeline Robl, Student

Dr. Melody Noland, Major Professor

Dr. Richard S. Riggs, Director of Graduate Studies

THE IMPACT OF MATERNAL SMOKING IN KENTUCKY AND EFFECT OF THE GIVING INFANTS AND FAMILIES TOBACCO-FREE STARTS PILOT PROJECT ON SMOKING CESSATION AND BIRTH OUTCOMES

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Education in the
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By
Joyce Madeline Robl

Lexington, Kentucky

Director: Dr. Melody Noland, Professor of Kinesiology and Health Promotion

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ABSTRACT OF DISSERTATION

THE IMPACT OF MATERNAL SMOKING IN KENTUCKY AND EFFECT OF THE GIVING INFANTS AND FAMILIES TOBACCO-FREE STARTS PILOT PROJECT ON SMOKING CESSATION AND BIRTH OUTCOMES

Smoking during pregnancy remains a significant public health issue despite knowledge about the adverse maternal and fetal health effects. This research had six purposes: identifying effective smoking cessation strategies for low income pregnant women; identifying characteristics of Kentucky women who smoke during pregnancy; estimating the role of smoking on birth outcomes in Kentucky; exploring the impact of tobacco reduction on birth outcomes; identifying the characteristics of women participating in the Giving Infants and Families Tobacco-free Starts (GIFTS) pilot program; and evaluating the impact of GIFTS on smoking status and birth outcomes.

Seven randomized controlled trials targeting low income women with smoking cessation interventions identified social support and incentives as promising strategies. Only one study focused on women living in rural settings. Live birth certificate data from 2004-2008 revealed that 26% of Kentucky women reported smoking during pregnancy. Continuing to smoke approximately doubled the odds for low birth weight (LBW) [Estimated Odds Ratio 1.95 (95% Confidence Interval 1.87-2.03)] and no breastfeeding initiation (NBI) [1.93 (1.87-1.98)] versus no pre-pregnancy smoking. Continuers also had higher odds for preterm birth (PTB) [1.25 (1.20-1.29)] and neonatal intensive care unit admissions (NICU) [1.20 (1.14-1.26)]. Reducers and quitters had increased odds of LBW and NBI. The probability of quitting relative to the probability of continuing was increased for women aged less than 25, non-White, Hispanic, graduate degree, obese and "other" payor source for the delivery.

The GIFTS program targeted pregnant women receiving local health department services who reported recent or current tobacco use. Significantly increased odds of participation were identified for women reporting 1-5 [2.05 (1.06-3.94)], 6-10 [2.06 (1.10-3.83)] and ≥11 [2.17 (1.12-4.20)] cigarettes per day compared to those reporting no cigarettes. Women with one [1.55 (1.07-2.24)] or two [1.83 (1.21-2.76)] previous quit attempts also had increased odds for participation compared to those with no quit attempts. GIFTS participants were significantly less likely to have preterm infants (p=.0369) than a matched comparison group. No significant differences were found on

tobacco cessation, tobacco reduction or cessation, LBW, NICU, or NBI. This research has implications for future cessation efforts as well as policy development.

KEYWORDS: tobacco, pregnancy, low income, cessation, preterm birth

Joyce M. Robl
Student's Signature

April 25, 2012
Date

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By

Joyce Madeline Robl

Melody Noland, PhD
Director of Dissertation

Richard S. Riggs, Ed.D
Director of Graduate Studies

April 25, 2012

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CHAPTER ONE

Introduction

Smoking before and during pregnancy is the single most preventable cause of illness and death among mothers and infants (Centers for Disease Control and Prevention, 2007). Smoking during pregnancy is associated with numerous adverse reproductive outcomes including: infertility, pregnancy complications (placental anomalies, premature rupture of membranes), adverse birth outcomes (low birth weight, preterm birth) and long term consequences for children (sudden infant death syndrome, respiratory problems) (U.S. Department of Health and Human Services, 2001, 2004).

The goal of this research was to identify strategies to increase smoking cessation among pregnant women in Kentucky and subsequently reduce the adverse effects associated with this health behavior. The purposes of this dissertation were six-fold; 1) to identify effective intervention strategies for smoking cessation among low income pregnant women; 2) to gain a better understanding of the characteristics of women who smoke during pregnancy in Kentucky; 3) to better understand the role of smoking on adverse birth outcomes in Kentucky; 4) to explore the impact of reduction in tobacco exposure on adverse birth outcomes; 5) to understand the characteristics of women who actively participated in the Giving Infants and Families Tobacco-free Starts (GIFTS) program, a pilot smoking cessation program in nine counties of Kentucky; and 6) to evaluate the impact of the GIFTS pilot project on smoking status and birth outcomes.

This dissertation is comprised of three separate papers in chapters two through four. Chapter Two describes a comprehensive literature review that addresses purpose one. Chapter Three utilizes Kentucky live birth certificate files to explore purposes two through four. Chapter Four uses data from the GIFTS program to examine purposes five and six.

Chapter Two Overview

The characteristics of the women with the highest rates of smoking during pregnancy include being white, unmarried, low income, less than a high school education, younger maternal age and with more previous births (Carlo C. DiClemente, Patricia Dolan-Mullen, & Richard A. Windsor, 2000; Fingerhut, Kleinman, & Kendrick,

1990; Holtrop et al., 2010; Ma, Goins, Pbert, & Ockene, 2005; Ockene et al., 2002). This concentration of tobacco use among the poorest women is exacerbated by other adverse health behaviors, being heavily addicted and limited psychosocial resources to overcome the addiction (Goldenberg, Klerman, Windsor, & Whiteside, 2000). Lower socioeconomic status women who continue to smoke have more psychological and emotional problems, less support and financial resources, more family problems, and less residential stability (C. C. DiClemente, P. Dolan-Mullen, & R. A. Windsor, 2000). Additionally, barriers such as transportation, child care, financial costs, time and possible resistance to revealing personal concerns to a group may result in decreased participation of this group in counseling programs (Solomon & Flynn, 2005).

The myriad of complications experienced in this population make it a difficult one to target with effective smoking cessation interventions and may require new innovative strategies. This critical review was undertaken in order to gain insight into successful strategies for smoking cessation among the low income population. The purposes of this critical review were: 1) to depict the intervention site and criteria used to identify low income women; 2) to describe the providers of the intervention; 3) to compare the interventions provided to low income women with particular attention to elements of social support, incentives and biomarker validation; 4) to summarize the results of these interventions in attaining smoking cessation during pregnancy in this population; and 5) to review the recruitment and attrition experienced in these studies.

Chapter Three Overview

An estimated 10.4% of women smoked during pregnancy in 2007 based on twenty-one states that used the 2003 U.S. Standardized Live Birth Certificate (Martin et al., 2010). Kentucky had more than double this percentage with 25.4% of women who delivered a live birth reporting that they smoked during their pregnancy (Martin, et al., 2010). A relative decline of 38% in smoking during pregnancy was observed between 1990 and 2002 nationally while Kentucky experienced only a 14.4% reduction (Centers for Disease Control and Prevention, 2004).

The increased rates of smoking during pregnancy suggest that Kentucky women may experience increased numbers of adverse birth outcomes due to continued tobacco exposures during pregnancy. This research was undertaken to increase knowledge about

the characteristics of women in Kentucky who smoke during pregnancy in order to better target prevention efforts. This research also sought to describe the role of smoking status on adverse birth outcomes including low birth weight, preterm births, NICU admissions, no breastfeeding initiation and birth defects.

The hypotheses that were addressed in this chapter include:

- There will be demographic differences (e.g. age, education level, rurality, payor source) between women who smoke during pregnancy compared to nonsmokers.
- There will be factors (e.g. race, education level, rurality, payor source, number of previous pregnancies, quantity smoked in three months prior to pregnancy) that predict tobacco abstinence or reduction of smoking by the third trimester of pregnancy among women who report smoking in the three months prior to pregnancy.
- Smokers will have increased odds of poor birth outcomes (low birth weight, preterm births, congenital anomalies, NICU admission and decreased breastfeeding initiation) compared to non-smokers. Women who quit or reduce their smoking by the third trimester of pregnancy will have birth outcomes similar to never smokers.

Chapter Four Overview

Numerous efforts focused on smoking cessation among pregnant women are documented in the literature. A systematic review of such interventions found a significant reduction in late pregnancy smoking in 6% of participating women (Lumley et al., 2009). The most effective best practice interventions rarely reached or exceeded quit rates of 20% (Orleans, Barker, Kaufman, & Marx, 2000). Additionally, these interventions had limited impact among heavier smokers, poor, and uneducated women with social networks comprised of smokers (Bullock et al., 2009).

The GIFTS smoking cessation intervention was implemented in a nine county area of rural Kentucky with high rates of women smoking during pregnancy. The program targeted any pregnant woman who received a service at the local health department. Women who reported any current or recent tobacco exposures were referred

to designated GIFTS professional staff. The program components included provision of educational materials to promote cessation, referral to the Kentucky Tobacco Quit Line, referral of family members to local tobacco control specialists for intervention, carbon monoxide monitoring, and assessments with appropriate referrals for social support, depression, and domestic violence. The GIFTS case managers attempted to contact participants at least once during each trimester of pregnancy, shortly after delivery and at three months postpartum. Small non-monetary incentives were provided to the expectant mothers at specified time points (enrollment, delivery, postpartum). A key component of the program was the provision of individualized counseling and ongoing support to program participants.

The hypotheses that were addressed in this chapter include:

- Tobacco history factors (e.g. number of years smoked, quantity smoked per day, number of previous quit attempts, number of smokers in the household, smoking within thirty minutes of waking, believes harmful effects on the fetus) will be identified that predict the women who choose to participate in the GIFTS program as compared to those who decline the program.
- Individuals referred to GIFTS who are in the preparation or action stages of change will be more likely to quit or reduce their tobacco use compared to individuals in the precontemplation or contemplation stages of change.
- A higher proportion of women who participate in the GIFTS program will quit or reduce their tobacco use compared to a matched comparison group of smokers who did not participate in the program.
- Participants in the GIFTS program will have improved birth outcomes (low birth weight, preterm births, NICU admission and breastfeeding initiation) compared to a matched comparison group of smokers who did not participate in the program.

Chapter Five Overview

Chapter Five provides a summary of the findings from the three papers in this dissertation. The findings were integrated in a comprehensive discussion that includes

practical implications for health promotion practice and recommendations for further research in smoking cessation among pregnant women. Significant efforts are needed to reduce smoking cessation rates in pregnant women resulting in improved outcomes for mothers and infants.

CHAPTER TWO

A Critical Review of Smoking Cessation Interventions for Low Income Pregnant Women

Introduction

Smoking before and during pregnancy is the single most preventable cause of maternal and infant morbidity and mortality (Centers for Disease Control and Prevention, 2007). Smoking during pregnancy is associated with numerous adverse reproductive outcomes including: infertility, pregnancy complications (placental anomalies, premature rupture of membranes), adverse birth outcomes (low birth weight, preterm birth) and long term consequences for children (sudden infant death syndrome, respiratory problems)(U.S. Department of Health and Human Services, 2001, 2004).

Despite increases in knowledge about the detrimental effects of smoking during pregnancy, an estimated 10.4% of women smoked during pregnancy in 2007 based on twenty-one states using the 2003 U.S. Standardized Live Birth Certificate (Martin et al., 2010). The highest rates of smoking during pregnancy are found among women who are white, unmarried, low income, with less than a high school education, younger maternal age, and a greater number of previous births (DiClemente, Dolan-Mullen, & Windsor, 2000; Fingerhut, Kleinman, & Kendrick, 1990; Holtrop et al., 2010; Ma, Goins, Pbert, & Ockene, 2005; Ockene et al., 2002). Smoking characteristics of these women include that they were of a younger age when they started smoking, have high levels of addiction, low levels of self-efficacy, and have a partner who smokes (Ma, et al., 2005; Ockene, et al., 2002; Ruger, Weinstein, Hammond, Kearney, & Emmons, 2008).

Pregnancy is an optimal time to promote smoking cessation because many women are concerned about the potential effects from smoking on their fetus. A wide variety of interventions have been used to promote smoking cessation during pregnancy. A recent meta-analysis, however, revealed that these interventions result in only about a six percent reduction in smoking (Lumley et al., 2009). Best practice interventions have had limited impact on pregnant women who are heavier smokers, poor, undereducated and have social networks with many smokers (L. Bullock et al., 2009). Spontaneous quit rates vary from 11% to 28% among publicly insured smokers and 40% to 65% among privately insured pregnant smokers (Melvin & Gaffney, 2004).

Low income women may be less likely to receive ongoing prenatal care and therefore may not be exposed to repeated cessation or intervention messages offered within routine prenatal care (Parker et al., 2007). Continuing smokers may also have multiple complex problems as evidenced by their having more psychological and emotional problems, less support and financial resources, more family problems and decreased residential stability (DiClemente, et al., 2000). These issues suggest that innovative strategies may be needed to attain increased smoking cessation rates in this population.

This study was undertaken to gain a comprehensive view of recent smoking cessation interventions targeting low income women. The purpose of this critical review was fivefold: 1) to depict the intervention site and criteria used to identify low income women; 2) to describe the providers of the intervention; 3) to compare the interventions provided to low income women with particular attention to elements of social support, incentives and biomarker validation; 4) to summarize the results of these interventions in attaining smoking cessation during pregnancy in this population; and 5) to review the recruitment and attrition experienced in these studies. The findings from this review may be useful in identifying promising strategies to reach this underserved population.

Methods

A comprehensive literature search was conducted using an OVID SP search engine with the resources of Journals@ Ovid Full Text, Allied and Complementary Medicine, Current Contents, Ovid Medline and Psyc Info. The following words or a portion of these words were used in the search: pregnancy, smoking or tobacco, intervention, randomized and low income. The results were limited to articles written in the English language from 1995 to 2010. Articles were excluded for the following reasons: 1) utilizing a study research design other than subject level randomization; 2) studies that did not include an outcome measure of smoking cessation during pregnancy; 3) interventions that focused on a broader scope of birth outcomes than smoking cessation alone; and 4) studies that focused solely on the postpartum period and relapse prevention.

This critical review focused on randomized controlled trials and the decision to exclude those with site randomization was due to the variability in program

implementation that is often a critical factor in this research design. As the major focus of this review was the effectiveness of smoking cessation interventions, those studies that did not report an outcome for cessation or that utilized numerous strategies to address a broader scope of outcomes were excluded. Finally, the focus of this review was smoking cessation among pregnant women and those focused solely on the postpartum period were excluded as different interventions may be more effective in the postpartum period due to differences in concerns about the health effects of smoking, stressors and triggers during these two time periods.

A review of all titles and abstracts that were identified in the literature search was completed to identify those articles that met the criteria for inclusion in the study. All review articles and meta-analyses identified in the search were reviewed for potential articles that focused on smoking cessation among low income pregnant women. The references for each of the studies included were also reviewed to identify potential articles.

Results

The comprehensive literature search resulted in a total of 9,891 unduplicated articles which reduced to 9,852 when limited to those in the English language and 9,715 published from 1995 to the present. A total of seven studies were identified that described randomized control trials of a smoking cessation intervention targeting low income pregnant women (L. Bullock, et al., 2009; R. J. Donatelle, Prows, Champeau, & Hudson, 2000; Dornelas et al., 2006; Gielen et al., 1997; Malchodi et al., 2003; Secker-Walker, Solomon, Flynn, Skelly, & Mead, 1998; Windsor et al., 2000).

Tables 2.1 through 2.3 provide a summary of the interventions included in this review. Table 2.1 provides a description of the recruitment site, low income criteria and inclusion/exclusion criteria for the included studies. Table 2.2 outlines the number of subjects eligible and enrolled for each intervention along with the intervention provider and a brief description of the intervention and control groups. Table 2.3 outlines incentives, social support, and biochemical validation components of the intervention along with a description of attrition and smoking cessation outcomes during pregnancy for the interventions.

The interventions included in this study occurred in Maryland (1), Vermont (2), Oregon (3), Alabama (4), Connecticut (5, 6) and the Midwest (7). Six of the studies were undertaken in urban settings, while only one study (7) specifically targeted rural women.

Three of the seven interventions (1, 5 and 6) occurred in obstetric clinics in which the low income description was that the clinic population was primarily low income or on medical assistance. Study two also occurred in an obstetric clinic that provided services to women receiving state support for their care or underserved women and adolescents. Two studies (3 and 7) focused on participants in the Women, Infants and Children (WIC) program while study 4 targeted Medicaid recipients. Criteria for participation varied among the studies although many of the interventions had a maternal age, gestational age and language requirement for subject inclusion.

Two of the studies (1, 5) used peer counselors to provide the intervention. Intervention 1 used a peer health counselor who was recruited from the community while intervention 5 used existing community outreach workers to implement the program. Studies 2 and 4 used only existing staff (physicians, nurses, social services and WIC) in the intervention site to provide the intervention. Study 3 used existing WIC staff in addition to research study staff. Trained research study staff were used in studies 6 and 7 to implement the program. Study 6 used master's prepared mental health counselors while study 7 used registered nurses.

The intervention for three of the seven studies (1, 2, 4) were comprised of individualized counseling for smoking cessation with reinforcement in the clinic setting throughout pregnancy. One intervention used individualized counseling with peer counselors and set a target of eight visits during pregnancy (5). The intervention in study 3 focused on designation of a social supporter and provision of incentives for the participant and social supporter. The intervention in study 6 was comprised of 90 minute psychotherapy sessions at the clinic with telephone follow-up throughout pregnancy. Three different intervention groups were included in study 7 with one focused on educational booklets, one on social support alone and one with a combination of the two with weekly phone calls and 24 hour nurse access for additional social support.

Only one study used incentives as a component of the intervention (3) as mentioned above. All seven studies incorporated some level of social support. Social

support was an integral component of studies 3 and 7. Study 3 had the participant identify the social supporter, while study 7 used a registered nurse in the support role. All of the studies used a biochemical marker for validation of smoking status.

Only three of the seven studies report significantly higher smoking cessation rates in the treatment group compared to the control groups (3, 4 and 6). Study 3 found that 32% of those in the treatment group were biochemically confirmed quitters at 8 months gestation compared to 9% in the control group. Study 4 found 17.3% in the treatment group and 8.8% in the control group were abstinent at least 60 days after their first visit. Study 6 found abstinence rates of 28.3% in the treatment group and 9.6% in the control group at the end of pregnancy.

The percentage of eligible participants that enrolled in the program ranged from 68.1% in study 4 to 94.5% in study 2. Percent enrollment could not be determined for study 5. In reviewing the attrition of each study at the time of determination of pregnancy smoking cessation rates, two studies had less than 10% attrition in the treatment group (no attrition in study 6, 5.7% to 8.2% in study 7). Study 4 had 13% unavailable for follow-up, while attrition in the remaining three studies (1, 2, 3) ranged from 31.5% to 40.4%.

Discussion

This critical review identified seven studies that implemented smoking cessation interventions specifically targeted to low income women. These women comprise an important target group for smoking cessation during pregnancy interventions as they are less likely to quit smoking spontaneously, and previous studies have shown that they are less amenable to interventions.

While all of the articles included in this review reported that the subjects were low income, only three studies used a target population with an income criteria for participation (WIC and Medicaid). In order to identify the most effective interventions for this underserved population, it is critical that studies truly target the low income population. Further, only one study was identified that provided an intervention to low income women in a rural setting. A study from twenty-one states using the Pregnancy Risk Assessment Monitoring System (PRAMS) 2002 data reported that low income smokers were more likely to live in less urbanized areas with reduced access to

physicians and neonatal intensive care beds (Adams, Melvin, & Raskind-Hood, 2008). Future studies may be enhanced by ensuring that a criterion to define low income is established within the study design. Further research is needed to establish effective interventions for women living in a rural setting.

The intervention providers in these studies were either primary care providers in the clinics, research staff, peer counselors, or a combination of primary providers and research staff. The utilization of existing health care providers may improve compliance, minimize costs and endure beyond a research study (Pbert et al., 2004). However, these health workers have a heavy workload such that even if the smoking cessation program is important to staff, it may not receive the attention necessary to be successful (Goldenberg, Klerman, Windsor, & Whiteside, 2000). The most effective counselor may vary by setting and environment, social and cultural therefore requiring further research in this area (Gielen, et al., 1997).

Many of the interventions focused on a brief intervention by the primary care providers to encourage smoking cessation in combination with individualized counseling and support. This brief medical quitting advice and counseling along with self-help materials in routine prenatal care has produced quit rates that are significantly higher (14-16%) than usual care (5-6%) (Orleans, Barker, Kaufman, & Marx, 2000). Previous pilot studies have suggested that feedback based on biochemical measures of smoking and incentives may increase smoking cessation rates among pregnant women (Goldenberg, et al., 2000). All of the studies in this review included biochemical verification of smoking quit status, however, it was unclear if this information was always conveyed to the participants.

One study (3) used monetary incentives for the participant and the social supporter. Financial incentives have been shown to be effective in three areas of smoking cessation including motivating attendance or participation, increasing abstinence, and preventing short term relapse (Rebecca J. Donatelle et al., 2004). Concerns related to the ethics of "buying" abstinence in an already vulnerable population and the translation of this strategy into routine care has been raised (Melvin & Gaffney, 2004).

Three studies used social support as a significant component of the intervention (3, 6, and 7). A major factor in smoking cessation is the smoking behavior and support of

the pregnant woman's partner and support persons (Melvin & Gaffney, 2004). Pregnant smokers report greater stress during pregnancy compared with nonsmokers (L. F. Bullock, Mears, Woodcock, & Record, 2001). These women are also more likely to have stressful intimate relationships, including partnerships characterized by domestic violence (Weaver et al., 2008). Further, the study using 2002 PRAMS data documented that over one-half of low income smokers were uninsured prior to pregnancy and that one-quarter reported multiple stressors including 36% with stress from drugs, 40% binge drinking and almost 11% reporting physical abuse (Adams, et al., 2008). Interestingly, none of the studies described a component addressing partner social support or smoking status. Partner smoking has a significant contribution to continuation of smoking during pregnancy and postpartum relapse (DiClemente, et al., 2000). Interventions that target low income women should be set in the context of the woman's real life problems (DiClemente, et al., 2000). Three studies (3, 4, 6) were identified that showed significantly increased smoking cessation rates in participants. Two of these studies (3, 6) had strong components of social support. These results provide more evidence that attempting smoking cessation efforts must consider the context in which women are living in order to show success. The highest cessation rates were found in study 3 that used incentives in addition to social support. Further research is needed to elucidate the role incentives may play in successful smoking cessation interventions. Expanding the social support arms of interventions to include the partner of these women in cessation attempts may also be useful to enhance programs.

Few studies were identified that met the stringent criteria for high quality studies in this review so further evaluation of the three studies with positive effects on smoking cessation is warranted. These studies were diverse in their location (Oregon, Alabama, Connecticut). The providers of the interventions in these studies were all professional staff. All studies incorporated a combination of written educational materials and individualized counseling sessions with clients, and included social support as a component. Interestingly, one of these three studies had no attrition from the study during pregnancy (6) suggesting that social support in combination with a mental health intervention may increase engagement of low income clients. The characteristics of these successful interventions (utilization of professional staff and multiple components

including social support) should be used to guide future research with low income pregnant women.

The highest recruitment rates were seen in study 2 that took place in a clinic setting. In the remaining studies, 23% to 31.9% of eligible subjects did not enroll in the intervention. Recruitment is a critical opportunity to maximize the public health impact with pregnant women (Ruggiero, Webster, Peipert, & Wood, 2003). A second issue is retaining these women in interventions. In this review, four of the seven studies (1, 2, 3, and 5) had attrition rates greater than 30%. Low income women may experience many barriers to participating in interventions including transportation, child care, financial costs, time and possible resistance to revealing personal concerns to a group (Solomon & Flynn, 2005). Further qualitative research may be helpful in determining factors and interventions that will more fully engage this population in smoking cessation efforts.

Limitations with this study include a lack of consistent criteria for defining low income in the studies identified. This may have resulted in the inclusion of participants in the studies who were not low income.

Conclusions

Smoking cessation interventions were identified that target low income women although not all studies had specific criteria to ensure that the participants were low income. Social support and incentives were identified as two strategies that increased smoking cessation rates in pregnant women. Brief provider advice to quit smoking with patient centered counseling was also shown to be effective with this population. Further research is needed to identify strategies that will improve the recruitment and retention of low income smokers into interventions and to identify interventions that are effective with women living in the rural setting. Further exploration of the role of social support (including involvement of the partner or significant other) and the use of incentives with low income women is needed to enhance efforts to increase smoking cessation rates in this population.

Table 2.1 Description of recruitment site, low income criteria and inclusion/exclusion criteria for included studies

Study	Year	Citation	Recruitment Site	Low Income Description	Inclusion Criteria	Exclusion Criteria
1	1997	(Gielen et al., 1997)	Obstetrical care outpatient clinic at Johns Hopkins Hospital	Most women were on medical assistance	• Self-reported smokers (even a puff in the last 7 days) • <28 wks gestation • African-American or White	• Changing to another prenatal clinic • Could not complete baseline interview at first prenatal visit
2	1998	(Secker-Walker, Solomon, Flynn, Skelly, & Mead, 1998)	University of Vermont, University Associates in Obstetrics and Gynecology	State supported clinic for underserved women or the adolescent clinic for ages 12-18	• Women smoking one or more cigarettes per day at their first visit	• None noted
3	2000	(Donatelle, Prows, Champeau, & Hudson, 2000)	Four Oregon WIC program sites	WIC participants	• Self-reported smokers (even a puff in the last 7 days) • ≥15 yrs old • English speaker/ reader	• Predetermined withdrawal criteria included pregnancy termination and fetal demise.
4	2000	(Windsor et al., 2000)	Maternity care sites in Alabama	Medicaid recipients	• Self-reported smokers	• None noted
5	2003	(Malchodi et al., 2003)	Hartford Hospital, a large urban obstetric clinic in Hartford, CT	All pregnant women at clinic screened; notes that the clinic serves a primarily low income pregnant population	• Current smoker • Documented pregnancy with intention to carry to term • < 20 wks gestation • Speaks English or Spanish • ≥18yrs old	• Women using smokeless tobacco or nicotine replacement products • Self-reported current substance abuse or dependence

Table 2.1 (continued)

Study	Year	Citation	Recruitment Site	Low Income Description	Inclusion Criteria	Exclusion Criteria
6	2006	(Dornelas et al., 2006)	Prenatal clinic in a non-profit tertiary care community hospital in Hartford, CT	Low income	• Current smokers • ≥18 yrs old • ≤30 weeks gestation	• Recent hx (prev 6 mos) of abuse or dependence on alcohol or other non-nicotine substance • Major psychiatric illness • Lack of telephone
7	2009	(Bullock et al., 2009)	21 Rural Women Infant and Children Nutritional Supplement (WIC) clinics in Midwest	WIC participants	• Women who reported smoking at least 1 cigarette per day • ≥18 yrs old • <24 wks gestation	• None noted beyond inclusion criteria.

Table 2.2 Number of subjects, intervention provider and descriptions of intervention and control groups

Study	# Subjects Eligible	# Enrolled (% of Eligible)	Provider	Intervention (I)	Control (C)
1	660	510 (77%)	Peer health counselor was a woman recruited from neighboring community	1. A Pregnant Woman's Guide to Quit Smoking (sixth grade reading level) 2. 15 min. one-to-one counseling session with peer health counselor on how to use the guide 3. Educational materials for cessation support persons 4. Clinic reinforcement and support including verbal support, written prescription to stop and 2 letters of encouragement	1. Usual clinic and inpatient counseling including a brief discussion from nurse about risks of smoking, a recommendation to quit and pamphlets from area voluntary agencies
2	380	359 (94.5%)	Physicians and nurses	1. Structured advice from physician on five visits including acknowledging smoking and CO level, progress and feelings about quitting, recommendation to stop, eliciting a commitment to change and discussion about and referral to counselor 2. Counselor advised on ways to accomplish behavior change	1. Physician acknowledged smoking, rationale for stopping, strong recommendation to quit and provided smoking cessation booklet 2. Prompt at first prenatal visit only
3	309	220 (71.2%)	WIC or research study staff	1. Designate a social supporter, preferably female non-smoker 2. Incentives for participant and social supporter if biochemically verified quit status 3. Monthly telephone calls for self-reported quit status	1. Verbal and written information on importance of smoking cessation 2. Self-help kit, *A pregnant woman's guide to smoking*

Table 2.2 (continued)

Study	# Subjects Eligible	# Enrolled (% of Eligible)	Provider	Intervention (I)	Control (C)
4	389 (Phases I and II)	265 (68.1%)	Primary patient educators chosen from prenatal care providers at each site (nursing, social services, WIC)	1. Ask and Advise as for control 2. Assist and Arrange (videocassette: *Commit to Quit During and After Pregnancy*, booklet *A Pregnant Woman's Guide to Quit Smoking*, and patient centered counseling session of ≤ 5 mins.	1. Ask (tobacco status identified) 2. Advise (health risks discussed, clear message to quit and eliminate ETS)
5	Not provided	142	Nonsmoking peer counselors from an existing pool of community outreach workers with the same social-environmental and cultural qualities of participants	1. Smoking cessation counseling (target: 8 visits) including encouragement to quit, communicate caring and concern, encourage discussion about quitting process and reinforce information about smoking and successful quitting.	1. Health care provider delivered strong quit message, discussed risk associated with smoking and distributed educational materials - "Quitting for You 2". 2. Assessed readiness to quit, provided smoking cessation counseling and documentation.
6	140	105 (75%)	Master's prepared mental health counselors trained in smoking cessation	1. 90 min psychotherapy session at clinic 2. Bi-monthly telephone calls during pregnancy 3. Monthly telephone calls after delivery	1. Educational booklet 2. Chart prompt to give personalized quit message each visit 3. Documentation in chart

Table 2.2 (continued)

Study	# Subjects Eligible	# Enrolled (% of Eligible)	Provider	Intervention (I)	Control (C)
7	932	695 (74.6%)	Nurses	3 groups: 1. Social Support Plus Booklets • Scheduled weekly telephone call • 24 hour access for any additional social support needed • 8 booklets comprising a program "Stop Smoking! A Special Program for Pregnant Women" 2. Social Support Alone 3. Booklets Alone	1. Usual care 2. *Quit Smoking for Good* pamphlet from American Heart Association.

Table 2.3 Description of incentives, social support, biochemical verification and measures for the intervention

Study	Incentive	Social Support	Biochemical Validation (Cutoff)	Attrition for Smoking Status	Smoking Cessation Results
1	None	Peer counseling discussion about the woman's thoughts and concerns about quitting Clinic reinforcement support both verbally and through letters of encouragement	Salivary cotinine (30 ng/ml)	I Group: 40.4% at third trimester and 70.2% at 6 mos postpartum C Group: 38.9% at third trimester and 71.7% postpartum	3rd trimester: 6.2% in I group and 5.6% in C group (NS) Reduction of cotinine value by 50% during pregnancy was 11% in both groups.
2	None	Individualized counseling discussed ways to achieve behavior change; quitters were praised for success	CO (>6 ppm) Urinary cotinine (500 ng/ml)	I Group: 31.5% at 36 wk visit; C Group: 30.2% at 36 wk visit	36 wk visit: 14.1% in I group and 9.9% in C group (NS)
3	Vouchers worth $50/mo for confirmed quitters (each mo through 2 mos PP)	Designated social supporter offered peer support and received $50 voucher 1st quit mo, $25 other quit mo, and $50 last quit mo	Salivary cotinine (30 ng/ml) Salivary thiocyanate (100 µg/ml)	I Group: 32% at 8 months gestation and 36% at 2 mos postpartum C Group: 51.5% at 8 mos gestation and 52% at 2 mos postpartum	8 mos gestation: 32% in I group were biochemically confirmed quitters vs. 9% in C group ($p<0.0001$)

Table 2.3 (continued)

Study	Incentive	Social Support	Biochemical Validation (Cutoff)	Attrition for Smoking Status	Smoking Cessation Results
4	None	Patient centered counseling included clarification of concerns	Salivary cotinine (30 ng/ml)	34 (13%) unavailable for follow-up	≥60 days after first visit: 17.3% in I group and 8.8% in C group (O.R. = 2.2 [95% C.I. 2.2-4.1]
5	None	Peer counselors provided encouragement and communicated caring and concern	CO (<8 ppm) Urinary cotinine (200 ng/mL)	I Group: 43% C Group: 36%	36 wks gestation: 24% of I group and 21% of C group were abstinent (not statistically significant) Reduction in daily smoking was statistically significant in I group compared to C group (9.1 cigs/day vs 4.5 cigs/day) (p=.03)
6	None	Identify potential psychological or social problems that might be barrier to quitting	CO (<8 ppm)	None during pregnancy; 18% at 6 months postpartum	Abstinence rates at end of pregnancy: 28.3% in I group vs. 9.6% in C group (p=0.015)
7	None	During calls, nurses used empathetic listening skills and provided social, emotional and/or informational support in response to individual needs.	Salivary cotinine (30 ng/ml)	Social Support Plus Booklets: 5.7%; Social Support Alone: 8.6%; Booklets Alone: 8.2%; Control: 5.6% Note: Attrition numbers include only those who dropped out or were lost to follow-up.	Last cotinine value before delivery: 17.0% in social support plus booklets; 22.0% in social support alone, 19.2% in booklets alone and 17.2% in control group (NS)

CHAPTER THREE

An Analysis of the Impact of Smoking during Pregnancy on Birth Outcomes in Kentucky

Introduction

Smoking during pregnancy is associated with numerous adverse reproductive outcomes including infertility, pregnancy complications (placental anomalies, premature rupture of membranes), adverse birth outcomes (low birth weight, preterm birth) and long term consequences for children (sudden infant death syndrome, respiratory problems) (U.S. Department of Health and Human Services, 2001, 2004). Despite increases in knowledge about the detrimental effects of smoking during pregnancy, only 18% to 25% of women quit smoking when they become pregnant (U.S. Department of Health and Human Services, 2004).

The prevalence of smoking during pregnancy has declined over the past two decades throughout the United States. According to 2007 final birth data (Martin et al., 2010), an estimated 10.4% of women smoked during pregnancy based on twenty-one states using the 2003 U.S. Standardized Live Birth Certificate. Kentucky has more than double the prevalence with 25.4% of women smoking during pregnancy (Martin, et al., 2010). In 2002, the last year of a national ranking on this issue, Kentucky had the second worst rate of smoking in pregnancy among all states and the District of Columbia (Centers for Disease Control and Prevention, 2004). Nationally, there was a 38% decline in smoking prevalence during pregnancy from 1990 to 2002 compared to only a 14.4% reduction in Kentucky (Centers for Disease Control and Prevention, 2004). Women 15-19 years of age who smoked during pregnancy in Kentucky increased by 4% between 1990 and 2002 compared to a 16% decline nationwide (Centers for Disease Control and Prevention, 2004). While this increase was not statistically significant, it may reflect a trend in Kentucky with which to be concerned.

A wide variety of interventions have been used to reduce smoking during pregnancy. A meta-analysis of these interventions found only about a six percent reduction in smoking (Lumley et al., 2009). Characteristics associated with continuing to smoke during pregnancy include younger maternal age, non-Hispanic white or American

Indian, lower education levels, lower income, higher parity, unmarried, low levels of social support, receive publicly funded maternity care and more likely to feel criticized by society (Centers for Disease Control and Prevention, 2004; Lumley, et al., 2009).

Prenatal smoking is associated with 30% of small for gestational age infants and 10% of preterm infants (Tong, Jones, Dietz, D'Angelo, & Bombard, 2009). Evidence has documented the relationship between maternal smoking and preterm births (less than 37 weeks completed gestation) with adjusted odds ratios of 1.2 to 1.3 among smokers compared to nonsmokers (U.S. Department of Health and Human Services, 2004).

Low birth weight (<2500 grams) has also been linked to maternal smoking. Studies show that women who smoke throughout pregnancy have infants who weigh about 200 grams less on average than infants of nonsmokers, and there appears to be a dose-response relationship (U.S. Department of Health and Human Services, 2004). Smoking during pregnancy is also associated with an increase in admissions to the neonatal intensive care unit (NICU) and decreased initiation and duration of breastfeeding (U.S. Department of Health and Human Services, 2001).

Research has demonstrated that smoking cessation during pregnancy results in improved birth outcomes for infants when compared to women who continue to smoke throughout pregnancy. Women who stop smoking in the first trimester (Polakowski, Akinbami, & Mendola, 2009) or prior to fifteen weeks gestation (McCowan et al., 2009) reduce the risks of preterm birth and small for gestational age infants compared to those of nonsmokers. There is, however, limited and conflicting literature about the effects of reductions in tobacco exposure and its impact on birth outcomes. England and researchers (2001) demonstrated that women who reduce their tobacco exposure by fifty percent have infants with a mean increased birth weight of 32 grams which was not found to be statistically significant. Further, these authors suggested that in order to improve birth weight, women who smoke may need to reduce their exposure during pregnancy to less than eight cigarettes per day (England et al., 2001).

The characteristics of women who smoke and adverse birth outcomes have been studied on a national level; however no studies have been completed in Kentucky where smoking rates have not declined as much as other states in the past decade. The higher rates of smoking during pregnancy suggest that newborns in Kentucky may be at a higher

risk for adverse birth outcomes. A greater understanding of the characteristics of pregnant women in Kentucky who smoke during pregnancy, and those who quit during their pregnancy may provide insight into the development of more effective interventions for this population.

The purpose of this study was threefold: 1) to gain a better understanding of the characteristics of pregnant smokers in Kentucky; 2) to estimate the role of smoking in adverse birth outcomes and the influence of quitting or reducing tobacco use on these outcomes; and 3) to identify the characteristics of women who are more likely to respond to interventions so that future efforts may target this group.

Methods

The data source used for this analysis was live birth certificate files for the calendar years 2004 through 2008 from the Kentucky Office of Vital Statistics. During this time period, Kentucky utilized the 2003 U.S. Standardized Live Birth Certificate. A copy of Kentucky's live birth certificate is available in appendix A. Plural births and births to non-Kentucky residents were excluded from the analyses. Variables used in this study included smoking, demographic and birth outcome variables.

Smoking exposure was classified by smoking status (nonsmoker, smoker) and quit status by the third trimester of pregnancy (quit, reduced, continued). Records were categorized as either nonsmokers or smokers based on response to the number of cigarettes smoked per day during each of the three trimesters of pregnancy. Any woman with reported tobacco use during any trimester of pregnancy was classified as a smoker. Smokers were also categorized into three groups based on reported tobacco use during the third trimester of pregnancy. These three groups included: 1) Women who quit smoking (report zero cigarettes per day but smoked in the three months prior to pregnancy); 2) Women who reduced their smoking by at least 50% (reported less than or equal to one-half the number of cigarettes reported in the three months prior to pregnancy); and 3) Women who continued smoking (reported greater than one-half the number of cigarettes reported in the three months prior to pregnancy).

Demographic variables included maternal age, race, ethnicity, maternal education, marital status, payment source, parity, pre-pregnancy body mass index (BMI), rurality, participation in the Women, Infants and Children (WIC) program and timing of entry into

prenatal care. Maternal age was determined by the difference between maternal and child dates of birth and was then categorized into five groups: <20, 20-24, 25-29, 30-34 and ≥35 years. Race was categorized into three groups including white, black and other. The other category was comprised of American Indian or Alaska Native, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, other Asian, Native Hawaiian, Guamian or Chamorro, Samoan, other Pacific Islander and any other reported race. Ethnicity was described as Hispanic (Mexican American, Chicana, Cuban or other Spanish/Hispanic/Latina) or non-Hispanic. Maternal education categories included less than high school diploma (8th grade or less and 9th to 12th grade, no diploma), high school, some college, college degree (Associate's or Bachelor's degree) and graduate degree (Master's or Doctorate degree). Marital status was dichotomized as married or unmarried. The payment source was based on responses to the principal source of payment for the delivery with three categories: Medicaid, private insurance and other (self-pay, other). Parity was the number of previous live births. The total number of live births was then categorized into four groups including 0, 1, 2 and 3 or more children. Pre-pregnancy BMI was calculated based on mother's height and pre-pregnancy weight using the formula, BMI = [Weight (lb) x 703] ÷ [Height (in) ^{2}]. BMI was then classified into four groups: underweight (<18.5), normal weight (18.5 - 24.9), overweight (25.0-29.9) and obese (≥30). Pre-pregnancy height and weight was self-reported by the mother on the birth certificate. Rurality was described using rural-urban continuum codes which are a classification system that distinguishes metropolitan and nonmetropolitan counties by degree of urbanization and adjacency to a metro area or areas (U.S. Department of Agriculture, 2004). In this study, the rural-urban continuum codes of 0, 1, 2 and 3 were considered urban, codes 4, 5, and 6 were semi-rural and codes 7, 8 and 9 were rural. WIC participation was dichotimized into two groups: yes or no. The month in which prenatal care was initiated was determined by comparison of the gestational age at the time of delivery with the date of the first prenatal visit. Entry into prenatal care was categorized into four groups: first trimester (months 1, 2 and 3), second trimester (months 4, 5 and 6), third trimester (≥ 7 months), and no prenatal care.

The birth outcomes used in this study were low birth weight (LBW), preterm birth (PTB), birth defects, NICU admission, and no breastfeeding initiation. Infants were

classified as LBW if the reported weight was <2500 grams. PTB was defined as a gestational age of <37 weeks. A child reported to have one or more of the birth defects included on the live birth certificate (anencephaly, spina bifida, congenital heart disease, congenital diaphragmatic hernia, omphalocele, gastroschisis, limb reduction defect, cleft lip with or without cleft palate, cleft palate, Down syndrome, suspected chromosomal disorder and hypospadias) was considered to have a birth defect. Breastfeeding initiation was dichotomized into the two groups of yes or no/unknown.

Implausible values were coded to missing values for the analyses. These included the following observations: <12 years and >55 years for maternal age; pre-pregnancy weights >550 pounds; pre-pregnancy heights of 7 and 8 feet; >70 prenatal visits; birth weights <100 grams and >6000 grams; and gestational ages >44 weeks.

Institutional Review Board (IRB) approval was obtained from two entities for this project. Approval was obtained from the Cabinet for Health and Family Services, which is responsible for maintenance of Vital Statistics data in Kentucky, and the University of Kentucky.

All statistical analyses were completed using SAS version 9.2. A p-value of ≤ 0.05 was considered statistically significant. The demographic characteristics of smokers and nonsmokers were summarized with counts and percentages. The chi square test of independence was used to determine if these demographic variables were associated with smoking. Counts and percentages were used to describe the smoking status in the three trimesters of pregnancy based on smoking status in the three months prior to pregnancy.

Unadjusted odds ratios were estimated for each of the five birth outcomes using quit status as the explanatory variable with women who had not smoked in the three months prior to pregnancy treated as a reference group. Multivariable logistic regression was completed for all outcomes with statistically significant unadjusted odds ratio estimates for smoking quit status. Manual backward elimination was completed to remove variables from the multivariable logistic regression model that were not statistically significant. The effects of explanatory variables were described using point and interval estimates of the odds ratios.

Polytomous logistic regression using the multinomial logit model was completed to estimate the probability of quitting or reducing smoking compared to continuing in

terms of demographic variables. Point and interval estimates were used to describe the multiplicative changes in ratios of such probabilities corresponding to changes in the demographic variables. The final model was then used to predict quitting, reducing, and continuing for subjects in the data set based on their demographic variables and these predictions were compared to the subjects' actual quit status.

Results

There were 270,886 singleton Kentucky resident live births from 2004 to 2008. Twenty-six percent of these women (70,185) smoked during their pregnancy. Compared to nonsmokers, these women were more likely to be: younger, white, non-Hispanic, less educated, unmarried, live in a rural county and have at least one child (Table 3.1). Seventy-one percent of pregnant smokers had Medicaid coverage for their delivery compared to 35% of nonsmokers. Similarly, 72% of smokers participated in the WIC program during their pregnancy compared to 42% of nonsmokers. Smokers were also more likely to begin prenatal care after their first trimester than nonsmokers (35.5% compared to 25%). Of women with a pre-pregnancy BMI in the underweight category, 41.8% were smokers. Among women living in rural counties, 34.2% were smokers compared to 29.9% and 21.5% of semi-rural and urban counties respectively.

From 2004 through 2008, 78,162 women reported smoking in the three months prior to pregnancy on the live birth certificate. Of these women, 87.1% (68,039) reported smoking in the first trimester of pregnancy with 81.2% (63,492) and 79.6% (62,200) reporting smoking in the second and third trimesters respectively.

Women who continued smoking throughout their pregnancy had increased unadjusted odds for low birth weight [est. OR=2.24 95% C.I. (2.17-2.32)], preterm birth [est. OR=1.42 95% C.I. (1.38-1.47)], NICU admissions [est. OR=1.30 95% C.I. (1.24-1.35)] and not initiating breastfeeding [est. OR=3.99 95% C.I. (3.89-4.08)] compared to women who did not smoke in the three months prior to pregnancy. Women who reduced their smoking had increased odds for all of these outcomes except NICU admissions, while women who quit smoking had increased odds for all outcomes except preterm birth (Table 3.2). Except for NICU admissions, an increase in estimated odds ratios is noted across the three levels of quit status with quitters having the lowest estimated odds and

continuers the highest estimated odds on low birth weight, preterm birth and no breastfeeding. Quit status was not significantly associated with birth defects.

Continuing to smoke throughout pregnancy was associated with almost double the odds for low birth weight [est. AOR=1.95 95% C.I. (1.87-2.03)] and not breastfeeding [est. AOR=1.93 95% C.I. (1.87-1.98)] compared to women who did not smoke in the three months prior to pregnancy and controlling for demographic factors selected by backward elimination (Table 3.3). These women also had higher estimated odds for preterm delivery [est. AOR=1.25 95% C.I. (1.20-1.29)] and NICU admissions [est. AOR=1.20 95% C.I. (1.14-1.26)]. Women who reduced their smoking had increased odds for low birth weight [est. AOR=1.65 95% C.I. (1.56-1.73)] and not breastfeeding [est. AOR=1.64 95% C.I. (1.59-1.70)] but curiously had slightly lower odds for NICU admission. Women who quit smoking by the third trimester of pregnancy had increased odds for delivery of a low birth weight child [est. AOR=1.18 95% C.I. (1.10-1.26)] and not breastfeeding [est. AOR=1.09 95% C.I. (1.06-1.13)] compared to women who did not smoke in the three months prior to pregnancy when controlling for all other variables in the model.

The polytomous logistic regression revealed that the probability of quitting relative to the probability of continuing was increased for women with characteristics of less than 25 years of age, black or other races, Hispanic ethnicity, graduate degree, obese, and "other" payor source for the delivery compared to their corresponding reference categories (Table 3.4). In particular, the probability of women less than 20 years of age quitting relative to their probability of continuing was an estimated 58% higher than for otherwise similar women ages 25-29 years. A reduced probability of quitting relative to the probability of continuing was noted for lower education levels, unmarried women, Medicaid recipients, one or more children, underweight, rural, WIC participants and those with late entry into prenatal care compared to their corresponding reference categories. In particular, the probability of rural women quitting relative to continuing was an estimated 43% lower than for otherwise similar urban women.

The probability of reducing tobacco exposure compared to continuing was higher among women less than 20 years of age and with "other" payor source. Reduced probabilities of reducing compared to continuing were noted for women over 30 years of

age, with education levels of less than or equal to a high school degree, with one or more children, overweight, rural or semi-rural counties, and no prenatal care. In particular, the probability of women from a rural county reducing relative to continuing was an estimated 29% lower than for otherwise similar urban women.

The polytomous model correctly assigned 52.8% of the subjects into their actual quit status group. The model was best at predicting continuers with 91.6% correctly assigned. Only 29.7% and 2.3% of quitters and reducers respectively were correctly assigned to their quit status.

Discussion

This study has demonstrated that despite knowledge about the adverse effects associated with smoking, a large number of pregnant women (26%) in Kentucky continue to smoke throughout their pregnancy; more than double the 10.4% estimated in the Nation (Martin, et al., 2010). This increased rate of smoking during pregnancy increases the risk for adverse birth outcomes among newborns in Kentucky.

Spontaneous quit rates during pregnancy have been estimated between 20% and 28% among settings serving lower income women and 40% to 65% among settings serving privately insured women (Solomon & Quinn, 2004). The proportion of women who quit by the first trimester of pregnancy may be considered a proxy for spontaneous quitting (Solomon & Quinn, 2004). These data suggest only a 12.9% reduction by the first trimester among Kentucky women who were smoking prior to pregnancy. Further, only 20.4% of women had quit by the third trimester of pregnancy. Vast improvements will be necessary to achieve the Healthy People 2020 goal of 30% cessation by the first trimester of pregnancy (Healthy People 2020).

The characteristics associated with smoking during pregnancy that were identified in this study include younger maternal age, white, non-Hispanic, less educational achievement, and Medicaid as the payor for the delivery. Moreover, in this study 41.8% of underweight pregnant women were smokers compared to 25.9% of normal weight and 25% of overweight and obese women. Women residing in rural areas were also more likely to smoke (34.2%) compared to urban (21.5%) and semi-rural (29.9%) women.

In this study, continuing to smoke during pregnancy was associated with LBW, PTB, NICU admissions and no breastfeeding. Women who quit smoking still had

increased odds of low birth weight [OR=1.18 (1.10-1.26)] compared to women who did not smoke in the three months prior to pregnancy. For preterm birth and NICU admissions, only women who continued to smoke had increased odds for these adverse birth outcomes highlighting the potential benefits of reduction or quitting by the third trimester of pregnancy. Similar to low birth weight, all quit status groups had increased odds of not initiating breastfeeding. Rural women were found to have increased odds for low birth weight, preterm birth, and not breastfeeding when compared to urban women.

Characteristics that were found to be associated with a higher probability of quitting smoking include younger women, black and other races, Hispanic, higher education, primiparous, "other" payor source, and obese. Colman and Joyce (2003) found that teenaged women, primiparous, college educated and privately insured women were more likely to quit. Women residing in a rural location were found to have a significantly decreased probability of quitting compared to continuing in this study. Future interventions should focus on women residing in rural locations as they have higher smoking rates and may have limited availability of resources and programs. Younger women (<25 years) comprise about 57% of all women who smoke during pregnancy in Kentucky. As they are more likely to quit, this group of women may benefit from well targeted smoking cessation interventions.

The final polytomous model for prediction of quit status correctly assigned 52.8% of the subjects into their actual quit status group. Although the model includes only demographic characteristics, it nevertheless demonstrates some ability to predict quit status. The inclusion of smoking characteristics (age when began smoking, amount and dependence) and environmental/social support (partner and household smoking status) characteristics should improve the predictability and therefore provide more insight into how interventions should be targeted.

Limitations with this study include the cross-sectional nature of the data which limits the outcomes that can be studied including changes in smoking status that may occur postpartum. Smoking status may also be underreported on live birth certificates (Centers for Disease Control and Prevention, 2004). As this was a secondary data analysis, there was no opportunity to verify seemingly implausible data which may have resulted in miscoding to missing data. In cases of adoption, the biological mother's

information was replaced with the adoptive mother's information so some records may not have reflected the characteristics of the biological mother at the time of delivery. This study also excluded births to Kentucky residents in out-of-state hospitals that were not using the revised 2003 U.S. Live Birth certificate (estimated at 2.4% of total Kentucky resident live births during this time period).

Conclusions

Twenty-six percent of pregnant women in this study reported tobacco use. This is a significant public health issue with implications for health promotion as continuing to smoke during pregnancy is associated with low birth weight, preterm birth, NICU admissions and not breastfeeding, factors related to infant morbidity and mortality. Characteristics that predicted quitting included younger women (<25 years), black and other races and Hispanic ethnicity. Public health programs such as home visitation programs that target at-risk families including young mothers and first time parents may be well positioned to promote smoking cessation interventions with women who may be responsive to such interventions. Enhancements in referrals, resources and smoking cessation interventions within the Medicaid and WIC programs would also reach a large number of women who might be assisted in quitting tobacco use during their pregnancy.

Table 3.1 Smokers and nonsmokers during pregnancy in Kentucky by demographic characteristics, 2004-2008*

	Smoker n = 70,185	Nonsmoker n = 200,020
Age**		
<20 years	11,765 (33.72%)	23,123 (66.28%)
20-24 years	28,104 (33.96%)	54,644 (66.04%)
25-29 years	17,996 (23.22%)	59,515 (76.78%)
30-34 years	7,870 (15.96%)	41,442 (84.04%)
≥35 years	4,390 (17.15%)	21,214 (82.85%)
Unknown	60 (42.25%)	82 (57.75%)
Race**		
White	65,124 (28.01%)	167,352 (71.99%)
Black	4,468 (18.23%)	20,038 (81.77%)
Other	297 (6.71%)	4,132 (93.29%)
Unknown	296 (3.37%)	8,498 (96.63%)
Ethnicity**		
Hispanic	513 (4.02%)	12,247 (95.98%)
Non-Hispanic	69,634 (27.07%)	187,602 (72.93%)
Unknown	38 (18.18%)	171 (81.82%)
Maternal Education**		
< High School	23,755 (41.48%)	33,508 (58.52%)
High School	27,094 (34.55%)	51,315 (65.45%)
Some College	13,787 (23.05%)	46,026 (76.95%)
College Degree	3,929 (7.28%)	50,049 (92.72%)
Graduate Degree	313 (1.73%)	17,804 (98.27%)
Unknown	1,307 (49.79%)	1,318 (50.21%)
Marital Status**		
Married	30,281 (17.98%)	138,177 (82.02%)
Unmarried	39,888 (39.23%)	61,799 (60.77%)
Unknown	16 (26.67%)	44 (73.33%)
Payment Source**		
Medicaid	49,832 (41.76%)	69,499 (58.24%)
Private	13,690 (11.33%)	107,188 (88.67%)
Other	6,445 (22.53%)	22,167 (77.47%)
Unknown	218 (15.75%)	1,166 (84.25%)
Parity**		
None	25,829 (23.14%)	85,807 (76.86%)
One	22,625 (25.47%)	66,195 (74.53%)
Two	12,993 (30.02%)	30,289 (69.98%)
Three or More	8,567 (33.45%)	17,047 (66.55%)
Unknown	171 (20.05%)	682 (79.95%)

Table 3.1 (continued)

	Smoker n = 70,185	Nonsmoker n = 200,020
Prepregnancy BMI**		
Underweight	5,620 (41.77%)	7,834 (58.23%)
Normal Weight	30,223 (25.90%)	86,489 (74.10%)
Overweight	16,300 (24.81%)	49,410 (75.19%)
Obese	17,378 (24.99%)	52,164 (75.01%)
Unknown	664 (13.87%)	4,123 (86.13%)
Rurality**€		
Urban	34,348 (21.51%)	125,311 (78.49%)
Rural	21,883 (34.18%)	42,147 (65.82%)
Semi-Rural	13,856 (29.91%)	32,467 (70.09%)
Unknown	98 (50.78%)	95 (49.22%)
WIC Participant**		
Yes	50,572 (37.62%)	83,852 (62.38%)
No	19,266 (14.41%)	114,451 (85.59%)
Unknown	347 (16.81%)	1,717 (83.19%)
Entry into Prenatal Care**		
First Trimester	44,538 (22.90%)	149,947 (77.10%)
Second Trimester	18,861 (33.54%)	37,375 (66.46%)
Third Trimester	4,371 (36.01%)	7,768 (63.99%)
No Prenatal Care	1,371 (37.16%)	2,318 (62.84%)
Unknown	1,044 (28.56%)	2,612 (71.44%)

* 2007 and 2008 data are preliminary. Numbers may change.
**Statistically significant finding at $p \leq 0.05$ by chi-square test of association.
€ Based on 2003 Urban-Rural Continuum Codes.

Table 3.2 Unadjusted odds ratio estimates for birth outcomes by quit status*

	Quit Smoking	Reduced Smoking	Continued Smoking
	Est. OR (95% CI)	Est. OR (95% CI)	Est. OR (95% CI)
Low Birth Weight	1.28 (1.20-1.36)**	1.83 (1.75-1.92)**	2.24 (2.17-2.32)**
Preterm Birth	1.03 (0.98-1.09)	1.13 (1.08-1.18)**	1.42 (1.38-1.47)**
NICU Admission	1.10 (1.03-1.18)**	0.96 (0.90-1.02)	1.30 (1.24-1.35)**
No Breastfeeding	1.52 (1.47-1.57)**	3.03 (2.94-3.12)**	3.99 (3.89-4.08)**
Birth Defects	1.27 (1.00-1.62)	1.14 (0.92-1.41)	1.15 (0.97-1.36)

* Quit status variables comparing smoking in the third trimester of pregnancy to three months prior to pregnancy. Quit = 0 cigarettes in third trimester. Reduced =≤1/2 the number of cigarettes reported prior to pregnancy. Continued = >1/2 the number of cigarettes reported prior to pregnancy. The reference group for all outcomes is nonsmokers in the three months prior to pregnancy.
**Statistically significant finding at $p \leq 0.05$.

Table 3.3 Adjusted odds ratio estimates for low birth weight, preterm birth, NICU admission and not initiating breastfeeding

	Low Birth Weight Est. AOR (95% CI)	Preterm Birth Est. AOR (95% CI)	NICU Admission Est. AOR (95% CI)	Not Breastfeeding Est. AOR (95% CI)
Age				
<20 years	0.80 (0.75-0.85)*	0.93 (0.88-0.98)*	0.84 (0.78-0.90)*	1.27 (1.23-1.32)*
20-24 years	0.90 (0.86-0.94)*	0.97 (0.93-1.00)	0.93 (0.88-0.97)*	1.10 (1.07-1.12)*
25-29 years	Reference	Reference	Reference	Reference
30-34 years	1.19 (1.14-1.26)*	1.08 (1.04-1.12)*	1.11 (1.06-1.17)*	0.96 (0.94-0.99)*
≥35 years	1.41 (1.32-1.50)*	1.23 (1.17-1.30)*	1.25 (1.18-1.34)*	0.87 (0.84-0.90)*
Race				
White	Reference	Reference	Reference	Reference
Black	2.06 (1.97-2.16)*	1.39 (1.33-1.46)*	1.25 (1.18-1.32)*	1.45 (1.40-1.49)*
Other	1.24 (1.09-1.40)*	0.80 (0.71-0.90)*	0.71 (0.61-0.84)*	0.59 (0.55-0.64)*
Ethnicity				
Hispanic		0.88 (0.78-0.995)*		0.32 (0.29-0.34)*
Non-Hispanic		Reference		Reference
Maternal Education				
< High School	1.66 (1.56-1.77)*	1.31 (1.24-1.38)*	1.24 (1.16-1.33)*	2.72 (2.62-2.81)*
High School	1.42 (1.34-1.50)*	1.20 (1.15-1.26)*	1.17 (1.10-1.24)*	2.23 (2.17-2.30)*
Some College	1.22 (1.15-1.29)*	1.14 (1.10-1.20)*	1.16 (1.10-1.23)*	1.41 (1.37-1.45)*
College Degree	Reference	Reference	Reference	Reference
Graduate Degree	0.85 (0.78-0.92)*	0.88 (0.83-0.94)*	0.87 (0.80-0.95)*	0.74 (0.71-0.77)*
Marital Status				
Married	Reference		Reference	Reference
Unmarried	1.13 (1.09-1.17)*		1.12 (1.08-1.17)*	1.45 (1.42-1.48)*
Payment Source				
Medicaid	1.25 (1.19-1.31)*	1.13 (1.09-1.18)*	1.13 (1.07-1.20)*	1.24 (1.21-1.27)*
Private	Reference	Reference	Reference	Reference
Other	1.20 (1.13-1.28)*	0.99 (0.94-1.05)	0.88 (0.82-0.94)*	1.22 (1.17-1.26)*

Table 3.3 (continued)

	Low Birth Weight Est. AOR (95% CI)	Preterm Birth Est. AOR (95% CI)	NICU Admission Est. AOR (95% CI)	Not Breastfeeding Est. AOR (95% CI)
Parity				
None	Reference	Reference	Reference	Reference
One	0.66 (0.63-0.69)*	0.86 (0.84-0.89)*	0.74 (0.71-0.77)*	1.70 (1.67-1.74)*
Two	0.67 (0.64-0.70)*	0.94 (0.90-0.98)*	0.75 (0.71-0.80)*	1.73 (1.68-1.78)*
Three or More	0.71 (0.67-0.75)*	1.07 (1.02-1.12)*	0.82 (0.76-0.87)*	1.51 (1.46-1.56)*
Prepregnancy BMI				
Underweight	1.69 (1.59-1.78)*	1.42 (1.35-1.50)*	1.27 (1.18-1.37)*	1.20 (1.15-1.25)*
Normal Weight	Reference	Reference	Reference	Reference
Overweight	0.81 (0.78-0.85)*	0.95 (0.92-0.98)*	1.01 (0.97-1.06)	1.06 (1.04-1.09)*
Obese	0.79 (0.75-0.81)*	1.02 (0.98-1.05)	1.21 (1.16-1.26)*	1.21 (1.18-1.24)*
Rurality€				
Urban	Reference	Reference	Reference	Reference
Rural	1.05 (1.01-1.10)*	1.10 (1.06-1.14)*	0.82 (0.78-0.86)*	1.74 (1.70-1.78)*
Semi-Rural	1.10 (1.06-1.15)*	1.08 (1.04-1.12)*	1.02 (0.98-1.07)	1.22 (1.19-1.25)*
WIC Participant				
Yes	0.88 (0.85-0.92)*	0.91 (0.88-0.94)*	0.88 (0.84-0.92)*	1.43 (1.39-1.46)*
No	Reference	Reference	Reference	Reference
Entry into Prenatal Care				
1st Trimester	Reference	Reference	Reference	Reference
2nd Trimester	0.97 (0.93-1.00)	0.88 (0.85-0.91)*	0.99 (0.95-1.03)	1.05 (1.03-1.08)*
3rd Trimester	0.92 (0.85-0.99)*	0.86 (0.80-0.92)*	0.92 (0.84-1.01)	1.02 (0.98-1.07)
No Prenatal Care	1.93 (1.74-2.14)*	2.27 (2.08-2.48)*	1.81 (1.61-2.04)*	1.60 (1.48-1.74)*

Table 3.3 (continued)

	Low Birth Weight Est. AOR (95% CI)	Preterm Birth Est. AOR (95% CI)	NICU Admission Est. AOR (95% CI)	Not Breastfeeding Est. AOR (95% CI)
Smoking Status				
Quit	1.18 (1.10-1.26)*	1.00 (0.94-1.05)	1.04 (0.97-1.12)	1.09 (1.06-1.13)*
Reduced	1.65 (1.56-1.73)*	1.04 (0.99-1.09)	0.91 (0.85-0.97)*	1.64 (1.59-1.70)*
Continued	1.95 (1.87-2.03)*	1.25 (1.20-1.29)*	1.20 (1.14-1.26)*	1.93 (1.87-1.98)*
Prior Nonsmoker	Reference	Reference	Reference	Reference

*Statistically significant finding at $p \leq 0.05$.
€ Based on 2003 Urban-Rural Continuum Codes.

Table 3.4 Probabilities of Quitting or Reducing Tobacco Use by Demographic Characteristics

	Probability of Quitting Compared to Continuing	Probability of Reducing Compared to Continuing
	Estimated Multiplicative Change, 95% C.I.	Estimated Multiplicative Change, 95% C.I.
Age		
<20 years	1.58 (1.47-1.70)*	1.13 (1.06-1.20)*
20-24 years	1.15 (1.09-1.21)*	1.04 (0.99-1.09)
25-29 years	Reference	Reference
30-34 years	0.84 (0.79-0.91)*	0.91 (0.85-0.97)*
≥35 years	0.70 (0.63-0.77)*	0.79 (0.73-0.86)*
Race		
White	Reference	Reference
Black	1.58 (1.46-1.72)*	0.96 (0.90-1.04)
Other	1.68 (1.29-2.21)*	1.16 (0.89-1.51)
Ethnicity		
Hispanic	2.14 (1.65-2.77)*	1.14 (0.88-1.48)
Non-Hispanic	Reference	Reference
Maternal Education		
< High School	0.25 (0.23-0.27)*	0.61 (0.56-0.66)*
High School	0.40 (0.37-0.44)*	0.74 (0.69-0.81)*
Some College	0.74 (0.69-0.81)*	0.99 (0.91-1.07)
College Degree	Reference	Reference
Graduate Degree	1.29 (1.02-1.63)*	1.16 (0.89-1.52)
Marital Status		
Married	Reference	Reference
Unmarried	0.78 (0.75-0.82)*	1.03 (0.99-1.07)
Payment Source		
Medicaid	0.64 (0.60-0.68)*	0.97 (0.92-1.03)
Private	Reference	Reference
Other	1.14 (1.05-1.23)*	1.20 (1.11-1.29)*
Parity		
None	Reference	Reference
One	0.48 (0.46-0.51)*	0.75 (0.72-0.78)*
Two	0.36 (0.34-0.38)	0.69 (0.65-0.72)*
Three or More	0.30 (0.28-0.33)	0.60 (0.57-0.65)*
Prepregnancy BMI		
Underweight	0.81 (0.74-0.88)*	1.03 (0.97-1.10)
Normal Weight	Reference	Reference
Overweight	0.98 (0.93-1.03)	0.92 (0.88-0.96)*
Obese	1.11 (1.06-1.17)*	0.97 (0.93-1.01)

Table 3.4 (continued)

	Probability of Quitting Compared to Continuing	Probability of Reducing Compared to Continuing
	Estimated Multiplicative Change, 95% C.I.	Estimated Multiplicative Change, 95% C.I.
Rurality€		
Urban	Reference	Reference
Rural	0.57 (0.54-0.60)*	0.71 (0.68-0.74)*
Semi-Rural	0.77 (0.73-0.82)*	0.86 (0.82-0.90)*
WIC Participant		
Yes	0.78 (0.75-0.83)*	1.04 (0.99-1.08)
No	Reference	Reference
Entry into Prenatal Care		
1st Trimester	Reference	Reference
2nd Trimester	0.82 (0.79-0.87)*	0.96 (0.92-1.00)
3rd Trimester	0.69 (0.63-0.77)*	0.94 (0.88-1.01)
No Prenatal Care	0.60 (0.50-0.71)*	0.69 (0.60-0.80)*

*Statistically significant finding at $p \leq 0.05$.
€ Based on 2003 Urban-Rural Continuum Codes.

CHAPTER FOUR

Smoking Cessation and Birth Outcomes in the Giving Infants and Families Tobacco-free Starts (GIFTS) Program

Introduction

Healthy People 2020 has established two national targets regarding smoking cessation in pregnancy. These include: 1) that 98.6% of women delivering a live birth will report abstaining from cigarette use during pregnancy; and 2) that 30% of women [smokers] aged 18 to 49 will stop smoking during the first trimester of pregnancy and remain abstinent throughout the remainder of pregnancy (Healthy People 2020). In 2007, the National Center for Health Statistics reported that 10.4% of women reported smoking during pregnancy based on twenty-one states using the 2003 U.S. Standardized Live Birth Certificate (Martin et al., 2010). In this same report, Kentucky has more than double this percentage with 25.4% of mothers reporting smoking during pregnancy (Martin, et al., 2010). Significant improvements are needed in order to bring Kentucky's rates of smoking during pregnancy closer to the national average and ultimately to the national goal.

Kentucky has not experienced the decline in smoking during pregnancy that is seen on the national level. Between 1990 and 2002, there was a 38% relative decline in smoking prevalence during pregnancy nationally compared to a 14.4% relative decline in Kentucky (Centers for Disease Control and Prevention, 2004). This is a significant public health issue as smoking during pregnancy is known to be associated with adverse birth outcomes including low birth weight and preterm birth.

The 2008 Clinical Practice Guideline, *Treating Tobacco Use and Dependence* (Fiore MC, 2008) recommends that women who smoke during pregnancy should be offered person-person psychosocial interventions that exceed minimal advice to quit and that clinicians should offer effective interventions to pregnant smokers at the first prenatal visit and throughout their pregnancy. A systematic review of interventions promoting smoking cessation during pregnancy found a significant reduction in late pregnancy smoking following interventions in 6% of women (Lumley et al., 2009). The quit rates that are observed in the most effective best practice interventions rarely reach

or exceed 20% (Orleans, Barker, Kaufman, & Marx, 2000). Further, the interventions developed for smoking cessation during pregnancy have limited impact for those smokers who are heavier smokers, poor, uneducated and whose social networks have smokers (Bullock et al., 2009).

The Kentucky Department for Public Health initiated a pilot project, Giving Infants and Families Tobacco-Free Starts (GIFTS) in February 2008 that targeted pregnant smokers in a nine county area of rural eastern Kentucky. The counties chosen for the pilot project had high rates of smoking during pregnancy (31.1% to 53.4%) in 2006 (Kentucky Department for Public Health, 2008). The counties included in the pilot project were Knott, Knox, Lee, Leslie, Letcher, Owsley, Perry, Whitley and Wolfe. These nine counties were rural based on codes seven through nine of the rural-urban continuum codes, a classification system that distinguishes metropolitan and nonmetropolitan counties by degree of urbanization and adjacency to a metro area or areas (U.S. Department of Agriculture, 2004). All nine counties were Appalachian and designated as distressed for economic status in fiscal year 2012 (Appalachian Regional Commission, 2011).

Any pregnant woman who screened positive for tobacco exposure and accessed services at the local health departments in these counties was eligible for the program. As this was a pilot project, there were no exclusion criteria for maternal age or gestational age at the time of enrollment. Local health department practitioners screened for tobacco use and referred eligible women to designated GIFTS personnel. All GIFTS case managers were either health educators or nurses. The GIFTS program provided individualized support and health education for participants including provision of educational materials, fax referral to the Kentucky Tobacco Quit Line, referral of family members or significant others to local tobacco control specialists, carbon monoxide monitoring, assessment for comorbidities (domestic violence, depression, and social support) and incentives (non-monetary) at three time points (entry, delivery, three months postpartum). Services were provided until three months postpartum with a goal of one visit per trimester as well as a visit around delivery and at three months postpartum.

With Kentucky's increased rate of smoking during pregnancy, it is critical that effective smoking cessation interventions be developed and implemented. The

information gained in Kentucky may provide an example for other areas that continue to have high rates of smoking in pregnancy. An evaluation of the effectiveness of the GIFTS program is needed to determine if the program resulted in changes in smoking status or birth outcomes in this high risk population. Characteristics related to participation are important to understand in order to develop strategies to improve engagement in future programs.

The purpose of this research was threefold; 1) to understand the characteristics of women who participated in the GIFTS program as compared to those declining the services; 2) to assess the association between stage of change and smoking status change during pregnancy for women referred to the GIFTS program; and 3) to evaluate the impact of the GIFTS pilot project on smoking status and birth outcomes.

Methods

GIFTS program data and live birth certificate files from 2008 to 2010 were used in this study. Data from the GIFTS program included information on all referrals to the program from inception through December 31, 2009. Duplicates were identified based on name, date of birth and date of referral with subsequent removal from the data. Additionally, any woman who was referred to the program over multiple pregnancies was identified and only the first encounter was retained in the final sample. Those women who were known to have a pregnancy loss (miscarriage, stillbirth), used cigars or smokeless tobacco, or who were referred for secondhand smoke (SHS) exposure only were also eliminated from the sample.

The remaining pregnant women who reported tobacco use during their pregnancy were classified as active participants if they completed the screening assessments and/or had two documented visits; otherwise they were considered inactive. Records were matched to the corresponding live birth certificate using the variables of mother's full name and date of birth initially followed by a manual review for unmatched records. Any participant who linked to more than one birth certificate was also manually reviewed to ensure that the included birth certificate corresponded to the pregnancy in which the mother was referred to GIFTS. After linkage with the live birth certificate, any non-singleton births were removed from the data set.

The analyses that were completed used a merged data file comprised of GIFTS programmatic data and live birth certificate information. The variables included demographic variables from the birth certificate, smoking variables from the GIFTS program, and outcome measures from the birth certificate.

Demographic variables included maternal age, race, maternal education, marital status, and payment source. Maternal age was determined by the difference between maternal and child dates of birth and was then categorized into four groups: <20, 20-24, 25-29, and ≥30 years. Maternal education categories included less than high school diploma (8th grade or less and 9th to 12th grade, no diploma), high school, and greater than high school (some college, college degree, and graduate degree). Three variables were dichotomized including race (white and non-white), marital status (married and unmarried) and principal source of payment for the delivery (Medicaid and non-Medicaid).

Smoking variables which were obtained from the GIFTS database include the number of years smoked, number of cigarettes per day, number of previous quit attempts, number of smokers in the household, whether the individual smoked within thirty minutes of waking, and whether the individual believed there were harmful effects on fetus. The number of years smoked was categorized into three groups: 0-5 years, 6-10 years and ≥11 years. Four levels were constructed for the variable of number of cigarettes per day including 0, 1-5, 6-10 and ≥11. Previous quit attempts were categorized into four groups: 0, 1, 2 and ≥3. There were three groups for the number of smokers in the home: 0, 1 and ≥2. "Smokes within thirty minutes of waking" and "believes harmful effects on the fetus" were obtained as a dichotomous yes/no variable.

A stage of change variable was constructed for all women referred to the program. Those women who were considered inactive in the program were classified as being in the precontemplation stage. Those women who were participants in the program and reported either that they were not ready to quit next month, or were still smoking, or not ready to quit, were considered to be in the contemplation stage. The preparation stage was comprised of participants who reported either that they were willing to quit next month, or that they had quit since the last visit or stayed quit. Finally, those in the action stage were participants who reported recent tobacco status at their initial visit.

The outcomes evaluated among the GIFTS participants were smoking status change (quit; quit or reduced), low birth weight (LBW), preterm birth (PTB), neonatal intensive care unit (NICU) admission, and no breastfeeding initiation. Women who reported cigarette smoking in the three months prior to pregnancy were categorized into three quit status groups based on reported tobacco use during the third trimester of pregnancy. These three groups included: 1) Women who quit smoking (report zero cigarettes per day but smoked in the three months prior to pregnancy); 2) Women who reduced their smoking by at least 50% (reported less than or equal to one-half the number of cigarettes reported in the three months prior to pregnancy); and 3) Women who continued smoking (reported greater than one-half the number of cigarettes reported in the three months prior to pregnancy). This classification has been used by others exploring the impact of smoking reduction on birth weight (England et al., 2001). Infants were classified as LBW if the reported weight was <2500 grams. PTB was defined as a gestational age of <37 weeks. These maternal and child health indicators are consistent with the literature (*Maternal and Child Health: Programs, Problems and Policy in Public Health*, 2005). NICU admission and breastfeeding initiation were collected as yes or no dichotomous variables.

A comparison group for the active participants was selected from all pregnant women who delivered singleton births between 2008 and 2010 in counties that directly bordered the counties in which the GIFTS program was implemented using the R statistical program. The matching criteria included the following: maternal age within five years, equivalent race, number of children differed by one or less, and pre-pregnancy smoking status differed by three or fewer cigarettes. Participants who reported smoking no cigarettes prior to pregnancy were matched to an individual reporting the same. The remaining participants were matched to individuals reporting at least one cigarette per day.

Institutional Review Board (IRB) approval was obtained from the Cabinet for Health and Family Services, the entity with responsibility for maintenance of Vital Statistics and GIFTS data in Kentucky, and the University of Kentucky.

All statistical analyses were completed using SAS version 9.2. A p-value of <0.05 was considered statistically significant. The demographic and smoking characteristics of

active and inactive participants were summarized with counts and percentages. The chi square test of independence was used to determine if these demographic and smoking variables were associated with participation in the program. The Fisher's exact test was used in instances where a cell contained five or fewer observations. Multivariable logistic regression was completed to estimate the role of demographic and smoking characteristics with participation status (active/inactive) in the program. Multiple imputation was used for the logistic regression if missing values eliminated greater than 20% of the sample size. The Spearman rank correlation test was used to ascertain whether the relationship between the stage of change upon entry into the program and smoking quit status was significant. The chi square test of independence was used to assess demographic differences in education, marital status and payment source for the delivery among GIFTS participants and the matched comparison group. McNemar's test was used to assess for significance the difference in proportion of GIFTS participants with selected outcomes (quit smoking during by the third trimester of pregnancy, quit or reduced smoking by the third trimester of pregnancy, LBW, PTB, NICU admission, and no breastfeeding initiation) compared to the matched group. Women who reported no tobacco use in the three months prior to pregnancy were excluded from the McNemar's tests in which quit smoking and quit or reduced smoking were the outcomes of interest. For the remainder of the outcomes, the McNemar's test was run twice, once for all participants and once when the women reporting no smoking in the three months prior to pregnancy were excluded.

Results

There were 1,572 records obtained from the GIFTS program for pregnant women referred to the program between February 10, 2008 and December 31, 2009. The removal of duplicate records (n=24) and subsequent pregnancies (n=38) reduced the sample to 1,510. Women who experienced a pregnancy loss (n=52), reported cigar or smokeless tobacco use (n=5) and those referred for SHS exposure only (n=182) were also removed from the sample resulting in a total of 1,271 pregnant women. Of these, 656 (51.6%) were active participants in the program and 615 (48.4%) were inactive. The matching of the GIFTS record with the corresponding live birth certificate was accomplished for 598

(90.7%) of the active participants and 539 (87.6%) of the inactive referrals resulting in a final total sample of 1,137.

Pregnant women referred to the GIFTS program were likely to be ages 20-24 years (40.9%), white (98.9%), non-Hispanic (99.5%), with less than a high school education (44.0%), unmarried (58.2%), and to have Medicaid as the source of payment for the delivery (91.5%) [Table 4.1]. Three smoking characteristics were found to be statistically different between the active and inactive referrals including number of previous quit attempts, smoking within thirty minutes of waking and belief in the harmful effects on the fetus. Active participants had higher proportions of women with one (28.1%) or two (20.1%) quit attempts compared to inactive women with 21.8% and 16.4% respectively. Participants were also more likely to smoke within thirty minutes of waking (69.8%) and believe there were harmful effects on the fetus (97.5%) compared to non-participants with 60.7% and 94.9% respectively.

The multivariable logistic regression was completed using multiple imputation for missing values. This regression found significantly increased odds of participating in the program for women reporting 1-5 [est. AOR=2.05 95% C.I. (1.06-3.94)], 6-10 [est. AOR=2.06 95% C.I. (1.10-3.83)] and greater than or equal to 11 [est. AOR=2.17 95% C.I. (1.12-4.20)] cigarettes per day compared to those that reported no cigarettes per day (Table 4.2). Women with one [est. AOR=1.55 95% C.I. (1.07-2.24)] or two [est. AOR=1.83 95% C.I. (1.21-2.76)] previous quit attempts also had increased odds for participation compared to those with no quit attempts when controlling for all other variables in the model. No significant association was found between stage of change on entry into the program and quit status (p=0.9569) using the Spearman rank correlation.

Among the 598 active GIFTS participants, ten were missing data that was used to identify a match and an appropriate match was not identified for an additional three participants which resulted in a total of 585 matched active participants. GIFTS participants did not differ significantly from the matched comparison group in education level or marital status (Table 4.3). GIFTS participants were significantly more likely to have Medicaid as the payment source for the delivery (92.3%) compared to the matched comparison group (83.6%) [Table 4.3].

Of the 585 matched participants, 92 (15.7%) reported smoking zero cigarettes per day in the three months prior to pregnancy. The McNemar's test of proportion excluded those participants for the outcomes of quitting and quitting/reducing smoking and found no significant difference between the GIFTS and comparison groups. Reduced numbers of preterm births, low birth weight and NICU admissions were observed in the GIFTS participants as compared to the matched cohort (Table 4.4). The test of proportion using the entire sample of 585 active participants found that GIFTS participants were significantly less likely (p=0.0369) to experience PTB when compared to the matched group (Table 4.4). Differences found for the outcomes of LBW, NICU admission or no breastfeeding initiation were not significant. When those participants who reported no smoking in the three months prior to pregnancy were removed from the sample, no statistically significant differences were found for any of the birth outcomes using the test of proportion. However, the difference on preterm birth was nearly statistically significant (p=.0728).

Discussion

This study provides findings from a smoking cessation intervention that targeted rural pregnant smokers in a nine county Appalachian area in Kentucky. The women referred to this program were primarily white, non-Hispanic and received Medicaid services for payment of the delivery. Over 60% of the referrals were women under the age of 25 and 44% had less than a high school education. The highest rates of smoking during pregnancy are present among women of younger maternal age, white, unmarried, low income, and less than a high school education (Ma, Goins, Pbert, & Ockene, 2005; Pbert et al., 2004). These demographics suggest that the program successfully reached the high risk population who were targeted.

Almost 52% of women who were referred to GIFTS were active participants. Two characteristics were identified that resulted in increased odds of participation in the program including number of cigarettes smoked per day and number of previous quit attempts. The more women reported smoking the higher the odds of participation in the program. Women with one or two quit attempts had increased odds of participation. Future efforts need to identify strategies that will result in improved engagement of pregnant smokers in the rural population including those with numerous prior quit

attempts. Research with other populations has also identified the critical need to identify ways to motivate women to enroll in interventions (Ruggiero, Webster, Peipert, & Wood, 2003).

No significant associations were found between the stage of change upon entry into the program and quit status in the third trimester of pregnancy. The transtheoretical model has been used extensively with smoking cessation programs including those targeting pregnant smokers. One study that assessed movement along the stages of change among low-income African American found that the woman's stage of change at the time of intake remained a significant predictor of stage during pregnancy (Pletsch, 2002). Another study using a motivational interviewing intervention for low income pregnant smokers found that while the pregnant smokers who received motivational interviewing had increased confidence to abstain from smoking, a decreased temptation to smoke and decreased depression, there was no forward progression in the stages of change (Stotts, DeLaune, Schmitz, & Grabowski, 2004).

The participants in the GIFTS program did not have increased rates of quitting smoking or quitting or reducing smoking when compared to the matched comparison group. Best practice interventions are known to have limited impact on pregnant women who are heavier smokers, undereducated, lower income and whose social networks are saturated with smokers (Bullock, et al., 2009). Only a few studies have focused specifically on pregnant smokers in the rural setting. Avidano Britton and colleagues (2006) integrated a nurse managed smoking cessation program into routine prenatal care and found that the program impacted women who were "recent quitters" but had no effect on women who reported smoking at their first prenatal visit (Avidano Britton, Brinthaupt, Stehle, & James, 2006). Another study in the rural setting used telephone individualized support along with smoking cessation booklets singly or in combination, and found no significant difference in late pregnancy abstinence (Bullock et al., 2009). Additional research is needed to identify effective interventions for high risk rural pregnant women. Further research with the GIFTS data should explore county level differences in the data that may have resulted from differences in program implementation among GIFTS providers.

An interesting finding in this study was that women in the GIFTS program were less likely to have a preterm birth than the comparison group, suggesting that this program may be a promising practice for reducing preterm births. This is a significant finding as preterm births were the leading cause of infant deaths in Kentucky in 2009 (Cabinet for Health and Family Services, 2011). Additionally, it has been estimated nationally that the costs associated with preterm birth/low birth weight infants represents 47% of the costs for all infant hospitalizations and 27% for all pediatric stays (Russell et al., 2007). A key component of the GIFTS program was the provision of social support to the participants. The role of social support in birth outcomes is an area of intense study with mixed results. One study that examined the effect of social support on pregnancy outcomes found that among smokers a greater proportion (10%) had preterm deliveries when they had low social support compared to smokers with high social support (0%) (Elsenbruch et al., 2007). Further research with the GIFTS program data should seek to identify components of the program associated with a reduction in preterm births, and to explore the effects that a more stringent definition of active participation may have on birth outcomes.

There are several limitations with this study. The research design was quasi-experimental; instead of a control group a matched comparison group was identified from surrounding counties. These two groups may differ on characteristics that might influence smoking cessation and birth outcomes that were not utilized in the matching criteria. A comparison of these two groups found no differences in education level or marital status. GIFTS participants were more likely to have Medicaid as the payment source for the delivery, however, making them higher risk than the comparison group for smoking during pregnancy and adverse birth outcomes such as preterm birth. This study occurred in a rural setting and the vast majority of participants were white, non-Hispanic and had Medicaid so the results may not be generalizable to other populations. Finally, the outcomes for all women who were referred to the program were not assessed because 10% of active clients and 12% of inactive clients were unable to be linked to a live birth certificate. Potential reasons for no linkage may include pregnancy loss or relocation of participants out of state.

Conclusions

The GIFTS program successfully reached high risk pregnant smokers in this nine county pilot project. Approximately 52% of women referred to the program became active participants. Strategies to recruit and engage these smokers who are resistant to smoking cessation are critical to influence smoking rates during pregnancy. The program did not result in any significant increases in quit or quit/reduction rates of smoking. Fewer numbers of low birth weight, preterm births and NICU admissions were observed in the GIFTS participants compared to a matched cohort, but preterm birth was the only outcome for which the difference was significant. The social support components of this intervention may have played a role in this finding. The GIFTS program is a promising practice for the prevention of preterm birth which is important given that preterm birth is a leading cause of infant mortality with significant associated medical costs.

Table 4.1 Demographic and smoking characteristics of women referred to the GIFTS program, 2008-2009

	All Referrals n (%)	Active n (%)	Inactive n (%)	p-value
Demographic Characteristics				
Age				0.4580
<20 years	238 (20.9%)	134 (22.4%)	104 (19.3%)	
20-24 years	465 (40.9%)	239 (40.0%)	226 (41.9%)	
25-29 years	285 (25.2%)	153 (25.6%)	133 (24.7%)	
≥30 years	148 (13.0%)	72 (12.0%)	76 (14.1%)	
Race^				0.3930
White	1125 (98.9%)	590 (98.7%)	535 (99.3%)	
Non-White	12 (1.1%)	8 (1.3%)	4 (0.7%)	
Ethnicity^				0.2214
Hispanic	6 (0.5%)	1 (0.8%)	1 (0.2%)	
Non-Hispanic	1130 (99.5%)	593 (99.2%)	537 (99.8%)	
Mother's Education				0.1174
< High School	498 (44.0%)	260 (43.5%)	238 (44.5%)	
High School	409 (36.1%)	230 (38.5%)	179 (33.5%)	
> High School	226 (20.0%)	108 (18.1%)	118 (22.1%)	
Marital Status				0.1361
Married	475 (41.8%)	262 (43.9%)	213 (39.5%)	
Unmarried	661 (58.2%)	335 (56.1%)	326 (60.5%)	
Payment Source for Delivery				0.2940
Medicaid	1038 (91.5%)	550 (92.3%)	488 (90.5%)	
Non-Medicaid	97 (8.6%)	46 (7.7%)	51 (9.5%)	
Smoking Characteristics				
# Years Smoked				0.8638
0-5 years	476 (43.6%)	258 (44.0%)	218 (43.1%)	
6-10 years	360 (33.0%)	189 (32.3%)	171 (33.8%)	
≥11 years	256 (23.4%)	139 (23.7%)	117 (23.1%)	
# Cigarettes/Day				0.0530
0	59 (6.1%)	25 (4.3%)	34 (8.6%)	
1-5	176 (18.1%)	105 (18.2%)	71 (18.0%)	
6-10	435 (44.9%)	262 (45.5%)	173 (43.9%)	
≥11	300 (30.9%)	184 (31.9%)	116 (29.4%)	

Table 4.1 (continued)

	All Referrals n (%)	Active n (%)	Inactive n (%)	p-value
# Previous Quit Attempts*				0.0052
0	390 (36.5%)	184 (32.1%)	206 (41.6%)	
1	269 (25.2%)	161 (28.1%)	108 (21.8%)	
2	196 (18.4%)	115 (20.1%)	81 (16.4%)	
≥3	213 (19.9%)	113 (19.7%)	100 (20.2%)	
# Smokers in House				0.3719
0	273 (28.7%)	157 (27.4%)	116 (30.8%)	
1	383 (40.3%)	230 (40.1%)	153 (40.6%)	
≥2	294 (31.0%)	186 (32.5%)	108 (38.7%)	
Smokes Within 30 Mins. of Waking*				0.0014
No	390 (34.5%)	179 (30.2%)	211 (39.3%)	
Yes	739 (65.5%)	413 (69.8%)	326 (60.7%)	
Believes Harmful Effects on Fetus*				0.0256
No	41 (3.7%)	15 (2.6%)	26 (5.1%)	
Yes	1057 (96.3%)	574 (97.5%)	483 (94.9%)	

*Statistically significant, $p<0.05$. Missing values excluded from analyses.
^Fishers Exact Test was used due to small numbers in some cells.

Table 4.2 Adjusted odds ratio estimates for active participation in the GIFTS program

	Active Participation Est. AOR (95% CI)	p-value
Age		
<20 years	1.31 (0.79 – 2.16)	0.2931
20-24 years	1.04 (0.71 – 1.52)	0.8447
25-29 years	Reference	
≥30 years	0.84 (0.51 – 1.39)	0.4987
Maternal Education		
< High School	0.92 (0.62 – 1.37)	0.6846
High School	Reference	
> High School	1.33 (0.89 – 1.98)	0.1658
Marital Status		
Married	Reference	
Unmarried	0.77 (0.57 – 1.02)	0.0726
Payment Source		
Medicaid	0.93 (0.54 – 1.59)	0.7845
Non-Medicaid	Reference	
# Years Smoked		
0-5 years	Reference	
6-10 years	0.88 (0.62 – 1.26)	0.4883
≥ 11 years	1.04 (0.65 – 1.66)	0.8842
# Cigarettes Smoked/Day		
0	Reference	
1-5	2.05 (1.06 – 3.9)*	0.0327
6-10	2.06 (1.10 – 3.83)*	0.0233
≥ 11	2.17 (1.12 – 4.20)*	0.0213
# Previous Quit Attempts		
None	Reference	
One	1.55 (1.07-2.24)*	0.0211
Two	1.83 (1.21 – 2.76)*	0.0042
Three or More	1.35 (0.91 – 2.00)	0.1320
# Smokers in Household		
0	Reference	
1	1.12 (0.79 – 1.57)	0.5310
≥ 2	1.25 (0.85 – 1.82)	0.2528
Smokes Within 30 Mins. of Waking		
Yes	1.15 (0.83 – 1.61)	0.4069
No	Reference	
Believes Harmful Effects on Fetus		
Yes	Reference	
No	1.97 (0.98 – 3.96)	0.0566

*Statistically significant, p<0.05.

Table 4.3 Comparison of education level, marital status and payment source for the delivery between matched GIFTS participants and the comparison group

	GIFTS Participants n (%)	Comparison Group n (%)	p-value
Mother's Education			0.1552
< High School	257 (43.9%)	232 (39.9%)	
High School	222 (37.8%)	219 (37.7%)	
> High School	106 (18.1%)	130 (22.4%)	
Marital Status			0.0792
Married	261 (44.6%)	290 (49.7%)	
Unmarried	324 (55.4%)	293 (50.3%)	
Payment Source for Delivery			<.0001*
Medicaid	538 (92.3%)	489 (83.6%)	
Non-Medicaid	45 (7.7%)	96 (16.4%)	

*Statistically significant, $p<0.05$. Missing values excluded from analyses.

Table 4.4 Proportion of women in GIFTS and matched comparison group with selected outcomes

	GIFTS Participants n (%)	Matched Group n (%)	McNemar's p-value
All Participants			
Low Birth Weight	69 (11.8%)	76 (13.0%)	0.5887
Preterm Birth	57 (9.7%)	81 (13.9%)	0.0369*
NICU Admission	35 (6.0%)	42 (7.2%)	0.4887
No Breastfeeding Initiation	443 (75.7%)	443 (75.7%)	1.00
Excluding Participants^			
Quit Smoking	33 (6.7%)	41 (8.3%)	0.4096
Quit or Reduced Smoking	138 (28.0%)	154 (31.2%)	0.2554
Low Birth Weight	62 (12.6%)	70 (14.2%)	0.5085
Preterm Birth	49 (9.9%)	68 (13.8%)	0.0728
NICU Admission	31 (6.3%)	33 (6.7%)	0.8991
No Breastfeeding Initiation	391 (79.3%)	388 (78.7%)	0.8708

^Women that reported no smoking in the three months prior to pregnancy (n=92) were excluded from these analyses.
*Statistically significant at $p<0.05$.

CHAPTER FIVE

Summary

The focus of this dissertation was on the significant health issue of smoking during pregnancy which is associated with numerous pregnancy complications (placental anomalies, premature rupture of membranes), adverse birth outcomes (low birth weight, preterm birth) and long term consequences for children (respiratory problems, sudden infant death syndrome) (U.S. Department of Health and Human Services, 2001, 2004). The goal of this research was to identify strategies to increase smoking cessation among pregnant women in Kentucky and subsequently reduce the adverse effects associated with this health behavior. The purposes of this dissertation were six-fold; 1) to identify effective intervention strategies for smoking cessation among low income pregnant women; 2) to gain a better understanding of the characteristics of women who smoke during pregnancy in Kentucky; 3) to better understand the role of smoking on adverse birth outcomes in Kentucky; 4) to explore the impact of reduction in tobacco exposure on adverse birth outcomes; 5) to understand the characteristics of women who actively participated in the Giving Infants and Families Tobacco-free Starts (GIFTS) program, a pilot smoking cessation program in nine counties of Kentucky; and 6) to evaluate the impact of the GIFTS pilot project on smoking status and birth outcomes. The findings from each paper in this dissertation are described below followed by a comprehensive discussion of the findings with implications for public health practice.

Chapter Two Summary

Chapter Two described a critical review of seven randomized control trials that targeted low income women with smoking cessation interventions. Low income criteria identified in four studies included Medicaid recipients, WIC participants, and clinics in which prenatal care was state supported. The remainder of the studies had no specific low income criterion (Table 2.1). The interventions were implemented in geographically diverse areas of the United States, but only one targeted women living in a rural setting (Table 2.1). Five of the seven interventions used professionally trained staff while two studies used peer counselors (Table 2.2).

Enrollment in the seven studies ranged from 68.1% to 94.5% (Table 2.2). Two studies had attrition rates lower than 10% while the remainder had 13% to 40.4% attrition (Table 2.4). Higher smoking cessation rates were observed in only three of the seven studies (Table 2.4). The study with the highest biochemically confirmed quit rates at 32% (9% in the control group) used incentives for the participant and a social supporter (Donatelle, Prows, Champeau, & Hudson, 2000). Tobacco abstinence rates of 28.3% (9.6% in the control group) were observed in a study comprised of psychotherapy sessions with a mental health consultant in combination with telephone follow-up (Dornelas et al., 2006). The final intervention with significant smoking cessation rates of 17.3% (8.8% in the control group) provided individualized counseling with reinforcement in the clinic setting (Windsor et al., 2000).

Chapter Three Summary

Chapter Three utilized live birth certificate files to estimate the proportion and characteristics of women that smoked during pregnancy in Kentucky. From 2004 to 2008, 26% of pregnant women reported smoking during their pregnancy. Of women who were smoking in the three months prior to pregnancy, only 20% of them reported abstinence by the third trimester of pregnancy. The characteristics of women who smoked during pregnancy compared to nonsmokers included: younger age, white, non-Hispanic, less educational attainment, unmarried, living in a rural county, having at least one child, Medicaid as the payment source for the delivery, and being a WIC recipient (Table 3.1). Smokers also began prenatal care later than nonsmokers.

This chapter also evaluated the impact of smoking quit status (continued, reduced, quit) during pregnancy on five adverse birth outcomes including low birth weight, preterm birth, NICU admissions, no breastfeeding initiation, and birth defects. Quit status was significantly associated with all outcomes except for birth defects when unadjusted logistic regressions were completed (Table 3.2).

Continuing to smoke during pregnancy was associated with increased odds for low birth weight [est. AOR = 1.95 95% CI (1.87-2.03)], preterm delivery [est. AOR = 1.25 95% CI (1.20-1.29)], NICU admissions [est. AOR = 1.20 95% CI (1.14-1.26)], and no breastfeeding initiation [est. AOR = 1.93 95% CI (1.87-1.98)] when controlling for demographic factors. Women who reduced their tobacco use by at least 50% had

increased odds for low birth weight [est. AOR = 1.65 95% CI (1.56-1.73)] and no breastfeeding initiation [est. AOR = 1.64 95% CI (1.59-1.70)] when compared to nonsmokers in the three months prior to pregnancy and controlling for other variables in the model. Unexpectedly, reductions in tobacco use showed lower estimated odds of NICU admission [est. AOR = 0.91 95% CI (0.85-0.97)]. Those women who quit smoking by the third trimester also had increased odds for low birth weight [est. AOR = 1.18 95% CI (1.10-1.26)] and no breastfeeding initiation [est. AOR = 1.09 95% CI (1.06-1.13)].

Polytomous logistic regression revealed that the demographic characteristics associated with an increased probability of quitting compared to continuing included: age less than 24 years, Black or Other races, Hispanic ethnicity, graduate level education, other payment source for delivery, and obese women (Table 3.4). A reduced probability of quitting was identified for the characteristics of age greater than or equal to 30 years, less than a college degree, unmarried status, Medicaid payment for the delivery, one or more children, underweight or overweight, rural or semi-rural residences, WIC participation, and entry into prenatal care after the first trimester of pregnancy.

The probability of reduced tobacco exposure was highest among women less than twenty years of age and with “other” payor source for the delivery while reduced probabilities of reduction were noted for women over thirty years of age, with education levels less than or equal to high school, with one or more children, overweight, living in a rural or semi-rural county, and accessing no prenatal care.

Chapter Four Summary

Chapter Four utilized data from the GIFTS pilot project in order to assess the characteristics of participants in the program and to evaluate the impact of the program on smoking status and birth outcomes. The GIFTS program was implemented in a nine county rural area of Kentucky to promote smoking cessation and reduction of secondhand smoke exposures. Almost 52% of the 1,271 pregnant smokers referred to the program were active participants with either full completion of all assessments or at least two documented visits.

Pregnant women referred to GIFTS were likely to be ages 20-24 years (44%), white (98.9%), non-Hispanic (99.5%), with less than a high school education (44%), unmarried (58.2%) and to have Medicaid as the payment source for the delivery (91.5%).

Active participants had higher proportions of women with one or two quit attempts, smoked within thirty minutes of waking, and believed that smoking had harmful effects on the fetus when compared to nonparticipants. Women who reported 1-5 [est. AOR=2.05 95% C.I. (1.06-3.94)], 6-10 [est. AOR=2.06 95% C.I. (1.10-3.83)], and greater than or equal to 11 [est. AOR=2.17 95% C.I. (1.12-4.20)] cigarettes per day had increased odds of participation compared to women reporting no tobacco use each day (Table 4.2). Also, women with one [est. AOR=1.55 95% C.I. (1.07-2.24)] or two [est. AOR=1.83 95% C.I. (1.21-2.76)] quit attempts had increased odds of participation compared to those with no quit attempts when controlling for other variables in the model.

A comparison of education level, marital status and payment source for the delivery found no differences between GIFTS participants and the matched comparison group except for payment source. GIFTS participants were significantly more likely to have Medicaid than the matched comparison group (Table 4.3). GIFTS participants were therefore a higher risk group than the comparison group.

Birth outcomes for GIFTS participants were compared to the matched comparison group using McNemar's test of proportion. Almost 16% of the GIFTS participants had nondisclosure of their smoking status reported on the live birth certificate. No significant differences in smoking cessation or cessation/reduction of tobacco use were observed between the two groups. Those participants with nondisclosure of tobacco use were excluded from the analysis.

All participants were included in the analyses for the birth outcomes of low birth weight, preterm birth, NICU admission and no breastfeeding initiation. GIFTS participants were significantly less likely to experience a preterm birth when compared to the matched group (p=0.0369). No statistically significant differences were identified for the other birth outcomes. When participants who did not disclose their tobacco use on the birth certificate were removed from the analyses, no statistically significant differences were found for any of the birth outcomes although the difference on preterm births was nearly statistically significant (p=0.0728).

Discussion

Lower socioeconomic status women are disproportionately affected by smoking during pregnancy (Malchodi et al., 2003). The need for effective interventions that target low income women was further documented in Kentucky's data that found 71% and 72% of pregnant smokers respectively had Medicaid as the payment source for their delivery and received WIC services. In order to enhance engagement, future smoking cessation interventions may be incorporated into these existing programs in which pregnant smokers are already enrolled.

Low income women have more psychological and emotional problems, less support and financial resources, more family problems, and less residential stability (DiClemente, Dolan-Mullen, & Windsor, 2000) making them a difficult group to target with smoking cessation interventions. The critical review in chapter two identified seven randomized control trials targeting low income women with smoking cessation interventions. Positive impacts on smoking cessation rates were identified for interventions with individualized counseling with clinic reinforcement, a mental health intervention, and incentives. Two of the three successful programs included social support as a significant component of the program. Future smoking cessation interventions for low income women should explore social support and incentives as integral components of an intervention. Social support strategies should also target the partner/significant other given that a major factor affecting the likelihood of quit attempts, success at quitting, and remaining abstinent is the smoking behavior and support of the partner or other primary support person (Melvin & Gaffney, 2004).

An additional concern that is noted among low income women are the difficulties in engaging and retaining these clients in interventions as evidenced by the recruitment and attrition findings in the critical review. Further, the GIFTS pilot program found that only about 52% of eligible women chose to participate in the program. In order to more effectively recruit women into health promotion programs, it is critical that qualitative studies be completed to identify innovative strategies to better engage and retain low income women in smoking cessation programs.

Kentucky has not experienced the reduction in smoking during pregnancy that has been noted over the past several decades on the national level. This study found that 26%

of women reported smoking during pregnancy which is significant given the Healthy People 2020 goal that 98.6% of women delivering a live birth will abstain from cigarette use (Healthy People 2020). A nondisclosure rate of almost 16% was identified among known smokers in the GIFTS program which suggests that Kentucky's actual smoking rate is higher than 26%. A recent study using National Health and Nutrition Examination Survey data found 22.9% nondisclosure among pregnant active smokers (Dietz et al., 2011). These findings support the need for biochemical verification of smoking status in future efforts.

The demographic characteristics associated with continuing to smoke during pregnancy in Kentucky included younger maternal age, white, non-Hispanic women with less education and Medicaid as the payment source for the delivery. One characteristic of significant concern is that 34.2% of women living in a rural setting reported smoking during pregnancy compared to 29.9% and 21.5% respectively in the semi-rural and urban settings. There are few interventions that have targeted this high risk population as evidenced by only one study in the critical review for low income women among rural pregnant women.

Compared to women who did not smoke in the three months prior to pregnancy, women who continued to smoke had increased odds for low birth weight, preterm birth, NICU admission and no breastfeeding initiation. Women who reduced their tobacco exposure by at least 50% or quit smoking by the third trimester had increased odds for low birth weight and no breastfeeding initiation only. The odds were highest for adverse birth outcomes among women who continued smoking and lowest for women who quit smoking. These findings suggest that while cessation of tobacco use is the goal of interventions that reduction in tobacco use is also associated with better birth outcomes.

In Kentucky, about 57% of the women who smoke during pregnancy were under the age of 25 years. These younger women also had an increased probability of quitting compared to continuing to smoke according to these data. Health programs that target young mothers such as home visitation programs for first time parents may be uniquely positioned to promote smoking cessation with women that that may benefit from the intervention.

Data from this dissertation may be used for policy development in the areas of school health, statewide smoking bans, and cigarette excise taxes. Programs may developed in schools to promote smoke-free campuses and to reduce initiation of tobacco use. The 2009 Kentucky Youth Risk Behavior Survey found that 12% of Kentucky youth smoked cigarettes on 20 or more days of the 30 prior to the survey compared to 7.3% of youth in the United States (Centers for Disease Control and Prevention, 2009). Kentucky youth were also more likely to report smoking on school property on at least 1 day during the 30 days before the survey than nationwide youth with 9.4% and 5.1% respectively (Centers for Disease Control and Prevention, 2009). School health activities are in a unique position to not only reduce cessation of tobacco use but also to reduce the initiation of tobacco use.

A strategy that may have the most widespread impact on smoking status during pregnancy is the implementation of a statewide smoking ban. Currently, Kentucky has a total of 33 counties/communities with smoke free ordinances or regulations (Kentucky Tobacco Policy Research Program, 2011) . As of December 22, 2011, only 11 of 120 counties in Kentucky have a smoke free ordinance (Kentucky Tobacco Policy Research Program, 2011). The data from this dissertation may be utilized in policy development to emphasize the scope of smoking during pregnancy in Kentucky as well as to inform policy makers about the associated adverse birth outcomes.

Increases in the excise cigarette tax are known to result in reductions in tobacco use. Kentucky currently has a cigarette excise tax of $0.60 which is ranked fortieth in the nation (Campaign for Tobacco-Free Kids, 2012). The average for all states is $1.46 per pack (Campaign for Tobacco-Free Kids, 2012). Increases in this tax may have a positive impact on tobacco use in Kentucky.

The GIFTS pilot project was implemented in nine rural counties in Kentucky with high rates of smoking during pregnancy. The two characteristics that resulted in increased odds of participating in the GIFTS program were the number of cigarettes smoked per day and the number of previous quit attempts. Women who reported greater quantities of cigarette use had greater odds of participation in the program. This may have influenced smoking quit status as heavier smokers are known to have low cessation rates (Higgins et al., 2004). Women with only one or two previous quit attempts also had higher odds of

participation. Strategies need to be identified that will engage women who have had multiple quit attempts in future cessation efforts.

GIFTS participants were found to have reduced odds of preterm birth compared to a matched group while no differences were found in tobacco status, low birth weight, NICU admissions or no breastfeeding initiation. A previous study examining the effect of social support on pregnancy outcomes found that among smokers a greater proportion (10%) had preterm deliveries when they had low social support compared to high (0%) (Elsenbruch et al., 2007). The individualized support that was an integral focus of the GIFTS program may have been an important factor in this finding.

The GIFTS program is a promising practice for prevention of preterm births. This is significant in Kentucky as preterm births were the leading cause of infant deaths in 2009 (Cabinet for Health and Family Services, 2011). Further, it has been estimated nationally that the costs associated with preterm birth/low birth weight infants represents 47% of the costs for all infant hospitalizations and 27% for all pediatric stays (Russell et al., 2007). The Institute of Medicine estimated that the annual economic burden of preterm birth was $26.2 billion or $51,600 per preterm infant (Institute of Medicine of the National Academies, 2006). The savings associated with reductions in preterm birth could be utilized to increase programs to reduce initiation and increase cessation of tobacco use.

The GIFTS program was unsuccessful in its primary objective which was to reduce tobacco use among women in the target population. Future funding for the purpose of reducing smoking during pregnancy is not recommended based on this research. Further analysis of the data is needed to evaluate the role of site of implementation and dosage on tobacco cessation. The interesting finding that GIFTS participants experienced fewer preterm births suggests that components of the program may be effective for prevention of preterm births. One possibility is that strong social support has a role in preterm births. Enhanced social support may be incorporated into existing programs to explore the impact on preterm births.

In summary, this dissertation has documented the scope of smoking during pregnancy in Kentucky and associated adverse birth outcomes. These data may be used to educate policy makers about the seriousness of the issue for promotion of smoke free

ordinances and increased smoking cessation services for pregnant women. Specific components including social support, incentives, and biochemical verification were suggested for incorporation in cessation efforts, especially those targeting low income women. Finally, the GIFTS program has been identified as a promising activity to prevent preterm births. Significant efforts are needed in Kentucky to reduce the number of women who smoke during pregnancy resulting in improved outcomes for mothers and infants.

FORM VS-2A

REGISTRAR'S NO. _____

COMMONWEALTH OF KENTUCKY

CABINET FOR HEALTH AND FAMILY SERVICES
REGISTRAR OF VITAL STATISTICS
CERTIFICATE OF LIVE BIRTH

FILE NO. 116

MUST BE TYPED

CHILD

1. CHILD'S NAME (First, Middle, Last, Suffix)
2. TIME OF BIRTH (24hr)
3. SEX
4. DATE OF BIRTH (Mo/Day/Yr)
5. FACILITY NAME (If not institution, give street and number)
6. CITY, TOWN, OR LOCATION OF BIRTH
7. COUNTY OF BIRTH

MOTHER

8a. MOTHER'S CURRENT LEGAL NAME (First, Middle, Last, Suffix)
8b. DATE OF BIRTH (Mo/Day/Yr)
8c. MOTHER'S NAME PRIOR TO FIRST MARRIAGE (First, Middle, Last, Suffix)
8d. BIRTHPLACE (State, Territory, or Foreign Country)
9a. RESIDENCE OF MOTHER-STATE
9b. RESIDENCE OF MOTHER-COUNTY
9c. RESIDENCE OF MOTHER-CITY, TOWN, OR LOCATION
9d. STREET AND NUMBER
9e. APT. NO.
9f. ZIP CODE
9g. INSIDE CITY LIMITS? ☐ Yes ☐ No

FATHER

10a. FATHER'S CURRENT LEGAL NAME (First, Middle, Last, Suffix)
10b. DATE OF BIRTH (Mo/Day/Yr)
10c. BIRTHPLACE (State, Territory, or Foreign Country)

CERTIFIER

11. CERTIFIER'S NAME _____

TITLE: ☐ MD ☐ DO ☐ HOSPITAL ADMIN. ☐ CNM/CM ☐ OTHER MIDWIFE ☐ OTHER (Specify) _____

12. DATE CERTIFIED ____/____/____ MM DD YYYY

13. DATE FILED BY REGISTRAR ____/____/____ MM DD YYYY

INFORMATION FOR ADMINISTRATIVE USE ONLY

14. MOTHER'S MAILING ADDRESS ☐ **Same as residence, or:** State: City, Town, or Location:
Street and Number: Apartment No.: Zip Code:

MOTHER

15. MOTHER MARRIED? (At birth, conception, or any time between) ☐ Yes ☐ No
IF NO, HAS PATERNITY ACKNOWLEDGEMENT BEEN SIGNED IN THE HOSPITAL? ☐ Yes ☐ No
16. SOCIAL SECURITY NUMBER REQUESTED FOR CHILD? ☐ Yes ☐ No
17. FACILITY ID. (NPI)
18. MOTHER'S SOCIAL SECURITY NUMBER:
19. FATHER'S SOCIAL SECURITY NUMBER:

INFORMATION FOR MEDICAL AND HEALTH PURPOSES ONLY

20. MOTHER'S EDUCATION (Check the box that best describes the highest degree or level of school completed at the time of delivery)

- ☐ 8th grade or less
- ☐ 9th - 12th grade, no diploma
- ☐ High school graduate or GED completed
- ☐ Some college credit but no degree
- ☐ Associate degree (e.g., AA, AS)
- ☐ Bachelor's degree (e.g., BA, AB, BS)
- ☐ Master's degree (e.g., MA, MS, MEng, MEd, MSW, MBA)
- ☐ Doctorate (e.g., PhD, EdD) or Professional degree (e.g., MD, DDS, DVM, LLB, JD)

21. MOTHER OF HISPANIC ORIGIN? (Check the box that best describes whether the mother is Spanish/Hispanic/Latina. Check the "No" box if mother is not Spanish/Hispanic/Latina)

- ☐ No, not Spanish/Hispanic/Latina
- ☐ Yes, Mexican, Mexican American, Chicana
- ☐ Yes, Puerto Rican
- ☐ Yes, Cuban
- ☐ Yes, other Spanish/Hispanic/Latina (Specify) _____

22. MOTHER'S RACE (Check one or more races to indicate what the mother considers herself to be)

- ☐ White
- ☐ Black or African American
- ☐ American Indian or Alaska Native (Name of enrolled or principal tribe) _____
- ☐ Asian Indian
- ☐ Chinese
- ☐ Filipino
- ☐ Japanese
- ☐ Korean
- ☐ Vietnamese
- ☐ Other Asian (Specify) _____
- ☐ Native Hawaiian
- ☐ Guamanian or Chamorro
- ☐ Samoan
- ☐ Other Pacific Islander (Specify) _____
- ☐ Other (Specify) _____

23. MOTHER'S PREPREGNANCY WEIGHT _____ (pounds)

24. MOTHER'S HEIGHT _____ (feet, inches)

25. DID MOTHER GET WIC FOOD FOR HERSELF DURING THIS PREGNANCY? ☐ Yes ☐ No

26a. CIGARETTE SMOKING BEFORE AND DURING PREGNANCY

For each time period, enter either number of cigarettes or the number of packs of cigarettes smoked. IF NONE, ENTER "0"
Average number of cigarettes or packs of cigarettes smoked per day.

	# of cigarettes		# of packs
Three Months Before Pregnancy	_____	OR	_____
First Three Months of Pregnancy	_____	OR	_____
Second Three Months of Pregnancy	_____	OR	_____
Last Three Months of Pregnancy	_____	OR	_____

26b. ALCOHOL USE Alcohol use during pregnancy ☐ Yes ☐ No Avg. number drinks / week ____

FATHER

27. FATHER'S EDUCATION (Check the box that best describes the highest degree or level of school completed at the time of delivery)

- ☐ 8th grade or less
- ☐ 9th - 12th grade, no diploma
- ☐ High school graduate or GED completed
- ☐ Some college credit but no degree
- ☐ Associate degree (e.g., AA, AS)
- ☐ Bachelor's degree (e.g., BA, AB, BS)
- ☐ Master's degree (e.g., MA, MS, MEng, MEd, MSW, MBA)
- ☐ Doctorate (e.g., PhD, EdD) or Professional degree (e.g., MD, DDS, DVM, LLB, JD)

28. FATHER OF HISPANIC ORIGIN? (Check the box that best describes whether the father is Spanish/Hispanic/Latino. Check the "No" box if father is not Spanish/Hispanic/Latino)

- ☐ No, not Spanish/Hispanic/Latino
- ☐ Yes, Mexican, Mexican American, Chicano
- ☐ Yes, Puerto Rican
- ☐ Yes, Cuban
- ☐ Yes, other Spanish/Hispanic/Latino (Specify) _____

29. FATHER'S RACE (Check one or more races to indicate what the father considers himself to be)

- ☐ White
- ☐ Black or African American
- ☐ American Indian or Alaska Native (Name of enrolled or principal tribe) _____
- ☐ Asian Indian
- ☐ Chinese
- ☐ Filipino
- ☐ Japanese
- ☐ Korean
- ☐ Vietnamese
- ☐ Other Asian (Specify) _____
- ☐ Native Hawaiian
- ☐ Guamanian or Chamorro
- ☐ Samoan
- ☐ Other Pacific Islander (Specify) _____
- ☐ Other (Specify) _____

Furnishing parent(s) Social Security Number(s) is required by Federal Law, 42 USC 405(c) of the Social Security Act. The number(s) will be made available to the State Social Services Agency to assist with child support enforcement activities and to the Internal Revenue Service for the purpose of determining Earned Income Tax Credit compliance.

Mother's Signature _____ Date _____ Father's Signature _____ Date _____

PARENT(S) AUTHORIZE RELEASE OF CHILD'S SOCIAL SECURITY NUMBER TO THE OFFICE OF VITAL STATISTICS AND THE DEPARTMENT OF EDUCATION ☐ Yes ☐ No

FORM VS-2B

INFORMATION SHEET FOR CERTIFICATE OF LIVE BIRTH

FILE NO. 116

PAGE 2

CHILD'S NAME (First, Middle, Last, Suffix) | DATE OF BIRTH (Mo/Day/Yr)

MOTHER

30. PLACE WHERE BIRTH OCCURRED (Check one)
- ☐ Hospital
- ☐ Freestanding birthing center
- ☐ Home Birth: Planned to deliver at home? ☐ Yes ☐ No
- ☐ Clinic/Doctor's office
- ☐ Other (Specify) _____

31. ATTENDANT'S NAME, NPI, AND TITLE
NAME: _____
NPI: _____
TITLE: ☐ MD ☐ DO ☐ CNM/CM ☐ OTHER MIDWIFE ☐ OTHER (Specify) _____

32. MOTHER'S WEIGHT AT DELIVERY
_____ (pounds)

33. MOTHER TRANSFERRED FOR MATERNAL, MEDICAL OR FETAL INDICATIONS FOR DELIVERY? ☐ Yes ☐ No
IF YES, ENTER NAME OF FACILITY MOTHER TRANSFERRED FROM:

34. NUMBER OF PREVIOUS LIVE BIRTHS (Do not include this child)
a. Now Living Number _____ ☐ None
b. Now Dead Number _____ ☐ None
c. DATE OF LAST LIVE BIRTH ____/____ MM YYYY

35. NUMBER OF OTHER PREGNANCY OUTCOMES (Spontaneous or induced losses or ectopic pregnancies)
a. Number _____ ☐ None
b. DATE OF LAST OTHER PREGNANCY OUTCOME ____/____ MM YYYY

36. PRENATAL CARE
Number of visits _____ (Enter 0 if none)
a. DATE OF FIRST VISIT: ____/____/____ MM DD YYYY
b. DATE OF LAST VISIT: ____/____/____ MM DD YYYY

37. PRINCIPAL SOURCE OF PAYMENT FOR THIS DELIVERY
- ☐ Private Insurance ☐ Medicaid
- ☐ Self-pay
- ☐ Other (Specify) _____

38. DATE LAST NORMAL MENSES BEGAN ____/____/____ MM DD YYYY

39. MOTHER'S MEDICAL RECORD NUMBER

MEDICAL AND HEALTH INFORMATION

40. RISK FACTORS IN THIS PREGNANCY (Check all that apply)
Diabetes
- ☐ Prepregnancy (Diagnosis prior to this pregnancy)
- ☐ Gestational (Diagnosis in this pregnancy)

Hypertension
- ☐ Prepregnancy (Chronic)
- ☐ Gestational (PIH, preeclampsia, eclampsia)
- ☐ Previous preterm birth
- ☐ Other previous poor pregnancy outcome (Includes perinatal death, small-for-gestational age/intrauterine growth restricted birth)
- ☐ Vaginal bleeding during this pregnancy prior to the onset of labor
- ☐ Pregnancy resulted from infertility treatment
- ☐ Mother had a previous cesarean delivery If yes, how many _____
- ☐ None of the above

41. INFECTIONS PRESENT AND/OR TREATED DURING THIS PREGNANCY (Check all that apply)
- ☐ Gonorrhea
- ☐ Syphilis
- ☐ Herpes Simplex Virus (HSV)
- ☐ Chlamydia
- ☐ Hepatitis B
- ☐ Hepatitis C
- ☐ None of the above

42. OBSTETRIC PROCEDURES (Check all that apply)
- ☐ Cervical cerclage
- ☐ Tocolysis

External cephalic version:
- ☐ Successful
- ☐ Failed
- ☐ None of the above

43. ONSET OF LABOR (Check all that apply)
- ☐ Premature Rupture of the Membrane (prolonged, => 12 hrs.)
- ☐ Precipitous Labor (< 3 hrs.)
- ☐ Prolonged Labor (=> 20 hrs.)
- ☐ None of the above

44. CHARACTERISTICS OF LABOR AND DELIVERY
- ☐ Induction of labor
- ☐ Augmentation of labor
- ☐ Non-vertex presentation
- ☐ Steroids (glucocorticoids) for fetal lung maturation received by the mother prior to delivery
- ☐ Antibiotics received by the mother during labor
- ☐ Clinical chorioamnionitis diagnosed during labor or maternal temperature ≥ 38° C (100.4° F)
- ☐ Moderate/heavy meconium staining of the amniotic fluid
- ☐ Fetal intolerance of labor such that one or more of the following actions was taken: in-utero resuscitative measures, further fetal assessment, or operative delivery
- ☐ Epidural or spinal anesthesia during labor
- ☐ None of the above

45. METHOD OF DELIVERY
a. Was delivery with forceps attempted but unsuccessful? ☐ Yes ☐ No
b. Was delivery with vacuum extraction attempted but unsuccessful? ☐ Yes ☐ No
c. Fetal presentation at birth
- ☐ Cephalic
- ☐ Breech
- ☐ Other

d. Final route and method of delivery (Check one)
- ☐ Vaginal/Spontaneous
- ☐ Vaginal/Forceps
- ☐ Vaginal/Vacuum
- ☐ Cesarean If cesarean, was a trial of labor attempted? ☐ Yes ☐ No

46. MATERNAL MORBIDITY (Check all that apply)
(Complications associated with labor and delivery)
- ☐ Maternal transfusion
- ☐ Third or fourth degree perineal laceration
- ☐ Ruptured uterus
- ☐ Unplanned hysterectomy
- ☐ Admission to intensive care unit
- ☐ Unplanned operating room procedure following delivery
- ☐ None of the above

NEWBORN INFORMATION

NEWBORN

47. NEWBORN MEDICAL RECORD NUMBER

48. BIRTHWEIGHT (grams preferred, specify unit)
_____ ☐ grams ☐ lb/oz

49. OBSTETRIC ESTIMATE OF GESTATION
_____ (completed weeks)

50. APGAR SCORE:
Score at 5 minutes: _____
If 5 minute score is less than 6,
Score at 10 minutes: _____

51. PLURALITY - Single, Twin, Triplet, etc.
(Specify) _____

52. IF NOT SINGLE BIRTH - Born First, Second, Third, etc.
(Specify) _____

53. ABNORMAL CONDITIONS OF THE NEWBORN (Check all that apply)
- ☐ Assisted ventilation required immediately following delivery
- ☐ Assisted ventilation required for more than six hours
- ☐ NICU admission
- ☐ Newborn given surfactant replacement therapy
- ☐ Antibiotics received by the newborn for suspected neonatal sepsis
- ☐ Seizure or serious neurologic dysfunction
- ☐ Significant birth injury (skeletal fracture(s), peripheral nerve injury, and/or soft tissue/solid organ hemorrhage which requires intervention)
- ☐ None of the above

54. CONGENITAL ANOMALIES OF THE NEWBORN (Check all that apply)
- ☐ Anencephaly
- ☐ Meningomyelocele/Spina bifida
- ☐ Congenital heart disease ☐ Cyanotic ☐ Non-cyanotic
- ☐ Congenital diaphragmatic hernia
- ☐ Omphalocele
- ☐ Gastroschisis
- ☐ Limb reduction defect (excluding congenital amputation and dwarfing syndromes)
- ☐ Cleft Lip with or without Cleft Palate
- ☐ Cleft Palate alone
- ☐ Down Syndrome ☐ Karyotype confirmed ☐ Karyotype pending
- ☐ Suspected chromosomal disorder ☐ Karyotype confirmed ☐ Karyotype pending
- ☐ Hypospadias
- ☐ None of the anomalies listed above
- ☐ Other (Specify) _____

55. WAS INFANT TRANSFERRED WITHIN 24 HOURS OF DELIVERY? ☐ Yes ☐ No
IF YES, NAME OF FACILITY TRANSFERRED TO: _____

56. IS INFANT LIVING AT TIME OF REPORT? ☐ Yes ☐ No ☐ Infant transferred, status unknown

57. IS INFANT BEING BREASTFED? ☐ Yes ☐ No

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Vita

Date of Birth **August 24, 1966**

Place of Birth **Leonardtown, Maryland**

Education

Year	Degree	Institution
1992	M.S., Human Genetics/Genetic Counseling	University of Michigan, Ann Arbor
1988	B.A., Biology	University of Maryland, Baltimore County

Professional Positions

2007 – Present	Genetic Coordinator University of Kentucky, College of Public Health Kentucky Department for Public Health
2005 – 2007	Branch Manager/Program Manager/Genetic Coordinator University of Kentucky, College of Public Health Kentucky Department for Public Health
2004 – 2005	Principal Investigator/Genetic Coordinator University of Kentucky, College of Public Health Kentucky Department for Public Health
1999 – 2004	Principal Investigator/Program Manager University of Kentucky, Department of Pediatrics Kentucky Department for Public Health
1993 – 1999	Genetic Counselor University of Kentucky, Department of Pediatrics
1991 – 1992	Research Assistant University of Michigan, Human Genome Center
1990 –1991	Medical Research Technician II, Biochemical Genetics Laboratory Tulane University, Human Genetics Program
1988 –1990	Laboratory Technologist, Biochemical Genetics Laboratory University of Maryland at Baltimore, Division of Human Genetics

Honors

Maryland Distinguished Scholar
University of Maryland, Baltimore County Chancellor's Scholarship
Diplomate, American Board of Genetic Counseling
Certificate of Public Health Leadership, Kentucky Public Health Leadership Institute

Publications

Bradburn, JM and Hall, BD: Spondyloepimetaphyseal Dysplasia with joint laxity (SEMDJL):Clinical and radiological findings in a Guatemalan patient. American Journal of Medical Genetics 59(2):234-237, 1995

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Joyce M. Robl

Signature