THE EFFECTS OF MATERNAL TOBACCO USE

ON LOW BIRTH WEIGHT

IN TEXAS 2001

THESIS

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by

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San Marcos, Texas
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DEDICATION

This thesis is dedicated to my parents who have supported me all the way since the beginning of my studies. Also, this thesis is dedicated to my husband who has been a great source of motivation and inspiration

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Low birth weight (LBW) is a major contributor to infant mortality and childhood morbidity and mortality. Maternal smoking is a major cause of low birth weight. This population-based retrospective cohort study examined the effects of maternal tobacco use during pregnancy on the incidence of LBW Computerized data of Texas 2001 live birth certificates were used, and only singleton births were analyzed. Descriptive statistics, relative risks, 95% confidence intervals, logistic regression analyses, and a multiple linear regression analysis were used to examine the association between maternal smoking and LBW. Mothers who smoked during

pregnancy were twice as likely than non-smokers (95% CI = 1.707 – 1.852) to have a low birth weight infant both before and after adjustment of covariates (sex of child; maternal age; maternal education; maternal racial/ethnicity; maternal tobacco use; maternal alcohol use; prenatal care, maternal marital status; maternal medical risk factors for this pregnancy, Medicaid status; preterm labor, preterm birth; and maternal weight gain during pregnancy). Less educated women (for 7 to 11 years of education, RR = 1.566, 95% CI = 1.48 – 1.66); women with medical problems (for diabetes, RR = 1.104, 95% CI = 1.021 – 1.193; for chronic hypertension, RR = 3.121, 95% CI = 2.866 – 3.399; and for pregnancy associated hypertension, RR = 2.936, 95% CI = 2.818 – 3.058); women with inadequate weight gain during pregnancy (for less than 17 pounds, RR = 3.337, 95% CI = 3.17 – 3.51); those who were on Medicaid (RR = 1 209, 95% CI = 1.177 – 1.242); those who used alcohol during pregnancy (RR = 1.628, 95% CI = 1.468 – 1 805); those who had no prenatal care (for those who had prenatal care, RR = 0.432, 95% CI = 0.402 – 0.464); women who had a preterm birth (RR = 12 114, 95% CI = 11.802 – 12 434); and women who had preterm delivery (RR = 9.816, 95% CI = 9 572 – 10.066) were at a higher risk of giving birth to LBW infants than mothers without these risk factors. Women who were 20 years old or older were less likely to have a LBW birth Births who were male were also less likely to be LBW than female births (RR = 0 89, 95% CI = 0.868 – 0 914) Before

adjustment for covariates, non-Hispanic whites had the lowest risk for LBW, and non-Hispanic blacks had two times higher risk than non-Hispanic whites. However, after adjustment for these covariates, Hispanics had the lowest risk of LBW and non-Hispanic whites had the highest risk The risk of LBW associated with maternal smoking also differed among the three racial/ethnic groups: non-Hispanic white smokers had the highest risk (OR = 2.033, 95% CI = 1.874 – 2.205), non-Hispanic black smokers had the second highest risk (OR = 1.780, 95% CI = 1.518 – 2.088), and Hispanic smokers had the lowest risk (OR = 1.721, 95% CI = 1.470 – 2.016). Educating women and teens about the risk of maternal tobacco use and other risk factors for low birth weight is an important intervention for reducing the incidence of LBW. Further studies should also be conducted to better understand potential factors among Hispanic women that lead to a reduced risk for LBW compared to women from other racial/ethnic groups.

CHAPTER I

INTRODUCTION

Low birth weight (LBW), defined as babies born weighing less than 2,500 grams or 5.5 pounds, is a major health problem in the United States. LBW is a major contributor to infant mortality and childhood morbidity and mortality (Kopp & Kaler, 1989; Law et al., 2003; Ventura et al., 2003; Walsh, 1994). LBW infants face an increased risk of physical and developmental complications and death (Cornelius & Day, 2000; Iyasu & Tomashek, 2001; Kleinman & Madans, 1985; Law et al., 2003; Lightwood et al., 1999; Mathews, 2001; Nandi & Nelson, 1992, Pollack, 2001; Rosenberg & Buescher, 2001; Ventura et al., 2003; Walsh, 1994). The major health problems that LBW infants are more susceptible to include asthma, cerebral palsy, learning disabilities, insulin resistance syndrome, serum lipids, type 2 diabetes mellitus, hypertension, and cardiovascular disease (Cornelius & Day, 2000; Hofhuis, de Jongste, & Merkus, 2003, Law et al , 2003). A low birth weight infant is born either due to preterm labor, defined as a birth prior to 37 completed weeks of gestation or due to intrauterine growth retardation (IUGR), defined as the unborn-

baby at or below the 10th weight percentile for his or her age in weeks (Fall et al., 2003; Kramer, 1987; Lightwood et al, 1999).

Risk Factors for Low Birth Weight

Many factors are associated with risk of low birth weight. Numerous studies have shown a well-defined positive association between maternal tobacco use and incidence of LBW (Arias, MacDorman, Strobino, & Guyer, 2003; Brooke, Anderson, Bland, Peacock, & Stewart, 1989; Cornelius & Day, 2000; Fingerhut et al., 1990; Fortier, Marcoux, & Brisson, 1994; Horne et al., 2001; Horta et al., 1997; LeClere & Wilson, 1997; Lightwood et al., 1999; Nandi & Nelson, 1992; Ventura et al., 2003; Walsh, 1994; Zhang & Radcliffe, 1993). Smoking is one of the major risk factors for IUGR (Wen, Goldenberg, Cutter, Hoffman, & Cliver, 1990) and also a risk factor for preterm labor (Shah & Bracken, 2000). Mothers who smoke during pregnancy are almost twice more likely to have a LBW infant than mothers who do not smoke during pregnancy (Law et al., 2003; Rosenberg & Buescher, 2001; Ventura et al., 2003; Walsh, 1994). According to Lightwood et al (1999), maternal smoking contributed to LBW rate between 17% and 26% in the 1980s in the United States. Brooke et al (1989) found that maternal smoking caused a five percent decrease in birth weight Generally, the average reduction in birth weight seen in smoking women is 200 grams (Meurs, 1999) Several studies have found a dose-response relationship

between mean birth weight and number of cigarettes smoked (Cornelius & Day, 2000; Horta et al., 1997; LeClere & Wilson, 1997). The more the mother smokes during pregnancy, the greater the reduction in infant birth weight. Nieberg used the term "fetal tobacco syndrome" to describe the strong positive association between smoking and LBW(as cited in Walsh, 1994)

Other risk factors for LBW include maternal age; maternal education; maternal racial /ethnicity; marital status; maternal weight gain during pregnancy; multiple births, maternal chronic health conditions; family income; length of gestation; prenatal care; Medicaid enrollment; and maternal alcohol use (Hueston et al., 2003; LeClere & Wilson, 1997; Nandi & Nelson, 1992; Rosenberg & Buescher, 2001; Wang, Ding, Ryan, & Xu, 1997) Older women smoke more heavily during pregnancy than younger women Thus, among the smokers, LBW rate is higher in older women (LeClere & Wilson, 1997; Nandi & Nelson, 1992; Showstack, Budetti, & Milkier, 1984). Unmarried women smoke more during pregnancy than married women (LeClere & Wilson, 1997; Pagel, Smikstein, Regen, & Montano, 1990). Higher income and higher educated mothers smoke less (LeClere & Wilson, 1997, Showstack et al , 1984; Ventura et al., 2003). Women with lower socioeconomic status have a higher risk for LBW (Forssas et al., 1999; Fuentes-Afflick et al., 1999). Absence of prenatal care is associated with LBW (Brooke et al , 1989, Guyer et al ,

1999; Hueston et al., 2003; Showstack et al., 1984). Women who do not have prenatal care are at three times higher risk for having a LBW baby compared to women who have prenatal care (Greenberg, 1983). Prenatal alcohol exposure causes a decrease in birth weight (Little, 1977; Nandi & Nelson, 1992). Ananth, Peedicayli, & Savitz (1995) found that mothers with preeclampsia during pregnancy are more likely to have a LBW baby and a preterm labor compared to mothers without preeclampsia.

Among non-Hispanic blacks, Hispanics, and non-Hispanic whites, non-Hispanic blacks have almost two times higher risk for LBW than non-Hispanic whites (Barnett, 1995; Hueston et al., 2003, Iyasu & Tomashek, 2001; LeClere & Wilson, 1997). Surprisingly, Hispanics have a lower LBW rate than non-Hispanic whites despite their lower socioeconomic status, a well known risk factor for LBW (Alexander et al., 2003; Barnett, 1995; Buekens et al., 2000; Collins & Shay, 1994; Dowling & Fisher, 1987; Fuentes-Afflick et al., 1999; Kleinman, 1990). This phenomenon is called the "Hispanic paradox" (Dowling & Fisher, 1987).

Purpose of Study

The primary objectives of this epidemiological study were to examine the association between maternal tobacco use and the risk of having low birth weight infants in Texas in 2001 and to compare the risk of LBW associated with tobacco use among women from different racial/ethnic groups. Another objective was to examine

risk factors for low birth weight other than maternal tobacco use in Texas in 2001.

CHAPTER II

METHODS

The 2001 Texas birth certificate data obtained from the Texas Department of Health (TDH) was used for this study. Dr. Jean Brender has given permission to graduate student, Mrs. Oksahn Park, to access data for this study No identifying data were available in this dataset. The following variables that were found to affect infant birth weight by previous studies were obtained from the birth certificates· sex of child; maternal age; maternal education; maternal racial/ethnicity; maternal tobacco use; maternal alcohol use; prenatal care, maternal marital status; maternal medical risk factors for this pregnancy; Medicaid enrollment; preterm labor; preterm birth; birth weight in grams; clinical estimate of gestation; pregnancy length in weeks; and maternal weight gain during pregnancy. The dependent variables were whether or not the infant was low birth weight and birth weight in grams. The independent variables were sex of child, maternal age; maternal education; maternal racial/ethnicity; maternal tobacco use; maternal alcohol use, prenatal care; maternal marital status, maternal medical risk factors for this pregnancy including diabetes, chronic

hypertension, and pregnancy-associated hypertension; Medicaid status; clinical estimate of gestation, pregnancy length in weeks; average number of cigarettes used per day; average number of drinks per week; number of prenatal care visits; and maternal weight gain during pregnancy

Research Design

The study design was a population-based retrospective cohort analysis investigating the relationship between maternal tobacco use and risk for low birth weight in offspring.

Study Population

The study population was drawn from the 2001 Texas birth certificate data. For the purpose of this study, only singleton births were considered, because there is a strong association between low birth weight and multiple births (Guyer et al., 1999; Rosenberg & Buescher, 2001). Arias et al. (2003) found that more than 90 % of triplets and 50 % of twins were born preterm or LBW.

Overall, the dataset included detailed information on 354,967 Texas births in 2001 An estimated 21,590 (6 1%) low birth weight infants and 333,139 (93 9%) comparison infants (normal birth weight, born 2,500 grams or higher) were available for this study Missing values were excluded from the analyses

Table 1 shows the total number of live births and their respective birth weight groups in Texas 2001.

Table 1. Total number of low birth weight and normal birth weight births in Texas, 2001

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<2500 grams	21590	6 1	6 1	6 1
	2500 or more grams	333139	93 9	93 9	100 0
	Total	354729	99 9	100 0	
Missing	System	238	1		
Total		354967	100 0		

Data Collection

The data used in this study included maternal demographic, and medical information, and conditions of the newborn retrieved from the 2001 Texas birth certificate data. Low birth weight was categorized into two groups: yes (less than 2,500 grams) and no (2,500 or more grams). Maternal tobacco use was categorized into two groups: yes (smokers) and no (non-smokers).

Statistical Analysis

Descriptive statistics was used to compare the incidence of low birth weight group (cohort) among various exposure groups including smokers. Relative risks (RR, e.g. LBW incidence rate of mothers who smoked divided by LBW incidence rate of

mothers who did not smoke) and 95% confidence intervals (CI) were calculated and also stratified by the factors listed in Table 2.

Table 2. Risk factors for low birth weight, Texas births 2001

Variables	Measurements
Sex of child	1 = Male
	2 = Female
Diabetes	1 = Yes
	2 = No
Chronic hypertension	1 = Yes
	2 = No
Preterm labor	1 = Yes
	2 = No
Pregnancy-associated	1 = Yes
Hypertension	2 = No
Prenatal care during	1 = No prenatal care
Pregnancy	2 = Had prenatal care
Maternal age in years	1 = <20
	2 = 20 – 24
	3 = 25 – 29
	4 = 30 – 34
	5 = 35 – 39
	6 = 40 and higher
Tobacco use during pregnancy	1 = Yes
	2 = No
Alcohol use during pregnancy	1 = Yes
	2 = No
Maternal education	1 = <7 years
	2 = 7 - 11 years
	3 = High school graduates
	4 = Some college
	5 = 16 years
	6 = Post graduate
Marital status	1 = Yes
	2 = No

Variables	Measurements
Preterm birth	1 = Yes 2 = No
Maternal weight gain during pregnancy in pounds	1 = < 17 2 = 17 – 25 3 = 26 – 35 4 = 36 – 39 5 = 40 and higher
On Medicaid	1 = Yes 2 = No

The associations between tobacco use during pregnancy and the risk of low birth weight were further evaluated by logistic regression models. Backward – likelihood ratio logistic regression analyses were performed to compute the odds ratios and 95% confidence intervals for LBW associated with tobacco use after adjusting for possible confounding factors including sex of child; maternal diabetes; chronic hypertension; pregnancy-associated hypertension; preterm labor; maternal alcohol use during pregnancy, marital status; prenatal care; Medicaid status; preterm birth, maternal weight gain during pregnancy; maternal age; maternal education; and maternal racial/ethnicity One logistic regression analysis for all racial/ethnic groups, and three other logistic regression analyses restricted to individual racial/ethnic groups (non-Hispanic white, non-Hispanic black; and Hispanic) were performed for the low birth weight outcome.

A stepwise multiple linear regression analysis was performed to determine the associations between average number of cigarettes used per day and birth weight

in grams, between average number of drinks per week and birth weight in grams, between numbers of prenatal care visits and birth weight in grams, between pregnancy length in weeks and birth weight in grams, between maternal weight gain during pregnancy and birth weight in grams, and between clinical estimate of gestation in weeks and birth weight in grams. All the variables in this analysis were continuous variables. The software program SPSS 12.0 was used to create the working file and to perform the statistical analyses, and the Computer Programs for Epidemiologists (PEPI 4.0) were also used to calculate relative risks and 95% confidence intervals for variables with more than two categories.

CHAPTER III

RESULTS

Among 354,967 Texas singleton births in 2001, an estimated 21,590 (6.1%) low birth weight infants (born weighing less than 2,500 grams) and 333,139 (93.9%) normal birth weight infants (born 2,500 grams or higher) were available for this study. A total of 238 (0.1%) babies were missing information and were excluded in the study.

Descriptive Analysis and Relative Risk

Table 3 shows the total number and percentage of low birth weight and normal birth weight births by sex of child; maternal conditions including diabetes, chronic hypertension, and pregnancy-associated hypertension; preterm labor status; maternal tobacco use during pregnancy; maternal alcohol use during pregnancy; maternal marital status, maternal racial/ethnicity; prenatal care, Medicaid status; preterm birth; maternal weight gain during pregnancy, maternal age; and maternal education. All the variables were significant risk factors with the p-values less than

0.01

TABLE 3. Comparison of characteristics of low birth weight and normal birth weight births in Texas, 2001

Characteristic	LBW N(%)	Normal Birth Weight N(%)	Relative Risk (95% CI)	p-value
Sex of child				
Male	10425 (5 7%)	171158 (94 3%)	0 89 (0 868 -0 914)	<0 001
Female	11165 (6 4%)	161981 (93 6%)	1 00 (Referent)	
Diabetes				
Yes	613 (6 7%)	8538 (93 3%)	1 104 (1 021 -1 193)	0 013
No	20977 (6 1%)	324601 (93 9%)	1 00 (Referent)	
Chronic hypertension				
Yes	440 (18 7%)	1909 (81 3%)	3 121(2 866 -3 399)	<0 001
No	21150 (6 0%)	331230 (94 0%)	1 00 (Referent)	
Pregnancy associated hypertension				
Yes	2165 (16 7%)	10810 (83 3%)	2 936 (2 818 -3 058)	<0 001
No	19425 (5 7%)	322329 (94 3%)	1 00 (Referent)	
Preterm labor				
Yes	4849 (47 7%)	5318 (52 3%)	9 816 (9 572 -10 066)	<0 001
No	16741 (4 9%)	327821 (95 1%)	1 00 (Referent)	
Tobacco use during pregnancy				
Yes	2345 (10 3%)	20472 (89 7%)	1 778 (1 707 - 1 852)	<0 001
No	18971 (5 8%)	309206 (94 2%)	1 00 (Referent)	
Alcohol use during pregnancy				
Yes	330 (9 8%)	3028 (91 2%)	1 628 (1 468 -1 805)	<0 001
No	20986 (6 0%)	326650 (94 0%)	1 00 (Referent)	

Characteristic	LBW N(%)	Normal Birth Weight N(%)	Relative Risk (95% CI)	p-value
Marital status				
Married	12561 (5 2%)	231118 (94 8%)	0 635 (0 618 – 0 651)	<0 001
Unmarried	8988 (8 1%)	101656 (91 9%)	1 00 (Referent)	
Maternal racial/ ethnicity				
Non-Hispanic whites	6745 (5 0%)	127659 (95 0%)	1 00 (Referent)	
Non-Hispanic blacks	4325 (11%)	34844 (89 0%)	2 2 (2 12 – 2 29)	<0 001
Hispanics	9703 (5 8%)	158499 (94 2%)	1 159 (1 12 – 1 20)	<0 001
Others	817 (6 3%)	12137 (93 7%)	1 274 (1 18 – 1 37)	<0 001
Prenatal care				
Yes	20918 (6 0%)	328957 (94 0%)	0 432 (0 402 –0 464)	<0 001
No	672 (13 8%)	4182 (86 2%)	1 00 (Referent)	
On Medicaid				
Yes	7674 (6 9%)	103476 (93 1%)	1 209 (1 177 - 1 242)	<0 001
No	13906 (5 7%)	229538 (94 3%)	1 00 (Referent)	
Preterm birth				
Yes	10696(34 5%)	20268 (65 5%)	12 114 (11 802 - 2 434)	<0 001
No	8372 (2 9%)	285222 (97 1%)	1 00 (Referent)	
Maternal weight gain group in pounds				
<17	4799 (10 5%)	41110 (89 5%)	3 337 (3 17 – 3 51)	<0 001
17 -25	5487 (7 1%)	71545 (92 9%)	2 274 (2 17 –2 39)	<0 001
26 -35	4655 (4 8%)	92429 (95 2%)	1 608 (1 53 – 1 69)	<0 001
36 –39	690 (3 7%)	18024 (96 3%)	1 177 (1 08 – 1 28)	<0 001
40+	2237 (3 1%)	69183 (96 9%)	1 00 (Referent)	
Maternal age group in years				
<20	4244 (8 0%)	48698 (92 0%)	1 00 (Referent)	
20-24	6389 (6 3%)	95259 (93 7%)	0 784 (0 75 – 0 82)	<0 001
25-29	4926 (5 3%)	88835 (94 7%)	0 655 (0 63 – 0 68)	<0 001
30-34	3585 (5 1%)	66577 (94 9%)	0 637 (0 61 – 0 67)	<0 001
35-39	1958 (6 5%)	27999 (93 5%)	0 815 (0 77 – 0 86)	<0 001

Characteristic	LBW N(%)	Normal Birth Weight N(%)	Relative Risk (95% CI)	p-value
Maternal age group in years				
40 +	483 (7 8%)	5745 (92 2%)	0 967 (0 88 – 1 06)	<0 001
Maternal education group				
<7 years	1203 (5 2%)	21833 (94 8%)	1 152 (1 07 – 1 25)	<0 001
7-11 years	6463 (7 0%)	85531 (93 0%)	1 550 (1 46 – 1 64)	<0 001
High school graduate	7222 (6 6%)	102716 (93 4%)	1 449 (1 37 – 1 54)	<0 001
Some college	3234 (5 6%)	54456 (94 4%)	1 237 (1 16 – 1 32)	<0 001
6 years	1566 (4 3%)	34536 (95 7%)	0 957 (0 89 – 1 03)	<0 001
Post graduate	1298 (4 5%)	27634 (95 5%)	1 00 (Referent)	

LBW was more common among female babies (6.4%) than male babies (5.7%); diabetic mothers (6.7%) than non-diabetic mothers (6.1%); mothers with chronic hypertension (18.7%) than mothers without chronic hypertension (6.0%); mothers with pregnancy-associated hypertension (16.7%) than mothers without pregnancy-associated hypertension (5.7%); mothers who had preterm labor (47.7%) than mothers who did not have preterm labor (4.9%); smokers (10.3%) than non-smokers (5.8%); alcohol users (9.8%) than non-alcohol users (6.0%); unmarried mothers (8.1%) than married mothers (5.2%), non-Hispanic blacks (11%) than non-Hispanic whites (5.0%), Hispanics (5 8%), and others (6.3%); mothers without prenatal care (13.8%) than mothers with prenatal care (6 0%); on Medicaid (6.9%) than not on Medicaid (5.7%); preterm births (34.5%) than full-term births (2.9%);

maternal weight gain less than 17 pounds during pregnancy (10.5%) than 17 to 25 pounds (7.1%), 26 to 35 pounds (4.8%), 36 to 39 pounds (3.7%), and 40 pounds or more (3.1%); mothers who were less than 20 (8.0%) years of age than mothers who were 20 to 24 years old (6.3%), 25 to 29 years old (5.3%), 30 to 34 years old (5.1%), 35 to 39 years old (6.5%), and 40+ (7.8%), and mothers with 7 to 11 years education (7.0%) than mothers with less than 7 years education (5.2%), high school graduates (6.6%), mothers with some college education (5.6%), mothers with 16 years education (4.3%), and post graduates (4.5%). Preterm births had the highest relative risk for LBW, 12.114 (95% CI = 11.802 – 12.434) and mothers who had preterm labor had the second highest relative risk for giving birth to a baby with LBW, 9.816 (95% CI = 9.572 – 10.066) of all the variables.

Sex of child

Among the 181,583 male babies and the 173,146 female babies, 10,425 (5.7%) male babies and 11,165 (6.4%) female babies were LBW. Male babies were 0.89 times (95% CI = 0.868 - 0.914) less likely to be of LBW than female babies.

Risks associated with maternal medical problems

Among the 9,151 diabetic mothers and the 345,578 non-diabetic mothers, 613 (6.7%) diabetic mothers and 20,977 (6.1%) non-diabetic mothers had a LBW infant. Diabetic mothers were 1.104 times (95% CI = 1 021 – 1.193) more likely to

have a LBW infant than non-diabetic mothers.

Among the 2,349 mothers with chronic hypertension and the 352,380 mothers without chronic hypertension, 440 (18.7%) mothers with chronic hypertension had a LBW infant and 21,150 (6.0%) mothers without chronic hypertension had a LBW infant. Mothers with chronic hypertension were at 3.121 times higher risk of having a LBW infant (95% CI = 2.866 – 3.399) than mothers without chronic hypertension.

Among the 12,975 mothers with pregnancy-associated hypertension and the 341,754 mothers without pregnancy-associated hypertension, 2,165 (16.7%) mothers with pregnancy-associated hypertension and 19,425 (5.7%) mothers without pregnancy-associated hypertension had LBW infants. Mothers with pregnancy-associated hypertension had a relative risk of 2.936 (95% CI = 2.818 – 3.058) for LBW compared to mothers without pregnancy-associated hypertension.

Preterm labor

Among the 10,167 mothers who had preterm labor and the 344,562 mothers who did not have preterm labor, 4,849 (47.7%) mothers who had preterm labor and 16,741 (4.9%) mothers who did not have preterm labor had a LBW baby. Mothers who had preterm labor were 9.816 times (95% CI = 9.572 – 10.066) more likely to have a LBW baby than mothers who did not have preterm labor

Tobacco use during pregnancy

Among the 22,817 mothers who used tobacco during pregnancy and the 328,177 mothers who did not use tobacco during pregnancy, 2,345 (10.3%) mothers who used tobacco during pregnancy and 18,971 (5.8%) mothers who did not use tobacco during pregnancy had a LBW infant. Mothers who used tobacco during pregnancy were almost two times (RR = 1 778, 95% CI = 1.707 – 1.852) more likely to have a LBW infant than mothers who did not use tobacco during pregnancy.

Alcohol use during pregnancy

Among the 3,358 mothers who used alcohol during pregnancy and the 347,636 mothers who did not use alcohol during pregnancy, 330 (9.8%) mothers who used alcohol during pregnancy and 20,986 (6.0%) mothers who did not use alcohol during pregnancy had a LBW infant. Mothers who used alcohol during pregnancy had a relative risk of 1.628 (95% CI = 1.468 – 1.805) compared to mothers who did not use alcohol during pregnancy.

Marital status

Among the 243,679 married mothers and the 110,644 unmarried mothers, 12,561 (5 2%) married mothers and 8,988 (8.1%) unmarried mothers had a LBW infant. Married mothers were 0 635 times (95% CI = 0.618 – 0.651) less likely to have a LBW baby than unmarried mothers

Maternal racial/ ethnicity

Among the 134,404 non-Hispanic whites, the 39,169 non-Hispanic blacks, the 168,202 Hispanics, and the 12,954 mothers in the others racial/ethnicity category, 6,745 (5.0%) non-Hispanic whites, 4,325 (11%) non-Hispanic blacks, 9,703 (5.8%) Hispanics, and 817 (6.3%) in the others category had a LBW infant. The non-Hispanic white group (RR = 1.0) was the reference group and had the lowest OR among the groups. The relative risk for the non-Hispanic black group was 2.2 (95% CI = 2.12 – 2.29), which was the highest among the groups, indicating that the non-Hispanic blacks were more than twice as likely to have a LBW infant. The Hispanic paradox was not found in Table 3, because the Hispanic group had a higher relative risk, 1.159 (95% CI = 1.12 – 1.20), than the non-Hispanic white group (OR = 1.0). The relative risk for the "others" group was 1.274 (95% CI = 1.18 – 1.37).

Prenatal care

Among the 349,875 mothers who had prenatal care during pregnancy and the 4,854 mothers who did not have prenatal care, 20,918 (6.0%) mothers who had prenatal care and 672 (13.8%) mothers who did not have prenatal care had a LBW infant. Mothers who had prenatal care were at 0.432 times (95% CI = 0.402 – 0.464) less risk of having a LBW infant than mothers who did not have prenatal care.

On Medicaid

Among the 111,150 mothers who were on Medicaid and the 243,444 mothers who were not on Medicaid, 7,674 (6.9%) mothers who were on Medicaid and 13,906 (5.7%) mothers who were not on Medicaid had a LBW infant. Mothers who were on Medicaid had a relative risk of 1.209 (95% CI = 1 177 – 1 242) compared to mothers who were not on Medicaid.

Preterm birth

Among the 30,964 preterm births and the 293,594 full-term births, 10,696 (34.5%) preterm births and 8,372 (2.9%) full-term births were LBW. The relative risk for preterm births was 12.114 (95% CI = 11.802 – 12.434).

Maternal weight gain group during pregnancy in pounds

Among the 45,909 mothers who gained less than 17 pounds, the 77,032 mothers who gained 17 to 25 pounds, the 97,084 mothers who gained 26 to 35 pounds, the 18,714 mothers who gained 36 to 39 pounds, and the 71,420 mothers who gained 40 pounds or more, 4,799 (10.5%) mothers who gained less than 17 pounds, 5,487 (7.1%) mothers in the 17 to 25 pound group, 4,655 (4.8%) mothers in the 26 to 35 pound group, 690 (3.7%) mothers in the 36 to 39 pound group, and 2,237 (3.1%) mothers in the 40 + pound group had a LBW infant When compared to the 40+ pound group (RR = 1.0), which had the lowest relative risk, the less than 17 pound

group had the highest relative risk (RR =3.337, 95% CI = 3.17 – 3.51); the 17 to 25 pound group had a relative risk of 2.274 (95% CI = 2.17 – 2.39); the 26 to 35 pound group had a relative risk of 1.608 (95% CI = 1.53 – 1.69); and the 36 to 39 pound group had a relative risk of 1.177 (95% CI = 1.08 – 1.28). Therefore, the more weight a mother gained during pregnancy, the less likely she had a LBW infant.

Maternal age group in years

Among the 52,942 mothers who were less than 20 years old, the 101,648 mothers who were 20 to 24 years old, the 93,761 mothers who were 25 to 29 years old, the 71,062 mothers who were 30 to 34 years old, the 29,957 mothers who were 35 to 39 years old, and the 6,228 mothers who were 40 years old or older, 4,244 (8.0%) mothers in the less than 20 age group, 6,389 (6.3%) mothers in the 20 to 24 age group, 4,926 (5.3%) mothers in the 25 to 29 age group, 3,585 (5.1%) mothers in the 30 to 34 age group, 1,958 (6.5%) mothers in the 35 to 39 age group, and 483 (7.8%) mothers in the 40 years or older age group had a LBW infant. When compared to the less than 20 age group (RR = 1.0), all the other age groups had relative risks lower than the less than 20 age group. Women in the 20 to 24 age group had a relative risk of 0.784 (95% CI = 0.75 – 0.82); the 25 to 29 age group had a relative risk of 0.655 (95% CI = 0.63 – 0.68); the 30 to 34 age group had the lowest relative risk, 0.637 (95% CI = 0.61 – 0.67); the 35 to 39 age group had a relative risk of 0 815 (95% CI = 0 77 – 0.86); and

the 40 years or older age group had a relative risk of 0.967 (95% CI = 0.88 – 1.06), which was almost same as the relative risk for the less than 20 age group. As age increased, the risk decreased through ages 30 to 34 years; then the relative risks increased in this analysis, so mothers in the less than 20 age group and the 40 years or older age group were at the highest risk of having a LBW infant.

Maternal education group

Among the 23,036 mothers with less than 7 years of education, the 91,994 mothers with 7 to 11 years of education, the 109,938 mothers who graduated from high school, the 57,690 mothers with some college education, the 36,102 mothers with 16 years of education, and the 28,632 mothers with post graduate education, 1,203 (5.2%) mothers in the less than 7 year education group, 6,463 (7.0%) mothers in the 7 to 11 year education group, 7,222 (6.6%) mothers in the high school graduate group, 3,234 (5.6 %) in the some college group, 1,566 (4.3%) mothers in the 16 year education group, and 1,298 (4.5%) mothers in the postgraduate group had a LBW infant. When compared to the post graduate group (RR = 1.0), mothers in the less than 7 year group had a relative risk of 1.152 (95% CI = 1.07 – 1.25); the 7 to 11 year group had a relative risk of 1.550 (95% CI = 1 46 – 1.64), which was the highest among the groups; the high school graduate group had a relative risk of 1.449 (95% CI = 1.37 – 1.54); the some college group had a relative risk of 1.237 (95% CI = 1.16

– 1.32); and the 16 year group had the lowest relative risk, 0.957 (95% CI = 0.89 – 1.03), among the maternal education groups. As the number of years of education increased above 11 years, the relative risks decreased for the subsequent education groups.

Logistic Regression Analyses

Table 4 shows the association between the same variables examined in Table 3 and risk of having a LBW newborn by the odds ratios (ORs) and 95% confidence intervals (CIs) with all racial/ethnic groups.

TABLE 4. Odds ratios and 95% confidence intervals for low birth weight with all racial/ethnic groups of births in Texas, 2001

Variables	Beta	p-value	Odds Ratio (95% CI)
Sex of child			
Male	-0 236	<0 001	0 789 (0 761 - 0 819)
Female			1.00 (Referent)
Diabetes			
Yes	0 367	<0 001	1 444 (1 291 – 1 614)
No			1 00 (Referent)
Chronic hypertension			
Yes	0 832	<0 001	2 297 (1 983 – 2 661)
No			1 00 (Referent)
Pregnancy-associated hypertension			
Yes	1 151	<0 001	3 162 (2 959- 3 380)
No			1 00 (Referent)
Preterm labor			
Yes	1 686	<0 001	5 399 (5 088 – 5 728)
No			1 00 (Referent)

Variables	Beta	p-value	Odds Ratio (95% CI)
Maternal racial/ethnicity		<0 001	
Non-Hispanic white			1 00 (Referent)
Non-Hispanic black	-0 016	<0 001	0 900 (0 858 – 0 943)
Hispanics	-0 579	<0 001	0 561 (0 529 – 0 594)
Others	-0 483	<0 001	0 671 (0 560 – 0 680)
Prenatal care			
Yes	-0 197	0 010	0 822 (0 707 – 0 954)
No			1 00 (Referent)
Preterm birth			
<37 weeks	2 500	<0 001	12 187 (11 735 – 12 657)
37 or more weeks			1 00 (Referent)
Maternal age group in years		<0 001	
<20			1 00 (Referent)
20-24	0 169	<0 001	1 184 (1 119 – 1 253)
25-29	0 245	<0 001	1 278 (1 200 – 1 360)
30-34	0 276	<0 001	1 318 (1 230 – 1 413)
35-39	0 118	0 005	1 126 (1 037 – 1 222)
40+	-0 013	0 855	0 987 (0 861 – 1 132)
Maternal education group		<0 001	
<7 years	0 240	<0 001	1 271 (1 135 – 1 424)
7-11 years	-0 008	0 864	0 992 (0 910 – 1 083)
High school graduate	-0 032	0 438	0 969 (0 893 – 1 050)
Some college	0 031	0 465	1 032 (0 948 – 1 123)
16 years	0 075	0 117	1 078 (0 982 – 1 183)
Post graduate			1 00 (Referent)
Tobacco use during pregnancy			
Yes	0 685	<0 001	1 984 (1 862 – 2 114)
No			1 00 (Referent)
Marital status			
Married	-0 172	<0 001	0 842 (0 806 – 0 879)
Unmarried			1 00 (Referent)
Maternal weight gain group in pounds		<0 001	
<17	1 151	<0 001	3 165 (2 967 – 3 367)
17-25	0 850	<0 001	2 342 (2 208 – 2 481)
26-35	0 533	<0 001	1 704 (1 605 – 1 808)

Variables	Beta	p-value	Odds Ratio (95% CI)
Maternal weight gain group in pounds			
36-39	0 280	<0 001	1 323 (1 198 – 1 462)
40+			1 00 (Referent)
Constant	-2 362	<0 001	0 094

Maternal tobacco use during pregnancy was still an independent factor even after adjustment for covariates including sex of child; maternal diabetes; chronic hypertension; pregnancy-associated hypertension, preterm labor; alcohol use during pregnancy; marital status; maternal racial/ethnicity; absence of prenatal care; Medicaid status; preterm birth; maternal weight gain during pregnancy; maternal age; and maternal education. Maternal alcohol use during pregnancy and Medicaid status were not statistically significant factors in this logistic regression analysis, so they were excluded from the logistic regression model.

Increasing risk for LBW was found with female infants; maternal diabetes; chronic hypertension; pregnancy-associated hypertension; preterm labor; non-Hispanic whites, absence of prenatal care; preterm birth; maternal age of 30 to 34 years; less than 7 years maternal education, tobacco use during pregnancy, unmarried mothers; and less than 17 pounds of maternal weight gain during pregnancy. Preterm births had the highest odds ratio, 12.187 (95% CI = 11 735 – 12.657), and preterm labor had the second highest odds ratio, 5.399 (95% CI = 5.088 – 5.728) Most of the covariates had the odds ratios similar to their relative risks, but maternal

racial/ethnicity had a quite different risk estimates than those without adjustment for covariates.

Sex of child

The odds ratio for male babies, 0.789 (95 % CI = 0.761 – 0.819), was slightly lower than the relative risk, 0.89 (95% CI = 0.868 – 0.914), indicating that male babies were 0.789 times less likely to be LBW than female babies.

Risks associated with maternal medical problems

The odds ratio for diabetic mothers, 1.444 (95% CI = 1.291 – 1.614), was higher than the relative risk, 1.104 (95% CI = 1.021 – 1.193). Diabetic mothers were 1.444 times more likely to have a LBW infant than non-diabetic mothers.

The odds ratio for mothers with chronic hypertension, 2.297 (95% CI = 1.983 – 2.661), was lower than the relative risk, 3.121 (95% CI = 2.866 – 3.399). Mothers who had chronic hypertension were more than twice as likely to have a LBW baby than mothers without chronic hypertension.

The odds ratio for mothers with pregnancy-associated hypertension, 3.162 (95% CI = 2.959 – 3.380), was higher than the relative risk, 2.936 (95% CI = 2.818 – 3.058). Mothers with pregnancy-associated hypertension were 3.162 times more likely to have a LBW baby than mothers without pregnancy-associated hypertension.

Preterm labor

The odds ratio for mothers who had preterm labor, 5.399 (95% CI = 5.088 – 5.728), was almost half of the relative risk, 9.816 (95% CI = 9.572 – 10.066). Mothers who had preterm labor were 5.399 times more likely to have a LBW infant than mothers who did not have preterm labor.

Maternal racial/ethnicity

The non-Hispanic white group was the reference group (RR = 1.0). The non-Hispanic black group had an odds ratio of 0.900 (95% CI = 0.858 – 0.943), which was about half of its relative risk, 2.2 (95% CI = 2.12 – 2.29). Hispanics had an odds ratio of 0.561 (95% CI = 0.529 – 0.594), which was the lowest among the groups and was about a half of its relative risk, 1.159 (95% CI = 1 12 – 1.20). Mothers classified in the "others" racial/ethnic group had an odds ratio of 0.671 (95% CI = 0.560 – 0.680), which was also about half of its relative risk, 1.274 (95% CI = 1.18 – 1.37). The Hispanic paradox that was not seen in the univariate analyses was found after adjusting for various potentially confounding factors. The non-Hispanic white group had the highest odds ratio and Hispanics had the lowest odds ratio, unlike Table 3 in which the non-Hispanic white group had the lowest relative risk; the non-Hispanic black group was more than two times at risk of having a LBW infant than the non-Hispanic white group; and the Hispanic group had a slightly higher risk for

giving a LBW baby than the non-Hispanic white group.

Prenatal care

The odds ratio for mothers who had prenatal care, 0.822 (95% CI = 0.707 – 0.954), was twice as high as the relative risk, 0.432 (95% CI = 0.402 – 0.464). Mothers who had prenatal care were 0.822 times less likely to have a LBW baby compared to mothers who did not have prenatal care.

Preterm birth

The odds ratio for preterm births, 12.187 (95% CI = 11.735 – 12.657), was the highest odds ratio among all potential risk factors and was similar to its relative risk, 12.114 (95% CI = 11.802 – 12.434). Preterm births were 12.187 times more likely to be LBW than full-term births.

Maternal age group in years

Women who were less than 20 years of age were the reference group (OR = 1.0) for maternal age. Women in the 20 to 24 age group had an odds ratio of 1.184 (95% CI = 1.119 – 1.253), which was higher than the relative risk, 0.784 (95% CI = 0.75 – 0.82). Women in the 25 to 29 age group had an odds ratio of 1 278 (95% CI = 1.200 – 1.360), which was about twice as high as the relative risk, 0.655 (95% CI = 0.63 – 0.68). Women in the 30 to 34 age group had the highest odds ratio among the groups, 1.318 (95% CI = 1.230 – 1.413), which was about twice as high as the relative

risk, 0.637 (95% CI = 0.61 – 0.67). Women in the 35 to 39 age group had an odds ratio of 1.126 (95% CI = 1.037 – 1.222), which was higher than the relative risk, 0.815 (95% CI = 0.77 – 0.86). Women who were 40 years or older had the lowest odds ratio, 0.987 (95% CI = 0.861 – 1.132), which was similar to the relative risk, 0.967 (95% CI = 0.88 – 1.06). As maternal age increased, the risk increased for ages 30 to 34 years; then, the odds ratios decreased for the subsequent age groups in this analysis.

Maternal education group

The postgraduate group was the reference group (OR = 1.0) in the analyses of maternal education and LBW Women with less than 7 years of education had the highest odds ratio among the groups for a LBW birth, 1.271 (95% CI = 1.135 – 1.424), which was similar to the relative risk, 1.152 (95% CI = 1.07 – 1.25). Women with 7 to 11 years education had an odds ratio of 0.992 (95% CI = 0.910 – 1.083), which was lower than the relative risk, 1.550 (95% CI = 1.46 – 1.64). Women who were high school graduates had the lowest odds ratio, 0.969 (95% CI = 0.893 – 1.050), which was lower than the relative risk, 1.449 (95% CI = 1.37– 1.54). Women with some college education had an odds ratio of 1.032 (95% CI = 0.948 – 1 123), which was lower than the relative risk, 1.237 (95% CI = 1.16 – 1.32). Women with 16 years education had an odds ratio, 1.078 (95% CI = 0.982 – 1.183), which was higher than

the relative risk, 0.957 (95% CI = 0.89 – 1.03) The odds ratios for all the groups were similar to each other in these analyses.

Tobacco use during pregnancy

The odds ratio of mothers who smoked during pregnancy, 1.984 (95% CI = 1.862 – 2.114), was higher than the relative risk (RR = 1.778, 95% CI = 1.707 – 1.852) after adjustment for potential confounding factors. Infants who were exposed to maternal tobacco use during pregnancy were almost two times more likely to be LBW than infants who were not exposed to maternal tobacco use during pregnancy.

Marital status

The odds ratio of married mothers was 0.842 (95% CI = 0.806 – 0.879), which was higher than their relative risk, 0.635 (95% CI = 0.618 – 0.651). Married mothers were 0.842 times less likely to have a LBW infant than unmarried mothers.

Maternal weight gain group in pounds

The odds ratios of all the weight gain groups were very similar to the relative risks. The 40 pound or higher group was the reference group (OR = 1.0) and women in this category had the lowest odds ratio Women who gained less than 17 pounds had the highest odds ratio, 3.165 (95% CI = 2.967 – 3.367), which was slightly lower than the relative risk, 3.337 (95% CI = 3.17 – 3 51). Women in the 17 to 25 pound group had an odds ratio, 2.342 (95% CI = 2.208 – 2.481), which was slightly higher

than the relative risk, 2.274 (95% CI = 2.17 – 2.39). Women in the 26 to 35 pound group had an odds ratio, 1.704 (95% CI = 1.605 – 1.808), which was slightly higher than the relative risk, 1.608 (95% CI = 1.53 – 1.69). Women in the 36 to 39 pound group had an odds ratio, 1.323 (95% CI = 1.198 – 1.462), which was higher than the relative risk, 1.177 (95% CI = 1.08 – 1.28). Therefore, as the maternal weight gain increased, the risk for LBW decreased.

Table 5 is similar to Table 4, but the logistic regression analysis was restricted to births among non-Hispanic white women in Texas, 2001. Maternal alcohol use during pregnancy, Medicaid status, and prenatal care were not included in the logistic regression analysis model due to their statistical insignificance in the model while prenatal care variable was included in the logistic regression model for analyses of all racial/ethnic groups combined. Tobacco use during pregnancy was a significant independent factor even after adjustment for all the covariates.

TABLE 5. Odds ratios and 95% confidence intervals for low birth weight restricted to non-Hispanic white births in Texas, 2001

Variables	Beta	p-value	Odds Ratio (95% CI)
Sex of child			
Male	-0 291	<0 001	0 748 (0 702 - 0 796)
Female			1 00 (Referent)
Diabetes			
Yes	0 463	<0 001	1 589 (1 286 – 1 964)
No			1 00 (Referent)

Variables	Beta	p-value	Odds Ratio (95% CI)
Chronic hypertension			
Yes	0 591	<0 001	1 806 (1 406 – 2 321)
No			1 00 (Referent)
Pregnancy-associated hypertension			
Yes	0 990	<0 001	2 691 (2 406- 3 010)
No			1 00 (Referent)
Preterm labor			
Yes	1 468	<0 001	4 342 (3 937 – 4 788)
No			1 00 (Referent)
Preterm birth			
<37 weeks	2 758	<0 001	15 764 (14 766– 16 830)
37 or more weeks			1 00 (Referent)
Maternal age group in years		<0 001	
<20			1 00 (Referent)
20-24	0 140	0 013	1 150 (1 030 – 1 285)
25-29	0 149	0 016	1 161 (1 028 – 1 311)
30-34	0 207	0 002	1 229 (1 080 – 1 400)
35-39	0 053	0 480	1 054 (0 911 – 1 220)
40+	-0 183	0 097	0 832 (0 670 – 1 034)
Maternal education group		<0 001	
<7years	-0 038	0 891	0 962 (0 556 – 1 666)
7-11 years	-0 266	0 000	0 766 (0 668 – 0 879)
High school graduate	-0 126	0 034	0 882 (0 785 – 0 990)
Some college	-0 004	0 945	0 996 (0 883 – 1 122)
16 years	0 059	0 358	1 060 (0 936 – 1 202)
Post graduate			1 00 (Referent)
Tobacco use during pregnancy			
Yes	0 710	<0 001	2 033 (1 874 – 2 205)
No			1 00 (Referent)
Marital Status			
Married	-0 238	<0 001	0 788 (0 727 – 0 854)
Unmarried			1 00 (Referent)
Maternal weight gain group in pounds		<0 001	
<17	1 231	<0 001	3 425 (3 077 – 3 817)

Variables	Beta	p-value	Odds Ratio (95% CI)
Maternal weight gain group in pounds			
17-25	1 231	<0 001	2 653 (2 404 – 2 924)
26-35	0 635	<0 001	1 887 (1 712 – 2 079)
36-39	0 325	<0 001	1 383 (1 175 – 1 629)
40+			1 00 (Referent)
Constant	-1 217	<0 001	0 296

Sex of child

Non-Hispanic white male infants were 0.748 times (95% CI = 0.702 – 0.796) less likely to be LBW compared to non-Hispanic white female infants. This odds ratio was similar to the odds ratio for all racial/ethnic groups combined, 0.789 (95% CI = 0.761 – 0.819).

Risks associated with maternal medical problems

Non-Hispanic white diabetic mothers were 1.589 times (95% CI = 1.286 – 1.964) more likely to have a LBW infant compared to non-Hispanic white non-diabetic mothers. This result was similar to the analysis for all racial/ethnic groups combined (OR = 1.444, 95% CI = 1.291 – 1.614).

Non-Hispanic white mothers with chronic hypertension were 1.806 times (95% CI = 1.406 – 2.321) more likely to have a LBW infant compared to non-Hispanic white mothers without chronic hypertension, which was lower than its odds ratio for all racial/ethnic groups combined, 2 297 (95% CI = 1.983 – 2.661).

Non-Hispanic white mothers with pregnancy-associated hypertension had an

odds ratio of 2.691 (95% CI = 2.406 – 3.010), which was lower than the odds ratio for all racial/ethnic groups combined, 3.162 (95% CI = 2.959 – 3.380). Non-Hispanic white mothers with pregnancy-associated hypertension were almost three times more likely to have a LBW infant than non-Hispanic white mothers without pregnancy-associated hypertension.

Preterm labor

Non-Hispanic white mothers who had preterm labor were 4.342 times (95% CI = 3.937 – 4.788) more likely to have a LBW infant than non-Hispanic white mothers who did not have preterm labor. This odds ratio was lower than the odds ratio for all racial/ethnic groups combined, 5.399 (95% CI = 5.088 - 5.728), indicating that preterm labor was not as significant factor for the non-Hispanic white group as it was for all racial/ethnic groups combined.

Preterm birth

Non-Hispanic white preterm births had an odds ratio of 15.764 (95% CI = 14.766 – 16.830), which was higher than the odds ratio for all racial/ethnic groups combined, 12.187(95% CI = 11.735 – 12.657), indicating that preterm birth was a greater risk factor for the non-Hispanic white group than for all racial/ethnic groups. Non-Hispanic white preterm births were almost 16 times more likely to be LBW than non-Hispanic white full-term births

Maternal age group in years

Non-Hispanic white women who were less than 20 years of age were the reference group for maternal age (OR = 1.0). Non-Hispanic white women in the 20 to 24 age group had an odds ratio of 1.150 (95% CI = 1.030 – 1.285). Non-Hispanic white women in the 25 to 29 age group had an odds ratio of 1.161 (95% CI = 1.028 – 1.311). Non-Hispanic white women in the 30 to 34 age group had the highest odds ratio, 1.229 (95% CI = 1.080 – 1.400). Non-Hispanic white women in the 35 to 39 age group had an odds ratio of 1.054 (95% CI = 0.911 – 1.220). Non-Hispanic white women who were 40 years or older had the lowest odds ratio, 0.832 (95% CI = 0.670 – 1.034). All those odds ratios were similar to the odds ratios in the analysis for all racial/ethnic groups combined.

Maternal education group

The non-Hispanic white postgraduate group was the reference group (OR = 1.0) for maternal education. Non-Hispanic white women with less than seven years of education had a lower odds ratio of 0.962 (95% CI = 0.566 – 1.666), than the odds ratio for all racial/ethnic groups combined, 1.271 (95% CI = 1 135 – 1.424). Non-Hispanic white women with 7 to 11 years education had a lower odds ratio, 0.766 (95% CI = 0 668 – 0.879), than the odds ratio for all racial/ethnic groups combined, 0 992 (95% CI = 0 910 – 1.083). Non-Hispanic white women who were high school

graduates had a lower odds ratio, 0.882 (95% CI = 0.785 – 0.990), than the odds ratio for all racial/ethnic groups combined, 0.969 (95% CI = 0.893 – 1.050). Non-Hispanic white women with some college education had a lower odds ratio, 0.996 (95% CI = 0.883 – 1.122), than the odds ratio for all racial/ethnic groups combined, 1.032 (95% CI = 0.948 – 1.123). Non-Hispanic white women with 16 years education was the only one that had a higher odds ratio, 1.060 (95% CI = 0.936 – 1.202), than the non-Hispanic white postgraduate group (OR = 1.0), but had a lower odds ratio than the odds ratio for all racial/ethnic groups combined, 1.078 (95% CI = 0.982 – 1.183).

Tobacco use during pregnancy

Non-Hispanic mothers who used tobacco during pregnancy were 2.033 times (95% CI = 1.874 – 2.205) more likely to have a LBW baby than non-Hispanic mothers who did not use tobacco during pregnancy. This odds ratio was just slightly higher than the odds ratio for all racial/ethnic groups combined, 1.984 (95% CI = 1.862 – 2.114), indicating that tobacco use during pregnancy had almost same effect for both all racial/ethnic groups combined and the non-Hispanic white group.

Marital status

Non-Hispanic married mothers were 0.788 times (95% CI = 0 727 – 0.854) less likely to have a LBW baby than non-Hispanic unmarried mothers. This odds ratio was slightly lower than the odds ratio for all racial/ethnic groups combined, 0.842

(95% CI = 0.806 – 0.879).

Maternal weight gain during pregnancy groups in pounds

Non-Hispanic white mothers who gained 40 pounds or more were the reference group (OR = 1.0) for weight gain and had the highest odds ratio. Non-Hispanic white women who gained less than 17 pounds had the highest odds ratio, 3.425 (95% CI = 3.077 – 3.817), which was higher than the odds ratio for all racial/ethnic groups combined, 3.165 (95% CI = 2.967 – 3.367). Non-Hispanic white women in the 17 to 25 pound category had a higher odds ratio, 2.653 (95% CI = 2.404 – 2.924), than the odds ratio for all racial/ethnic groups combined, 2.342 (95% CI = 2.208 – 2.481). Non-Hispanic white women in the 26 to 35 pound category had a higher odds ratio, 1.887 (95% CI = 1.712 – 2.079), than the odds ratio for all racial/ethnic groups combined, 1.704 (95% CI = 1.605 – 1.808). Non-Hispanic white women in the 36 to 39 pound category had a slightly higher odds ratio, 1.383 (95% CI = 1.175 – 1.629), than the odds ratio for all racial/ethnic groups combined, 1.323 (95% CI = 1.198 – 1.462). As weight gain increased, the risk for LBW births decreased.

Table 6 shows the same logistic regression analyses in Tables 4 and 5 but analyses were restricted to non-Hispanic black births. Medicaid status was included only in this logistic regression analysis model. Maternal alcohol use, maternal

education group, and prenatal care variables were not included in this model due to their statistical insignificance in the model. Maternal education group only dropped out in the model for this racial/ethnic group. The odds ratios of these analyses restricted to the non-Hispanic black group were similar to those of the analyses restricted to the non-Hispanic white group and all racial/ethnic groups combined.

TABLE 6. Odds ratios and 95% confidence intervals for low birth weight restricted to non-Hispanic black births in Texas, 2001

Variables	Beta	p-value	Odds Ratio (95% CI)
Sex of child			
Male	-0 317	<0 001	0 728 (0 667 - 0 795)
Female			1 00 (Referent)
Diabetes			
Yes	0 508	0 001	1 662 (1 232 – 2 243)
No			1 00 (Referent)
Chronic hypertension			
Yes	0 889	<0 001	2 433 (1 832 – 3.232)
No			1 00 (Referent)
Pregnancy-associated hypertension			
Yes	1 083	<0 001	2 953 (2 530 – 3 447)
No			1 00 (Referent)
Preterm labor			
Yes	1 810	<0 001	6 110 (5 282 – 7 069)
No			1 00 (Referent)
On Medicaid			
Yes	0 108	0 025	1 114 (1 014 – 1 225)
No			1 00 (Referent)
Preterm birth			
<37 weeks	2 264	<0 001	9 624 (8 797 – 10 530)
37 or more weeks			1 00 (Referent)

Variables	Beta	p-value	Odds Ratio (95% CI)
Maternal age group in years		<0 001	
<20			1 00 (Referent)
20-24	0 141	0 020	1 152 (1 022 – 1 298)
25-29	0 313	<0 001	1 367 (1 186 – 1 576)
30-34	0 213	0 010	1 237 (1 053 – 1 452)
35-39	0 197	0 055	1 218 (0 996 – 1 490)
40+	-0 113	0 530	0 893 (0 628 – 1 271)
Tobacco use during pregnancy			
Yes	0 577	<0 001	1 780 (1 518 – 2 088)
No			1 00 (Referent)
Marital Status			
Married	-0 167	<0 001	0 846 (0 761 – 0 941)
Unmarried			1 00 (Referent)
Maternal weight gain group in pounds		<0 001	
<17	0 991	<0 001	2 700 (2 347 – 3 086)
17-25	0 689	<0 001	1 992 (1 745 – 2 273)
26-35	0 399	<0 001	1 490 (1 304 – 1 704)
36-39	0 228	0 057	1 256 (0 994 – 1 587)
40+			1 00 (Referent)
Constant	-1 217	<0 001	0 296

Sex of child

Non-Hispanic black male babies were 0 728 times (95% CI = 0.667 – 0.795) less likely to be LBW than the non-Hispanic black female babies, which was slightly lower than the odds ratio for the non-Hispanic white group, 0.748 (95% CI = 0.702 – 0.796).

Risks associated with maternal medical problems

Non-Hispanic black diabetic mothers were 1.662 times (95% CI = 1.232 – 2.243) more likely to have a LBW baby compared to non-Hispanic black non-diabetic mothers, which was slightly higher than the odds ratio for the non-Hispanic white group, 1.589 (95% CI = 1.286 – 1.964).

Non-Hispanic black mothers who had chronic hypertension were 2.433 times (95% CI = 1.832 – 3.232) more likely to have a LBW baby than non-Hispanic black mothers without chronic hypertension, which was higher than the odds ratio for the non-Hispanic white group, 1.806 (95% CI = 1.406 – 2.321).

Non-Hispanic black mothers who had pregnancy-associated hypertension were 2.953 times (95% CI = 2.530 – 3.447) more likely to have a LBW baby than non-Hispanic black mothers without pregnancy-associated hypertension, which was higher than the odds ratio for the non-Hispanic white group, 2.691 (95% CI = 2.406 – 3.010).

Preterm labor

Non-Hispanic black mothers who had preterm labor were 6.110 times (95% CI = 5.282 – 7.069) more likely to have a LBW baby than non-Hispanic black mothers who did not have preterm labor, which was higher than the odds ratio for the non-Hispanic white group, 4.342 (95% CI = 3.937 – 4.788).

Medicaid Status

Non-Hispanic black mothers who were on Medicaid were 1.114 times (95% CI = 1.014 – 1.225) more likely to have a LBW baby compared to non-Hispanic black mothers who were not on Medicaid, which was lower than the relative risk for all racial/ethnic groups combined, 1.209 (95% CI = 1.177 – 1.242).

Preterm birth

Non-Hispanic black preterm births were 9.624 times (95% CI = 8.797 – 10.530) more likely to be LBW than non-Hispanic black full-term births, which was almost two thirds of the odds ratio for the non-Hispanic white group, 15.764 (95% CI = 14.766 – 16.830).

Maternal age group in years

Non-Hispanic black women who were less than 20 years of age were the reference group (OR = 1.0) for maternal age. Non-Hispanic black women in the 20 to 24 age group had almost the same odds ratio, 1.152 (95% CI = 1.022 – 1.298), as the odds ratio for the non-Hispanic white group, 1.150 (95% CI = 1.030 – 1.285). Non-Hispanic black women in the 25 to 29 age group had a higher odds ratio, 1.367 (95% CI = 1.186 – 1.576), which was the highest among the groups, than the odds ratio for the non-Hispanic white group, 1.161 (95% CI = 1.028 – 1.311). Non-Hispanic black women in the 30 to 34 age group had a similar odds ratio, 1.237 (95% CI = 1.053 –

1.452), to the odds ratio for the non-Hispanic white group, 1.229 (95% CI = 1.080 – 1.400). Non-Hispanic black women in the 35 to 39 age group had a higher odds ratio, 1.218 (95% CI = 0.996 – 1.490), than the odds ratio for the non-Hispanic white group, 1.054 (95% CI = 0.911 – 1.220). Non-Hispanic black women who were 40 years or older had a slightly higher odds ratio, 0.893 (95% CI = 0.628 – 1.271), which was the lowest among the non-Hispanic black maternal age groups, than the odds ratio for the non-Hispanic white group, 0.832 (95% CI = 0.670 – 1.034).

Tobacco use during pregnancy

Non-Hispanic black mothers who used tobacco during pregnancy were 1.780 times more likely to have a LBW baby than mothers who did not use tobacco, which was lower than the odds ratio for the non-Hispanic white group, 2.033 (95% CI = 1.874 – 2.205). It indicated that maternal tobacco exposure affected non-Hispanic white births more than non-Hispanic black births.

Marital status

Non-Hispanic black married mothers were 0.846 times (95% CI = 0.761 – 0.941) less likely to have a LBW baby than non-Hispanic black unmarried mothers, which was higher than the odds ratio for the non-Hispanic white group, 0.788 (95% CI = 0.727 – 0.854).

Maternal weight gain in pounds during pregnancy

Non-Hispanic black women who gained 40 pounds or more were the reference group (OR =1.0) and had the lowest odds ratio. Non-Hispanic black women who gained less than 17 pounds had a lower odds ratio, 2.700 (95% CI = 2.347 – 3.086), which was the highest among the groups, than the odds ratio for the non-Hispanic white group, 3.425 (95% CI = 3.077 – 3.817). Non-Hispanic black women who gained between 17 and 25 pounds had a lower odds ratio, 1.992 (95% CI = 1.745 – 2.273), than the odds ratio for the non-Hispanic white group, 2.653 (95% CI = 2.404 – 2.924). Non-Hispanic black women who gained between 26 and 35 pounds had a lower odds ratio, 1.490 (95% CI = 1.304 – 1.704), than the odds ratio for the non-Hispanic white group, 1.887 (95% CI = 1.712 – 2.079). Non-Hispanic black women who gained between 36 and 39 pounds had a lower odds ratio, 1.256 (95% CI = 0.994 – 1.587), than the odds ratio for the non-Hispanic white group, 1.383 (95% CI = 1.175 – 1.629). The more weight non-Hispanic black women gained during pregnancy, the less likely she was to have a LBW birth.

Table 7 shows the same logistic regression analysis in Tables 4, 5, and 6 but it was restricted to the Hispanic group births in Texas, 2001. Maternal alcohol use during pregnancy and Medicaid status were not included in the analysis model due to their statistical insignificance in the model. Tobacco use during pregnancy was still a

risk factor for Hispanics with adjustment for covariates. The model for this ethnic group was the only one that included prenatal care.

TABLE 7. Odds ratios and 95% confidence intervals for low birth weight restricted to Hispanic births in Texas, 2001

Variables	Beta	p-value	Odds Ratio (95% CI)
Sex of child			
Male	-0 175	<0 001	0 840 (0 795 – 0 887)
Female			1 00 (Referent)
Diabetes			
Yes	0 288	<0 001	1 334 (1 145 – 1 555)
No			1 00 (Referent)
Chronic hypertension			
Yes	1 052	<0 001	2 864 (2 238 – 3 666)
No			1 00 (Referent)
Pregnancy-associated hypertension			
Yes	1 344	<0 001	3 836 (3 466 – 4 245)
No			1 00 (Referent)
Preterm labor			
Yes	1 837	<0 001	6 275 (5 729 – 6 872)
No			1 00 (Referent)
Prenatal care			
Yes	-0 237	0 012	0.789 (0 656 – 0 949)
No			1 00 (Referent)
Preterm birth			
<37 weeks	2 414	<0 001	11 177 (10 562 – 11 827)
37 or more weeks			1 00 (Referent)
Maternal age group in years		<0 001	
<20			1 00 (Referent)
20-24	0 199	<0 001	1.221 (1 128 – 1 321)
25-29	0 290	<0 001	1 336 (1 225 – 1 457)
30-34	0 342	<0 001	1 408 (1 274 – 1 555)
35-39	0 076	0 220	1 079 (0 956 – 1 217)

Variables	Beta	p-value	Odds Ratio (95% CI)
Maternal age group in years			
40+	0 106	0 353	1 112 (0.889 – 1 392)
Maternal education in years		<0 001	
<7 years	0 435	<0 001	1 546 (1 280 – 1 866)
7-11 years	0 238	0 009	1 268 (1 062 – 1 515)
High school graduate	0 126	0 163	1 134 (0 950 – 1 353)
Some college	0 195	0 042	1 215 (1 007 – 1 466)
16 years	0 191	0 088	1 211 (0 972 – 1 508)
Post graduate			1 00 (Referent)
Tobacco use during pregnancy			
Yes	0 543	<0 001	1 721 (1 470 – 2 016)
No			1 00 (Referent)
Marital Status			
Married	-0 149	<0 001	0 862 (0.812 – 0 915)
Unmarried			1 00 (Referent)
Maternal weight gain group in pounds		<0 001	
<17	1 136	<0 001	3 115 (2 825 – 3 425)
17-25	0 779	<0 001	2 179 (1 984 – 2 398)
26-35	0 485	<0 001	1 623 (1 475 – 1 789)
36-39	0 272	<0 001	1 312 (1 122 – 1 536)
40+			1 00 (Referent)
Constant	-2 995	<0 001	0 050

Sex of child

Hispanic male babies were 0.840 times (95% CI = 0.795 – 0.887) less likely to be LBW than Hispanic female babies This odds ratio was the highest among the three racial/ethnic groups, so being male was not as protective for Hispanics as it was for the other racial/ethnic groups. The odds ratio for non-Hispanic whites and non-Hispanic blacks were almost same

Risks associated with maternal medical problems

Hispanic diabetic mothers were 1.334 times (95% CI = 1.128 – 1.257) more likely to have a LBW newborn compared to Hispanic non-diabetic mothers. This odds ratio was lower than the odds ratios for both the non-Hispanic white group and the non-Hispanic black group.

Hispanic mothers with chronic hypertension were 2.864 times (95% CI = 2.238 – 3.666) more likely to have a LBW infant compared to Hispanic mothers without chronic hypertension, which was the highest among the three (non-Hispanic white, non-Hispanic black, and Hispanic) racial/ethnic groups. This odds ratio was about 1.5 times higher than that for the non-Hispanic white group, indicating that having chronic hypertension was a 1.5 times greater risk factor for Hispanic mothers than non-Hispanic white mothers.

Hispanic mothers with pregnancy-associated hypertension were 3.836 times (95% CI = 3.466 – 4.245) more likely to have a LBW baby than Hispanic mothers without pregnancy-associated hypertension. This odds ratio was the highest among the three racial/ethnic groups. It was about 1.5 times higher than that for the non-Hispanic white group, indicating that Hispanic mothers with pregnancy-associated hypertension were at a 1 5 times greater risk for LBW than non-Hispanic white mothers with pregnancy-associated hypertension.

Preterm labor

Hispanic mothers who had preterm labor were 6.275 times (95% CI = 5.729 – 6.872) more likely to have a LBW baby than Hispanic mothers who did not have preterm labor. This odds ratio was the highest among the three racial/ethnic groups.

Prenatal care

Hispanic mothers who had prenatal care were 0.789 times (95% CI = 0.656 – 0.949) less likely to have a LBW baby compared to Hispanic mothers who did not have prenatal care, which was higher than the relative risk for all racial/ethnic groups combined, 0.432 (95% CI = 0.402 – 0.464), and slightly lower than the odds ratio for all racial/ethnic groups combined, 0.822 (0.707 – 0.954). This factor was not included in the non-Hispanic white group and the non-Hispanic black group analyses due to its statistical insignificance, indicating that prenatal care was more important for Hispanics.

Preterm birth

Hispanic preterm births were 11.177 times (95% CI = 10.562 – 11.827) more likely to be LBW compared to Hispanic full-term births. This was higher than the odds ratio for the non-Hispanic black group, 9.624 (95% CI = 8.797 – 10.530), and lower than the odds ratio for the non-Hispanic white group, 15.764 (95% CI = 14.766 – 16.830). Preterm births were a more significant risk factor for the non-Hispanic

white group than the other racial/ethnic groups.

Maternal age group in years

Hispanic women who were less than 20 years of age were the reference group (OR =1.0) for maternal age and had the lowest odds ratio among the age groups. All the odds ratios were higher than those for the non-Hispanic white group. Hispanic women in the 20 to 24 age group had an odds ratio of 1.221 (95% CI = 1.128 – 1.321), which was higher than the odds ratio for the non-Hispanic black group, 1.152 (95% CI = 1.022 – 1.298). Hispanic women in the 25 to 29 age group had an odds ratio of 1.336 (95% CI = 1.225 – 1.457), which was lower than the odds ratio for the non-Hispanic black group, 1.367 (95% CI = 1.186 – 1 576). Hispanics in the 30 to 34 age group had the highest odds ratio among the age groups, 1.408 (95% CI = 1.274 – 1.555), which was higher than the odds ratio for the non-Hispanic black group, 1.237 (95% CI = 1.053 – 1.452). Hispanic women in the 35 to 39 age group had a lower odds ratio, 1.079 (95% CI = 0.956 – 1.217), than the odds ratio for the non-Hispanic black group, 1.218 (95% CI = 0.996 - 1.490). Hispanic women who were 40 years or older had a higher odds ratio, 1.112 (95% CI = 0 889 – 1.392), than the odds ratio for the non-Hispanic black group, 0.893 (95% CI = 0.628 – 1 271). For both the non-Hispanic white and the Hispanic groups, women in the 30 to 34 age group had the highest odds ratio among the age groups, but women in 25 to 29 age group had the

highest odds ratio for the non-Hispanic black group.

Maternal education group

The Hispanic postgraduate group was the reference group for maternal education (OR = 1.0) and had the lowest odds ratio among the groups. Hispanic women with less than 7 years education had the highest odds ratio, 1.546 (95% CI = 1.280 – 1.866). All the odds ratios for the Hispanic maternal education groups were higher than those for the non-Hispanic white group. All the non-Hispanic white age groups except the 16 years of education group (OR = 1.060) had odds ratios below the postgraduate group, but all the Hispanic age groups had odds ratios higher than the postgraduate group.

Tobacco use during pregnancy

Hispanic mothers who smoked during pregnancy were 1.721 times (95% CI = 1.470 – 2.016) more likely to have a LBW baby than Hispanic mothers who did not smoke, and this was the lowest odds ratio associated with smoking among the three racial/ethnic groups. The non-Hispanic white group had the highest odds ratio, 2.033 (95% CI = 1.874 – 2.205), and the non-Hispanic black group had a similar odds ratio (OR = 1.780, 95% CI = 1.518 – 2.088) to the Hispanic group. This result indicated that tobacco use during pregnancy did not have as strong an effect on risk for LBW among Hispanics as it did on non-Hispanic whites.

Marital status

Hispanic married mothers were 0.862 times (95% CI = 0.812 – 0.915) less likely to have a LBW baby than Hispanic unmarried mothers, which was the highest odds ratio among the three racial/ethnic groups. The non-Hispanic white group had the lowest odds ratio, 0.788 (95% CI = 0.727 – 0.854).

Maternal weight gain group in pounds

Hispanic women who gained 40 pounds or more were the reference group for weight gain (OR = 1.0) and had the lowest odds ratio for LBW births among the Hispanic maternal weight gain groups. The more weight Hispanic women gained during pregnancy, the less risk they had for low birth weight births. The non-Hispanic black group had the lowest odds ratios among the three racial/ethnic groups and the non-Hispanic white group had the highest odds ratios. Therefore, regardless of racial/ethnicity, the more weight a mother gained during pregnancy, the less risk for low birth weight births.

Multiple Linear Regression Analysis

Table 8 shows the correlations and associations between birth weight in grams and average number of cigarettes per day, average number of drinks per week, number of prenatal care visits, clinical estimate of gestation in weeks, pregnancy length in weeks, and maternal weight gain in pounds Birth weight in grams was a

continuous dependent variable, and all independent variables were continuous.

TABLE 8. Multiple linear regression analysis for birth weight in grams

Model #	R-square	S E E	Pearson Correlation (p-value)	Independent Variable	Beta	p-value
1	0 336	441 782	-0 075 (<0 001)	Average number of cigarettes per day	–11 968	<0 001
			-0 015 (<0 001)	Average number of drinks per week	– 4 916	0 034
			0 121 (<0 001)	Number of prenatal care visits	5 081	<0 001
			0 555 (<0 001)	Clinical estimate of gestation in weeks	135 332	<0 001
			0 398 (<0 001)	Pregnancy length in weeks	20 736	<0 001
			0 182 (<0 001)	Maternal weight gain during pregnancy in pounds	4 997	<0 001
				Constant	– 2925 794	<0 001

Correlations with birth weight in grams

The correlations between birth weight in grams and all the independent variables were significant. The p-values for all the correlations were less than 0.001

However, most of the correlations were mild. Clinical estimate of gestation in weeks had the strongest correlation, 0.555 (p-value = < 0.001), with birth weight in grams among the independent variables. Average number of drinks per week had the weakest correlation, - 0.015, with birth weight in grams among the independent variables.

Associations with birth weight in grams

Average number of cigarettes per day (Beta = -11.968) and average number of drinks per week variables (Beta = -4.916) had a negative association with birth weight in grams, indicating that as one unit of average number of cigarettes per day increases, birth weight in grams decreases by 11.968, and that as one unit of average number of drinks per week increases, birth weight in grams decreases by 4.916. Other than those two variables, all the other variables had a positive association with birth weight in grams. Clinical estimate of gestation in weeks had the strongest association (Beta = 135.332) with birth weight in grams. Pregnancy length in weeks had the second strongest association (Beta = 20.736) with birth weight in grams.

CHAPTER IV

DISCUSSION

Hofius et al. (2003) found that prenatal tobacco exposure has many adverse effects on infant mortality and morbidity, and pregnant women who smoke are at higher risk of pregnancy complications, including premature rupture of membranes, abruptio placentae, spontaneous abortion, and preterm birth. Infants who were exposed to maternal tobacco use are weighted five percent smaller than infants who were not exposed (Simpson, 1957). However, if a mother quits smoking by the first trimester, infant weight is nearly the same as that of an infant of a non-smoker (Haug, 1995). Maternal age, maternal education, marital status, length of gestation, weight gain during pregnancy, and parity are some of the known risk factors associated with low birth weight (Nandi & Nelson, 1992).

This study examined the effect of tobacco use during pregnancy on risk for low birth weight for 354,967 Texas singleton births in 2001 with adjustment for several covariates including sex of child; the maternal health conditions of diabetes, chronic hypertension, and pregnancy-associated hypertension; preterm labor, maternal

alcohol use during pregnancy; maternal marital status; maternal racial/ethnicity; absence of prenatal care; Medicaid status; preterm birth; maternal weight gain during pregnancy; maternal age; and maternal education group. Furthermore, the effect of tobacco use during pregnancy on risk of LBW was examined separately for various racial/ethnic groups with adjustment for the above covariates.

Findings and Relation to Previous Studies

Tobacco use during pregnancy

The results of this study confirmed previous reports of the increased risk for low birth weight births to smokers. This factor was a significant independent factor in every analysis in this study, even after adjustment for various potentially confounding factors. After adjustment for socioeconomic and biological factors, the risk of smokers increased. Compared to non-smoking mothers, smoking during pregnancy significantly increased the risk of LBW nearly two times for all racial/ethnic groups combined, two times for non-Hispanic whites, 1.8 times for non-Hispanic blacks, and 1.7 times for Hispanics. Smokers were twice as likely to have a LBW infant than non-smokers.

Table 9 shows the non-Hispanic white group had the highest percentage of smokers among the racial/ethnic groups studied. The percentage of smokers in the non-Hispanic white group, 12.8%, was more than 6 times higher than that of the

Hispanic group, 1.9%, and nearly 2 times higher than that of the non-Hispanic black group, 5.9%.

Table 9. Descriptive analysis of maternal racial/ethnic and maternal tobacco use during pregnancy of births in Texas, 2001

		Tobacco use during pregnancy	
		Yes N (%)	No N (%)
Maternal racial/ethnicity	Non-Hispanic white	16996 (12 8%)	115652 (87 2%)
	Non-Hispanic black	2301 (5 9%)	36496 (94.1%)
	Hispanic	3226 (1 9%)	163725 (98.1%)
	Others	311 (2 4%)	12462 (97.6%)

Ventura et al (2003) reported that in 2000, the prenatal smoking rate of non-Hispanic whites was 15.6 percent and 9.2 percent for non-Hispanic blacks. Among Hispanics, 1.5 percent of Central and South Americans and 10.3 percent of Puerto Ricans smoked. They also found that among smokers, non-Hispanic white women used more cigarettes than Hispanics and non-Hispanic blacks. In 2001, non-Hispanic whites had the highest maternal smoking rate (15.6%); non-Hispanic blacks had the second highest rate (9.1%); and Hispanics had the lowest maternal smoking rate (3.5%) (MacDorman, Minino, Strobino, & Guyer, 2002). According to Arias et al. (2003), in 2002, American Indians had the highest percentage of mothers who smoked during pregnancy (19.9%); non-Hispanic whites had the second highest (15.5%);

Puerto Ricans had the third highest (9.7%); non-Hispanic blacks had the fourth highest (9.0%); and other racial/ethnicity including Mexicans, Cubans, Central and South Americans, and Asians had the lowest smoking rate ranging from 1 percent to 3 percent. Those previous studies and Table 9 in this study showed that non-Hispanic whites had the highest rate of smoking during pregnancy and Hispanics had the lowest rate among all racial/ethnicity groups.

Average number of cigarettes per day

A negative association was found between average number of cigarettes per day and birth weight in grams, indicating that as one unit of average number of cigarettes per day increases, birth weight in grams decreases by 11.968. Carbon monoxide in cigarette smoke inhibits the absorption of oxygen into the bloodstream and nicotine reduces uterine blood flow. When combined, carbon monoxide and nicotine make the fetus deprived of oxygen and nourishment, resulting in fetal intrauterine growth retardation (Horne et al., 2001; Law et al., 2003; Walsh, 1994).

According to Martinez, Wright, and Taussig (1994), the average birth weight of infants of mothers who smoked more than a pack of cigarettes per day was 273 grams lower than that of infants of non-smokers. That result was very similar to this study result. English et al. (1994) found that as one unit of nanogram of cotinine increases, birth weight decreases by 0.85 grams for non-Hispanic whites and by 1.18

grams for non-Hispanic blacks, indicating that maternal smoking has a greater effect on birth weight of non-Hispanic blacks than non-Hispanic whites.

Study Strengths and Limitations

The results of this study confirm the findings of previous studies that found tobacco exposure to be a risk factor for low birth weight. In this study, mothers who smoked during pregnancy were twice as likely to have low birth weight babies compared to non-smokers. Moreover, the results of this study indicated that even though Hispanics have socioeconomic disadvantages, these women tended to have lower rates of low birth weight than non-Hispanic whites and non-Hispanic blacks after adjustment for potentially confounding factors.

This study had several strengths. First, since all the Texas singleton births in 2001 were examined, selection bias was minimized, and the sample size was large enough to provide adequate statistical power to examine smoking in relation to numerous covariates. Second, information on many potentially confounding variables were available to better examine the association between tobacco use and low birth weight. Furthermore, the risk effects associated with these covariates were consistent with previous findings about risk factors for low birth weight including female sex of child; maternal diabetes; maternal chronic hypertension; pregnancy-associated hypertension; preterm labor, maternal alcohol use; marital status; absence of prenatal

care; Medicaid enrollment; preterm birth; inadequate maternal weight gain during pregnancy; maternal age; and maternal educational level.

Nevertheless, this study also has some limitations. This study used information from the birth certificate that is filled out by a mother, or a health care worker, so there is the possibility of underreporting because there is a stigma associated with smoking or drinking during pregnancy. Second, this study did not consider maternal work, maternal nutritional status, maternal substance drug use, caffeine intake, or whether the Hispanic women were born in U.S or Mexico. Hispanics born in U.S. tend to have a higher risk for low birth weight than Hispanics born in Mexico (Cohen et al., 1993; Scribner & Dwyer, 1989). Maternal occupation has been found to be significantly associated with low birth weight (Wang et al, 1997). Poor maternal nutrition status is a major risk factor for low birth weight in some countries (Mansour et al., 2001). Illegal drug use and caffeine intake elevate the risk for preterm labor (Fried & O'Connell, 1987). Last, the impact of socioeconomic status was examined indirectly using Medicaid status and maternal education. More precise measures should be used in future studies.

Conclusion

According to the results of this study, smoking during pregnancy increases the risk of low birth weight regardless of the mother's racial/ethnic group. Therefore,

more smoking prevention and cessation programs should be aimed at women who smoke during pregnancy. Despite being more likely to have a lower socioeconomic status, Hispanic women had a lower risk giving birth to low birth weight infants than non-Hispanic white women or non-Hispanic black women. Future studies should focus on the Hispanic's protective behaviors that might reduce the risk of low birth weight. Educating high risk women about risk factors for low birth weight and other adverse reproductive outcomes is needed to reduce the incidence of low birth weight rate and its associated morbidity and mortality.

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