The Associations Between Neighborhood Poverty and Crime and Adverse Birth Outcomes in Hispanic Women

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A Thesis Presented

By

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DEDICATION

To Aaron: Without your love, support, and grit, I never would have gotten this far. Thank you for everything said and unsaid. You are my strength. I love you.

To Esposito: Thank you for picking me up when I was at my lowest, keeping me company when I didn't expect it, loving me when I didn't deserve it.

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ABSTRACT

THE ASSOCIATIONS BETWEEN NEIGHBORHOOD POVERTY AND CRIME AND ADVERSE BIRTH OUTCOMES IN HISPANIC WOMEN

MAY 2024

BRITTANY NICOLE GRIFFIN, A.B., CORNELL UNIVERSITY

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Approximately one in nine babies born in the United States is premature and has low birthweight (LBW) with the second highest rates among Puerto Rican women (14.5%) (2). Disparities exist by socioeconomic status as well as by race and ethnicity. However, established risk factors only account for a portion of the disparities in adverse outcomes. Other factors that have not been studied as frequently include environmental, contextual, and neighborhood-level factors. These are of particular interest because of their potentially modifiable nature.

We evaluated the association between neighborhood poverty, overall neighborhood crime, and violent neighborhood crime and adverse birth outcomes using data from Proyecto Buena Salud, a prospective cohort study of 1,610 Hispanic women conducted from 2006-10. Participant addresses were mapped and census block-level crime information from 2006-2010 using AGS CrimeRisk data to model the association between neighborhood crime and preterm birth, LBW, and small-for-gestational age (SGA) adjusting for individual demographic, medical, and socioeconomic variables.

We found no association between neighborhood poverty and preterm birth or LBW. There was a positive association between neighborhood poverty and SGA (OR 2.0, 95% CI 1.114-3.585) when comparing women who lived in the highest quartile of neighborhood poverty to women who lived in

the lowest quartile for neighborhood poverty when adjusted for age of the mother, pre-pregnancy BMI, and stress in the second and third trimesters.

There was no association between overall neighborhood crime and adverse birth outcomes. There was no association between violent neighborhood crime and preterm birth or LBW. Violent neighborhood crime was positively associated with a 1.5 times higher odds SGA (95% CI: 1.03-2.2) when adjusted for smoking before pregnancy, smoking during early pregnancy, education levels, parity, age of the mother, pre-pregnancy BMI, and gestational weight gain. Women who lived in the highest quartile of violent neighborhood crime had 2.1 times higher odds of SGA (95% CI: 1.2-3.4, p-trend of 0.0037) compared to women who lived in the lowest quartile of violent neighborhood crime when adjusted for smoking before pregnancy, education levels, age of the mother, and pre-pregnancy BMI.

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A. Introduction

1. Adverse Birth Outcomes

a. Preterm birth

Preterm birth, or premature birth, is defined as birth less than 37 weeks of gestational age (1). Almost half a million children each year are born prematurely (2) with one in every nine U.S. babies born prematurely in 2012 (1). This number varies by race and ethnicity. Women of Puerto Rican origin are second only to women who are non-Hispanic Black in terms of rate of preterm birth (14.5 preterm births per 100 live births) (3). The increase in people of Hispanic ethnicity living in the U.S. heightens the particular interest in this population (9).

Preterm birth is associated with poor health outcomes later in life such as intellectual disability, cerebral palsy, breathing and respiratory problems, vision problems, hearing loss, and feeding and digestive issues (1). Aside from these debilitating lifelong conditions, preterm birth can cause infant death. As many as 35% of all infant deaths in 2010 were related to preterm birth (2). In 2005 alone, over $26 billion was spent in healthcare costs because of preterm birth (2).

Several risk factors have been established for preterm birth. Some of these include having a previous preterm birth, being African American, being of Hispanic ethnicity, experiencing multiple gestation, uterine or cervical problems, suffering from high blood pressure, diabetes, clotting disorders, infection during pregnancy, smoking, alcohol use, and drug use during pregnancy (1), being at an extreme of maternal age, possessing low maternal income or socioeconomic status, and enduring stress (2). However, these established risk factors only account for a portion of the cases of preterm birth. Racial, ethnic, and socioeconomic disparities in risk for preterm birth have been well documented (46). After looking so much at these individual characteristics, researchers started to

look beyond this to explain risk (46). Some of the modifiable group-based factors include environmental, contextual, and neighborhood-level factors in a group-based fashion. Thus, there is recent interest in examining ecological factors that may play a role in risk (10, 11, 12, 14).

b. Low birthweight

Low birth weight is defined as less than 5.5 lbs or 2500 grams at birth (4). For every 12 births in the U.S., one baby is born with low birth weight (5). This varies by race and ethnicity. Among U.S. Hispanic women, those who are of Puerto Rican descent have the highest rates of low birthweight (9.4% compared to 7% for Hispanics overall) (7). When compared to infants born at a normal weight, infants born at a low birth weight are at risk for more health problems, both in the immediacy and long term. Immediate health outcomes for infants include infection or illness within the first six days of life (4), birth defects, respiratory distress syndrome, bleeding in the brain, heart defects, intestinal problems, retinopathy of prematurity (5), and hydrocephaly (6). Some health outcomes present later in life and include delayed motor skills, delayed social development, learning disabilities (4), diabetes, heart disease, high blood pressure, metabolic syndrome, obesity (5), blindness, deafness, mental retardation, and cerebral palsy (6).

Factors that may increase a mother's risk of giving birth to a baby with low birth weight include smoking during pregnancy, drinking alcohol during pregnancy, lack of sufficient weight gain during pregnancy, extremes of maternal age, socioeconomic factors (low income, low educational level, stress, domestic or other abuse, marital status) (4), preterm birth (5), having a previous preterm birth, exposure to air pollution and drinking water contaminated with lead (4), fetal growth restriction, chronic health conditions, infection during pregnancy, problems with the placenta, and being African American (5). Again, all of these risk factors do not explain the prevalence of low birth weight. This has led researchers to begin examining neighborhood risk factors to explain risk of low birth weight (10, 11, 14).

c. Small for gestational age (SGA)

Small for gestational age (SGA) is typically defined as weighing in the 10th percentile or lower for a baby of the same gestational age (8). This varies by race and ethnicity from the lowest rates of SGA in white, non-Hispanic women (around 8%) to the highest rates of SGA in black, non-Hispanic women (around 17%) (80). Among U.S. Hispanic women, those who are of Puerto Rican descent have higher rates of all adverse birth outcomes (79) including SGA compared to rates observed when examining Hispanic women overall (overall rate of ~10%) (80).

Risk factors for SGA include problems with the umbilical cord or placenta, high blood pressure during pregnancy, diabetes, anemia, chronic lung or kidney conditions, autoimmune diseases, very low weight, obesity, poor nutrition or weight gain during pregnancy, use of alcohol, drugs, or cigarettes during pregnancy, multiple gestation, infection during pregnancy, birth defects, or genetic problems (8).

There are both short- and long-term health effects of being born with growth restriction. Shorter term effects include low birth weight, low blood sugar levels, low body temperature, too many red blood cells, trouble fighting infections, and trouble breathing. Some of the longer term health effects include heart and blood vessel problems later in life (8). However, in spite of the established risk factors for having an SGA baby, these risk factors alone do not explain the prevalence of SGA. Because of this, other factors, such as neighborhood risk factors have begun to be examined (10,11, 13, 14).

2. Social Epidemiology: what are neighborhood-level factors?

Social epidemiology bloomed to understand the development of pathology in the human body. It began by looking at how social ties were associated with disease survival. From there, the field turned to look at how neighborhood characteristics shape population health. In spite of all of this interest socially, there are limited studies on how macro-level forces such as neighborhood poverty affect health. While biology is what influences diseases, it is much more difficult to say why a person undertakes a behavior that is negative. For example, we know that smoking is a risk factor for

lung cancer. But what makes a person smoke? Is it the neighborhood that he grows up in or the stress of life in a violent neighborhood or learning these behaviors from parents? (81)

The underlying idea behind why group-level data is important lies in the theory that individuals are not only affected by personal characteristics but also by characteristics of social groups to which people belong. Contextual or multilevel analysis is what is referred to when using collective or group characteristics to determine individual-level outcomes. These group level variables are often called ecological, macro-level, contextual, or aggregate. The ability to investigate these ecological measures can shape the distribution of risk factors. There are also situations in which one's individual characteristics do not predict one's individual risk, but instead one's group-level characteristics predicts one's individual risk (84). One example is one that Goldberger et al. discovered where risk of pellagra was not related to individuals' income but instead related to availability of food within the village (85).

Area-based measures of deprivation are found to be associated with health outcomes when individual-level variables are adjusted for. Further studies suggested that neighborhood-level variables also could predict the distribution of health outcomes. Some group-level variables capture information that individual-level variables do not. For example, neighborhood-level income may give a better indicator of factors affecting everyone within a community regardless of an individual's personal income. For these reasons, neighborhood poverty, neighborhood crime, and neighborhood food access may say more about health of a neighborhood than whether or not a person individually is poor, experiences crime, or eats certain foods (84).

Neighborhood-level factors contribute to understanding health dynamics and disease distribution. For example, neighborhoods have many factors that can affect health, positively or negatively, such as crime, poverty, food access, socioeconomic status, access to green spaces, walkability, and pollution (19). These factors have been associated with such health outcomes as asthma (10), chronic illness, mortality, and cardiovascular disease (35). Therefore, policy planners use

geographic information to target interventions for health services and other health-related inequities. In this document, we will focus on neighborhood factors of crime, poverty, and food access in relation to adverse birth outcomes.

a. Crime

Neighborhood crime is a characteristic that has been examined in relation to birth outcomes (10). Neighborhood crime itself also is associated with fear of crime which in turn has been associated with pregnancy outcomes (10, 12, 40, 42, 53-59). Crime has been associated inversely with physical activity, particularly among young women, a group of interest in pregnancy studies (10), and education (33).

Eleven studies have examined neighborhood-level crime and adverse birth outcomes (10, 12, 40, 42, 53-59) (Table 1). Of these studies, eight were conducted in the U.S (10, 12, 42, 53, 56-8) and three were conducted abroad in Chile (40), Quebec, Canada (54), and Scotland (55). Of the eight U.S., all but one (53) took place in specific cities (i.e., Chicago, IL (57, 59), Durham, NC (56), Philadelphia, PA (12), Raleigh, NC (10, 42), and Washington, DC (58)).

i. Study Designs

Of the eleven studies, eight were retrospective cohort studies (10, 12, 42, 53-56), one was a prospective cohort study (40), one was a cross-sectional study (57), and one was a retrospective hierarchical analysis (58). Four studies (53, 56, 58-59) included Hispanic participants (ranging from 11.8 – 39.5%) with one study adjusting for race and ethnicity (56) while the other three separately reported results by race and ethnicity. Four of the remaining studies did not include Hispanic participants at all (10, 12, 42, 57) while another three (all three outside of the U.S.) neither adjusted for nor specified race or ethnicity of participants (40, 54-55).

ii. Crime Assessment Tools

Neighborhood crime has been classified in a variety of ways including episodes of political violence, violent crime density, violent crime incidence, and area crime rates (10). Neighborhood crime was the exposure for all studies but measurement occurred in different ways. Six studies used a city police database or similar database for crime classification (10, 12, 42, 54, 56, 59), three used Census Bureau information (53, 57-58), one used a country-wide database (55), and one had researchers individually classify crime (40).

iii. Study Findings

Findings were not consistent. A total of seven studies evaluated the association between neighborhood crime and preterm birth (10, 12, 42, 55-57, 59). In the only study to present results among Hispanics, Masi et al. found a positive association (OR: 1.10, no confidence interval provided) between neighborhood violent crime and preterm birth. The remaining studies either found that neighborhood violent crime was positively associated with preterm birth (12) (no reported odds ratio), not associated (55-57) (nonsignificant odds ratios ranging from 0.91 - 1.05), or limited to associations among a particular ethnic/racial background that did not include Hispanic women in analysis (10, 42).

A total of three studies evaluated the association between neighborhood crime and low birthweight (42, 55-56)). None presented results explicitly among Hispanics. There was no association between exposure to neighborhood violent crime and low birthweight in one ethnically diverse study (56), results varied by race among non-Hispanic black and non-Hispanic white women with positive and no association respectively (42). A study based in Scotland found a positive association (55) (OR: 1.15, 95%CI 1.01-1.31).

Three studies evaluated the association between neighborhood crime and continuous birthweight (56, 58-59). All three studies included Hispanic women. Masi et al. and Kane et al. reported separate results for Hispanic women and both found that neighborhood violent crime was

inversely associated with continuous birthweight (β = -1.81 ($p < 0.01$) and β = -24.3 ($p < 0.05$)). The remaining study found no association after adjusting for race and ethnicity (56).

A total of four studies evaluated the association between neighborhood crime and SGA (54-56, 59). In the only study to present results among Hispanics, Masi et al. found that there was a positive association between neighborhood crime and SGA (odds 1.20, $p < 0.05$, no CI reported). The remaining studies found conflicting results with one seeing a positive association (OR: 1.09, 95% CI 1.02-1.16) (55) between neighborhood crime and SGA in a Scottish population, one seeing an inverse association (54) (Beta: -0.15, SE: 0.057), and one seeing no association (56).

iv. Literature gaps

Only four studies included Hispanics in their analysis (53, 56, 58-59). Of these studies, only three separated race and ethnicity in a meaningful way (53, 58-59); The two studies with comparable outcomes looked at births over 20 years before present (58-59). Additionally, these studies evaluated Hispanic women as one group in spite of differences seen in literature among preterm birth rates based on Hispanic subgroup. This is problematic because racial differences exist in adverse birth outcomes and by keeping the Hispanic subgroup homogeneous, effects could be dampened. Prior studies are sparse.

b. Poverty

Neighborhood poverty has been associated with many negative health outcomes including lower likelihood of tobacco cessation (49), increased hypertension (50), poorer HIV outcomes (51), and sleep apnea in children (52). While individual socioeconomic status and socioeconomic measures of poverty have been associated with poor birth outcomes (34), few have examined results according to ethnicity.

Seventeen studies have examined the association between neighborhood poverty and adverse birth outcomes (Table 2). Fourteen were conducted in the U.S. (12, 42, 48, 59-69) while three

were conducted outside of the U.S. in Canada (11), France (71), and Sweden (70). Of the 14 in the U.S., two were multi-site studies (60, 69). Seven of the studies occurred in cities or the metro areas thereof including New York City, NY (64, 68), Philadelphia, PA (12), Portland, OR (67), Raleigh, NC (42), and Chicago, IL (48, 59). The remaining five studies all occurred in the states of California (61), Louisiana (62), South Carolina (63, 66), and Washington and Florida (65).

i. Study Designs

Of the seventeen studies, 13 were retrospective cohort studies (11, 12, 42, 48, 59-63, 66-69), two were prospective cohort studies (70-71), and the remaining two were case-control studies (64-65). Both of the prospective cohort studies occurred outside the U.S. in France and Sweden. Seven of the studies did not include Hispanic women (12, 42, 60, 62-63, 66, 69) while another three did not specify race or ethnicity (11, 70-71) and were based in Ontario Canada, Brittany, France, and Sweden. The seven remaining studies all included Hispanic women (59, 48, 61, 64-65, 67-68), however three of them adjusted for race and ethnicity rather than reporting race/ethnicity separately (61, 64-65). Only Masi, Huynh, Collins, and Wentz reported findings separately by ethnicity and race. Wentz et al. (67) did not have sufficient sample size to report all results among Hispanic women.

ii. Poverty Assessment Tools

Neighborhood poverty has been defined in many ways. One study designated poverty by using census data on tract-level persons below poverty (49), while another looked at whether a tract had 20% or more of the population living below the poverty line using census data (50), and a third used individual information on address and group-level information using the American Community Survey (52). Neighborhood poverty was the exposure for all studies but measurement occurred differently. All studies used their country's version of a census bureau with 14 using the U.S. Census Bureau (12, 42, 48, 59-69), one using the Canadian Census (11), one coming from the France Census Blocks (71), and one using Statistics Sweden (70). Poverty was defined differently in each study. Two studies used percent low income or percent below poverty (11, 12). Four studies looked at these

percentages but then separated them into quantiles (71, 61-63). Median family income was separated into tertiles for one study (48). Change in economic status was separated into quintiles for a different study (68). The remainder of the study formed a composite measure and called it "neighborhood deprivation index" (42, 60, 64-67, 69-70) or "census tract disadvantage" (59).

iii. Study Findings

The observed associations were not consistent. A total of 12 studies evaluated the association between neighborhood poverty and preterm birth (11-12, 42, 59-64, 66, 69, 71). Both studies that presented results on Hispanics (59, 68) found no relation between neighborhood poverty and preterm birth (59, 68) (β= 0.0497, OR = 1.02, 95% CI: 0.91, 1.16) The remaining studies found a positive association between neighborhood poverty and preterm birth (12, 60-61, 64, 66) (ORs ranged from 1.01 - 1.38), no association (11, 61, 63, 71), or results that varied according to non-Hispanic race (42, 62).

A total of six studies evaluated the association between neighborhood poverty and low birthweight (11, 48, 62-65). In the only study presenting results on Hispanics, Collins et al. reported that there was a positive association between neighborhood poverty and preterm birth for Puerto Rican woman compared to women of Mexican descent in every tertile of poverty (OR from 1.9 – 2.2, no p trend reported). The remaining studies found a positive association between neighborhood poverty and low birthweight (11, 62-64) (OR from 1.09 – 5.23), or no association between neighborhood poverty and low birthweight (63, 65).

One study presented results on the association between neighborhood poverty and continuous birthweight (59). In this study among Hispanic women, Masi et al. found a positive relationship between neighborhood poverty and reduced continuous birthweight (beta -34.6, $p < 0.05$).

A total of five studies evaluated the association between neighborhood poverty and SGA (59, 67, 69-71). Masi et al. found a positive association between neighborhood poverty and SGA

among Hispanic women (0.182 $p < 0.05$). The remaining studies either found a positive association between neighborhood poverty and SGA (69-70) (OR from 1.09 to 1.28) or no association between neighborhood poverty and SGA (71).

iv. Literature Gaps

Few studies have examined the association between neighborhood poverty and adverse birth outcomes with even fewer reporting results for Hispanic women. No studies have separated Hispanic women by subgroup. This would be valuable to do because different Hispanic subgroups have different rates of preterm birth. Puerto Rican women have appreciably higher rates of adverse birth outcomes than By keeping all Hispanic subgroups together, the true effect might not be measured. Only two of the studies were prospective cohort studies (70-71) and, to our knowledge, no prospective studies have been performed in the U.S. This is a valuable distinction because neighborhood-level exposure patterns in the U.S. and abroad are likely different and distinct due to different political and health infrastructures.

c. Food access/security

Food insecurity in the U.S. has been associated with adverse health outcomes in children and adults (16) affecting overall health, risk of hospitalization, risk for being underweight, risk for being overweight, emergency department admission, and depression. (16). Only three studies have examined the association between neighborhood-level food security or access and adverse birth outcomes (11, 14, 72) (Table 3). One of these studies was conducted outside of the U.S. in Ontario, Canada (11) and the remaining two were US-based in Syracuse, NY (72) and South Carolina (14).

i. Study Design

All three of the studies that examined neighborhood food access and adverse birth outcomes were retrospective cohort studies (11, 14, 72). The Canadian study did not specify race or ethnicity (11). The U.S. studies both adjusted for race but did not include Hispanic women (14, 72).

ii. Food Access/Security Assessment Tools

A variety of different questionnaires have been used to assess food security on an individual level. These questionnaires have focused on food security via the U.S. Household Food Security Survey Module (16), an 18-question questionnaire that is viewed as the gold standard, a shorter two-question survey (16), and questionnaires incorporating types of food at various fast food restaurants (18). Food security has been classified in several different ways: dichotomous or ordinally (e.g. food secure, marginally food insecure, or food insecure) (16).

Each of the three studies used a different food access/security assessment tool. Meng et al. used the Canadian Census that contains measures on percent food insecurity and percent insufficient vegetable intake (11). Lane et al. used a supermarket map analysis to determine if there was a supermarket within a half-mile radius of the census tract (72). However, the authors did not have information on participants' specific addresses (72). Ma et al. used a previously constructed database in South Carolina to determine both the distance from home to the nearest food store as well as the number of food stores within one mile of a participant's house (14).

iii. Study Findings

Two studies evaluated the association between neighborhood food access/security and preterm birth (11, 14). One study found a positive association between neighborhood food insecurity and preterm birth (11) (β= 1.301, 95%CI: 0.779 – 1.823) while the other study found no association between neighborhood food access and preterm birth (14).

Two studies evaluated the association between neighborhood food access/security and low birthweight (11, 14). One study found a positive association between neighborhood food insecurity and low birthweight (11) (β= 2.186, 95%CI: 1.396 – 2.977) while the other study found no association between neighborhood food access and low birthweight (14).

One study evaluated the association between neighborhood food access and SGA (72). It found a positive association between neighborhood food access and SGA (OR: 3.38, 95% CI: 1.26-9.09).

One study evaluated the association between neighborhood food access and continuous birthweight (14) and found no association between proximity to a healthy food store and continuous birthweight (Beta: -3.9, 95% CI -16.6, 8.7), and a positive association between proximity to a convenience store and continuous birthweight (Beta: 21.0, 95% CI: 9.5, 32.4).

One study evaluated the association between food access and continuous gestational age (14) and found no association between proximity to a healthy food store and continuous gestational age (Beta: 0.01, 95% CI -0.04, 0.06), and a slight positive association between proximity to a convenience store and continuous gestational age (Beta: 0.06, 95% CI 0.01, 0.10).

iv. Literature gaps

Prior studies on the relationship between neighborhood-level food access/security and adverse birth outcomes are sparse with only three studies, to our knowledge, that examine this association. None of the studies included or adjusted for Hispanic women of any ethnicity and all of the studies that exist are retrospective cohort studies. None of the studies use personal information for participants; All use birth record-level information. This is problematic because information is not validated. Questionnaires that focus on fast food alone are insufficient to determine a person's food environment and the environment's effects on health outcomes (18).

B. Methodology

Spatial analysis focuses on the role of place as an important indicator of health and disease. Maps historically have been the source for conveying spatial information. Presently, the emergence of Geographic Information Systems (GIS) as a software platform allows for more comprehensive analyses than can be performed using solely maps (73).

GIS is a computer system that captures, stores, checks, and displays data that are related to positions on the surface of the Earth. GIS data not only shows position but also can display other types of data (e.g. crime levels, occupancy levels, population rates, etc.). Locational information in GIS can be analyzed on many different levels, from as broad as a zip code to as narrow as an exact address (78). GIS is able to integrate this spatial data with public health data. GIS can show violence or poverty rates by county, zip code, or address. GIS can also measure distance in a way that can show how far a person's house is from a location of interest, such as a school or a supermarket. Incumbent in the program is the ability to store locational data along with these other metrics. That makes GIS a ready tool for public health analysis.

C. Conclusion

In conclusion, research on the association with neighborhood-level factors and the risk of adverse birth outcomes is sparse, conflicted, and has typically been conducted among non-Hispanic white and black women. Non-Hispanic white and black women have different associations between neighborhood-level effects and adverse birth outcomes. Because Hispanic women are an increasing group in the U.S., their inclusion in these studies is important for understanding population health. Additionally, those studies that do exist treat Hispanic women as a homogeneous population. Subgroups have different health outcomes and health risks and as such should be separated, just as non-Hispanic white and black women are. The literature in this area is sparse in general but particularly in Hispanic women. The association between neighborhood-level food access and adverse birth outcomes is a nearly untouched area of research.

CHAPTER II

NEIGHBORHOOD POVERTY AND ADVERSE BIRTH OUTCOMES

A. Specific Aims and Hypotheses:

Specific Aim: We evaluated the association between neighborhood poverty during pregnancy and adverse birth outcomes (preterm birth, low birthweight, and small-for-gestational age (SGA) birth) in a population of Hispanic women

Hypothesis 1a: Women exposed to high levels of neighborhood poverty will have an increased risk of adverse birth outcomes compared to women exposed to low levels of neighborhood poverty.

Hypothesis 2a: Neighborhood poverty will be positively associated with risk of adverse birth outcomes.

B. Background and Significance:

1. Introduction: Public Health Impact of Adverse Birth Outcomes

a. Preterm birth

Preterm birth, or premature birth, is defined as birth less than 37 weeks of gestational age (1). Almost half a million children each year are born prematurely (2) with one in every nine U.S. babies born prematurely in 2012 (1). This number varies by race and ethnicity. Women of Puerto Rican origin have the second highest preterm birth rates (14.5 preterm births per 100 live births) only to women who are non-Hispanic Black (18.3 preterm births per 100 live births) (3). The increase in people of Hispanic ethnicity living in the U.S. due both to immigration and birth rates heightens the particular interest in this population (9).

Preterm birth is associated with poor health outcomes later in life such as intellectual disability, cerebral palsy, breathing and respiratory problems, vision problems, hearing loss, and feeding and digestive issues (1). Aside from these debilitating lifelong conditions, preterm birth can

cause infant death. As many as 35% of all infant deaths in 2010 occurred in infants born prematurely (2). In 2005 alone, over $26 billion was spent in healthcare costs as a result of preterm birth (2).

Several maternal risk factors have been established for preterm birth. Some of these include being African American, being of Hispanic ethnicity (1), being at an extreme of maternal age (2), uterine or cervical problems, having a previous preterm birth, experiencing multiple gestation, infection during pregnancy, smoking, alcohol use, or drug use during pregnancy, infection, suffering from high blood pressure, diabetes, clotting disorders (1), possessing low maternal income or socioeconomic status, and enduring stress (2). However, these established risk factors only account for a portion of the cases of preterm birth. The presence of racial, ethnic, and socioeconomic disparities in preterm birth rates (46) has raised the possibility that modifiable environmental, contextual, and neighborhood-level factors may play a role (10, 11, 12, 14).

b. Low birthweight

Low birth weight is defined as weighing less than 5.5 lbs or 2500 grams at birth (4). For every 12 births in the U.S., one baby is born with low birth weight (5). Rates of low birth weight vary by race and ethnicity. Among U.S. Hispanic women, those who are of Puerto Rican descent have the highest rates of giving birth to a low birthweight baby (9.4% compared to 7% for Hispanics overall) (7). When compared to infants born at a normal weight, infants born at a low birth weight are at risk for more health problems, both in the immediacy and long term. Immediate health outcomes for infants include infection or illness within the first six days of life (4), birth defects, respiratory distress syndrome, bleeding in the brain, heart defects, intestinal problems, retinopathy of prematurity (5), and hydrocephaly (6). Some health outcomes present later in life and include delayed motor skills, delayed social development, learning disabilities (4), diabetes, heart disease, high blood pressure, metabolic syndrome, obesity (5), blindness, deafness, mental retardation, and cerebral palsy (6).

Factors that may increase a mother's risk of giving birth to a baby with low birth weight include smoking during pregnancy, drinking alcohol during pregnancy, lack of sufficient weight gain

during pregnancy, extremes of maternal age, socioeconomic factors (low income, low educational level, stress, domestic or other abuse, marital status) (4), preterm birth (5), having a previous preterm birth, exposure to air pollution and drinking water contaminated with lead (4), fetal growth restriction, chronic health conditions, infection during pregnancy, problems with the placenta, and being African American (5). As with preterm birth, these risk factors do not explain the prevalence of low birth weight alone. This observation in conjunction with racial/ethnic disparities in rates of low birth weight leads researchers to examine the role of neighborhood risk factors in risk of low birth weight (10, 11, 14).

c. Small for gestational age (SGA)

Small for gestational age (SGA) is typically defined as a baby weighing in the 10th percentile or lower for a baby of the same gestational age (8). This varies by race and ethnicity from the lowest rates of SGA in White, non-Hispanic women (approximately 8%) to the highest rates of SGA in Black, non-Hispanic women (around 17%) (80). Among U.S. Hispanic women, those who are of Puerto Rican descent have higher rates of all adverse birth outcomes (79) including SGA compared to rates observed when examining Hispanic women overall (overall rate of ~10%) (80).

There are both short- and long-term health effects of being born with growth restriction. Shorter term effects include low birth weight, low blood sugar levels, low body temperature, too many red blood cells, trouble fighting infections, and trouble breathing. Some of the longer term health effects include heart and blood vessel problems later in life (8).

Maternal risk factors for SGA include problems with the umbilical cord or placenta, high blood pressure during pregnancy, diabetes, anemia, chronic lung or kidney conditions, autoimmune diseases, very low weight, obesity, poor nutrition or weight gain during pregnancy, use of alcohol, drugs, or cigarettes during pregnancy, multiple gestation, infection during pregnancy, birth defects, or genetic problems (8).

However, in spite of the established risk factors for having an SGA baby, these risk factors alone do not explain the prevalence of SGA. This provides a rationale for new research to examine neighborhood risk factors as other factors that may influence SGA (10,11, 13, 14).

1. Physiology of Exposure-Outcome Relationship

The mechanism linking neighborhood poverty to adverse birth outcomes is unclear. There are three possible theories as to how exposure to neighborhood poverty has been associated with adverse birth outcomes.

One possible mechanism is the construct of allostatic load (62). Allostatic load is theorized to disrupt regulation within multiple systems of the body. This disruption occurs to systems that are responsible for maintaining equilibrium within the body when a challenge is faced, such as stress or living in a neighborhood with high poverty (62). Allostatic load is measured in multiple ways including using biomarkers but is consistently higher regardless of measure in people who live in poorer neighborhoods as compared to wealthier neighborhoods (98-102) and minority neighborhoods as compared to predominantly White neighborhoods (103-106). People who have a high score on allostatic load have shown increased risk for chronic morbidities and all-cause mortality (107-111). Chronic and repeated stress from dealing with a situation such as neighborhood poverty increases allostatic load up to the time of pregnancy and the increased allostatic load may result in adverse birth outcomes (112). This happens specifically by disrupting the regulation of the hypothalamic-pituitary axis resulting in higher outputs of stress hormones which, in turn, have been associated with increased risk of preterm birth (113).

A second possible mechanism posits that increased neighborhood stressors acts through income inequality to result in adverse birth outcomes (63). In this mechanism, social support acts as a buffer to the negative effects of neighborhood stressors on psychological and emotional health during pregnancy. When one lives in an area with a high level of income inequality and the detriments associated with that inequality, there results an imbalance in a person's relationship with

the community. Trust is eroded between people and the community until people within these enclaves reduce their social interactions (118, 120). This results in an isolation that when coupled with income insecurity could amplify the release of a psycho-neuroendocrine hormone that affects birth weight, gestational length, or behaviors including smoking and drug use which result in adverse birth outcomes. Meanwhile, women who live in wealthier neighborhoods participate in more meaningful social activities, may be more engaged and less isolated, and then create the opportunity to share information, receive advice, and become connected to resources that result in improved birth outcomes (63, 118, 120).

A third possible mechanism is that neighborhood poverty is a proxy of another measure: lack of investment in healthcare and social systems necessary for improving prenatal healthcare (114-16). First, there is a systemic lack of development, little money spent on social services, and lack of maintenance of public spaces (63). Because high-poverty neighborhoods have fewer resources, this results in disparities in infrastructure. This, in turn, leads to an unequal distribution of disease and adverse health outcomes, in particular, PTB and LBW (116-119).

2. Epidemiology of Exposure and Outcome

Seventeen studies have examined the association between neighborhood poverty and adverse birth outcomes (Table 11). Fourteen were conducted in the U.S. (12, 42, 48, 59-69) while three were conducted outside of the U.S. in Canada (11), France (71), and Sweden (70). Of the 14 in the U.S., two were multi-site studies (60, 69). Seven of the studies occurred in cities or the metro areas thereof including New York City, NY (64, 68), Philadelphia, PA (12), Portland, OR (67), Raleigh, NC (42), and Chicago, IL (48, 59). The remaining five studies all occurred in the states of California (61), Louisiana (62), South Carolina (63, 66), and Washington and Florida (65).

Of the seventeen studies, 13 were retrospective cohort studies (11, 12, 42, 48, 59-63, 66-69), two were prospective cohort studies (70-71), and the remaining two were case-control studies (64-65). Both of the prospective cohort studies occurred outside the U.S. in France and Sweden. Seven

of the studies did not include Hispanic women (12, 42, 60, 62-63, 66, 69) while another three did not specify race or ethnicity (11, 70-71) and were based in Ontario Canada, Brittany, France, and Sweden. The seven remaining studies all included Hispanic women (59, 48, 61, 64-65, 67-68), however three of them adjusted for race and ethnicity rather than reporting race/ethnicity separately (61, 64-65). Only Masi, Huynh, Collins, and Wentz reported findings separately by ethnicity and race. Wentz et al. (67) did not have sufficient sample size to report all results among Hispanic women.

The observed associations were not consistent. A total of 12 studies evaluated the association between neighborhood poverty and preterm birth (11-12, 42, 59-64, 66, 69, 71). Both studies that presented results on Hispanics (59, 68) found no relation between neighborhood poverty and preterm birth (59, 68) (β= 0.0497, OR = 1.02, 95% CI: 0.91, 1.16) The remaining studies found a positive association between neighborhood poverty and preterm birth (12, 60-61, 64, 66) (ORs ranged from 1.01 - 1.38), no association (11, 61, 63, 71), or results that varied according to non-Hispanic race (42, 62).

A total of six studies evaluated the association between neighborhood poverty and low birthweight (11, 48, 62-65). In the only study presenting results on Hispanics, Collins et al. reported that there was a positive association between neighborhood poverty and preterm birth for Puerto Rican woman compared to women of Mexican descent in every tertile of poverty (OR from 1.9 – 2.2, no p trend reported). The remaining studies found a positive association between neighborhood poverty and low birthweight (11, 62-64) (OR from 1.09 – 5.23), or no association between neighborhood poverty and low birthweight (63, 65).

One study presented results on the association between neighborhood poverty and continuous birthweight (59). In this study among Hispanic women, Masi et al. found a positive relationship between neighborhood poverty and reduced continuous birthweight (beta -34.6, $p < 0.05$).

A total of five studies evaluated the association between neighborhood poverty and SGA (59, 67, 69-71). Masi et al. found a positive association between neighborhood poverty and SGA among Hispanic women (0.182 $p < 0.05$). The remaining studies either found a positive association between neighborhood poverty and SGA (69-70) (OR from 1.09 to 1.28) or no association between neighborhood poverty and SGA (71).

3. Summary of Significance and Innovation

This study is the first to our knowledge to examine women of Puerto Rican and Dominican origin specifically. This is important as rates of adverse birth outcomes and exposure to neighborhood poverty differ according to Hispanic subgroup. Therefore, we propose to investigate the association between neighborhood poverty and adverse birth outcomes using data from a prospective cohort study of pregnant Hispanic (Puerto Rican and Dominican) women, *Proyecto Buena Salud* (PBS). Given the high prevalence of adverse birth outcomes in this Hispanic subgroup, the growing Hispanic population, and the cost of these outcomes to the U.S. healthcare system, the proposed study will be **significant** because it will evaluate a potential risk factor that is modifiable for birth outcome that has an impact on the future health of children. No prospective studies, to our knowledge, have been performed in the United States. The prospective nature and the first-of-its-kind novelty of this proposal to study neighborhood poverty and adverse birth outcomes in a Hispanic subgroup, a group whose women are grossly underrepresented in the overall literature, proves that it is **innovative**.

C. Study Design and Methods

1. Study Design

We assessed the association between neighborhood poverty and risk of adverse birth outcomes using data from PBS. PBS is a prospective cohort study. Participants enrolled in PBS from January 2006 through October 2010. Recruitment occurred in Springfield, Massachusetts at the outpatient clinics of Baystate Health. The study population of Baystate Health is ethnically and

socioeconomically diverse. The demographics of the population indicate that 57% claim Hispanic descent, 23% claim non-Hispanic White descent, 17% claim African-American descent, and 3% claim another ethnic descent (91).

Interviewers who were fluent in both English and Spanish recruited patients at a prenatal care visit before participants were 20 weeks of gestation. Interviewers informed patients of the procedures and aims of the study before providing written informed consent. Informed consent was approved by the Institutional Review Boards (IRB) of the University of Massachusetts and Baystate Health. Interviews, each conducted in the language of the patients' choosing (English or Spanish), were performed at the time of recruitment, in mid, and in late pregnancy. Interviewers collected information on sociodemographic factors and health behaviors. Medical records were abstracted after birth for medical and obstetric history (91).

a. Study Population

Women were eligible to participate in PBS if they were of Puerto Rican or Dominican (Caribbean Islanders) heritage. Specifically, women had to be either born in the Caribbean Islands, have one parent born in the Caribbean Islands, or have two grandparents born in the Caribbean Islands. Women were excluded from the study if they had (a) current medications thought to adversely affect glucose tolerance; (b) multiple gestation; (c) a history of diagnosis of diabetes, hypertension, heart disease, or chronic renal disease; or (d) age under 16 years or over 40 years old. These women were excluded because these conditions might reflect a different physiological association with gestational diabetes mellitus (91). Additional exclusion criteria for this analysis included if women were missing information on address at time of IRB consent, or missing information on birthweight or gestational age were excluded.

b. Exposure Assessment – Neighborhood Poverty

Neighborhood poverty was derived using census data. Each participant's physical address at the time of entry into the study as designated from the informed consent form was the designator of

that subject's physical location for the study. Each woman's address was mapped using ArcGIS, a geographic information system software Poverty information was abstracted from abstracted from the time period that the participant lived at her address. Participants were placed into groups based on census block group. Percent of people below the poverty line measured neighborhood poverty. It was measured as a continuous variable, as a dichotomous variable, and in quartiles (Table 3).

c. Validity of Exposure Assessment

There is no "gold standard" for measurement of neighborhood poverty, but this method is common in prior studies (11, 12, 61-62, 71). There are no validation studies. Neighborhood poverty using this method has been association significantly with preterm birth in a non-Hispanic population of Black and White women (12), with preterm birth in a diverse population not adjusted for race or ethnicity (61), and with LBW in Black and White women (62-63).

d. Outcome Assessment – Adverse Birth Outcomes

i. Preterm Birth

Researchers abstracted gestational age from medical records based on the best clinical estimate of gestational age. Ultrasound, when available, or last menstrual period helped determine gestational age. Women who gave birth before the 37th week of gestation were diagnosed as "preterm" while women who gave birth at 37 weeks of gestation or later was considered "term." The study obstetrician confirmed all cases of preterm birth.

ii. Low Birthweight (LBW)

Birth weight was abstracted from medical records. LBW was defined as < 2,500 grams.

iii. Small-for-Gestational Age (SGA)

SGA was defined as a baby's weighing in the 10th percentile or lower for a baby of the same gestational age using gestational age-specific infant birthweight reference values from a population-based Hispanic female sample (93).

4. Validity of Outcome Assessment

The study obstetrician confirmed all cases of preterm birth and low birth weight. We used established cut-off points, consistent with the prior literatures, to classify each of these adverse birth outcomes.

5. Covariate Assessment

Researchers collected covariates throughout the study, both during interviews and through medical record abstraction. Covariates collected via interview include: marital status, number of adults and children in the household, smoking before and during early, mid-, and late pregnancy, alcohol consumption during pregnancy, education level, income level, depression levels (Edinburgh Postnatal Depression Scale (93)), acculturation (the Psychological Acculturation Scale (94)), generation in the United States, language preference, perceived stress, and trait anxiety. Covariates abstracted from medical records include: parity, age, BMI, and gestational weight gain. Previous literature informed covariate selection based on being risk factors for neighborhood poverty and/or adverse birth outcomes and potential for confounding.

D. Data Analysis Plan

Specific Aim: We evaluated the association between neighborhood poverty during pregnancy and adverse birth outcomes (preterm birth, low birthweight, and small-for-gestational age (SGA) birth) in a population of Hispanic women

1. Univariate Analysis

A total of 1627 women had complete information after the first level of exclusion (did not deliver in the hospital). Women (212 in total) were excluded women were excluded based on missing

address information (roughly 13.0% of the remaining sample). Women (219 in total) were excluded because their pregnancies ended in a spontaneous or therapeutic abortion or stillbirth (roughly 13.50% of the remaining sample). One woman was excluded from analysis on preterm birth and SGA because there was missing information on gestational age. The total sample size for this study was 1184.

The distribution of neighborhood poverty is presented in Table 3. Approximately 10% of the women (n=120) had babies born preterm (Table 4). Approximately 8.2% of women (n=97) had babies born LBW (Table 5). Approximately 12.4% of women (n=146) had babies born SGA (Table 6).

2. Bivariate Analysis

Potential confounders were assessed by cross-tabulating covariates by neighborhood poverty (Table 7), and by each outcome variable (Table 8). Chi-square tests were used for categorical variables, and t-tests were performed for continuous variables. In the case of small cell sizes, Fisher's Exact Test was used. Associated p-values were reported. The association between neighborhood poverty and each adverse outcome was modeled using unadjusted logistic regression (Tables 9a, 9b, 9c). Odds ratios and 95% confidence intervals were reported.

3. Multivariable Analysis

Multivariable logistic regression was used to model the association between neighborhood poverty and each adverse birth outcome (Table 9). Covariates were entered into the model individually. Three separate models were constructed with adjusted variables. First, adjusted for age and BMI regardless of whether $p < 0.05$. This was performed so that it could be comparable to previous literature where age and BMI are routinely adjusted. Second, adjusted for if $p < 0.05$ for both exposure and outcome variables. Third, adjusted for if $p < 0.05$ for either exposure or outcome variable. We *a priori* planned to adjust if a variable caused a change of 10% of more to the estimate

for outcome variables, however no covariate showed such change. Odds ratios and 95% confidence intervals were reported (Tables 9a, 9b, 9c).

E. Results

Overall, participants were unmarried (78.0%) however the majority had 2 or more adults living in the household (66.8%) (Table 3). The majority of women had a child already living in the house (83.1%), but most women were nulliparous (44.2%). Women were equally split between those born in Puerto Rico or the Dominican Republic (45.1%) and those with a parent born in Puerto Rico or the Dominican Republic (46.0%). A majority of women had low acculturation levels (67.7%) but preferred English to Spanish (71.5%). The sample largely did not smoke or drink either before or during pregnancy with 30.0% smoking before pregnancy and a range of 6.0 - 9.12% smoking during pregnancy. Very few women reported alcohol consumption during pregnancy (0.6-1.8%).

The distribution of poverty is presented in Table 2a. Neighborhood poverty was broken into quartiles based on percentile below the federal poverty line. The lowest quartile ranged from 2.1% of the FPL to 27.3% of the FPL while the highest quartile ranged from 65.1% below the FPL to 95.8% below the FPL. (Table 2a) Approximately 10% of women (n=120) had babies born preterm (Table 4). Approximately 8.2% (n=97) of women had babies born LBW (Table 5). Approximately 12.4% of women (n=146) had babies born SGA (Table 6).

We then evaluated participant characteristics according to neighborhood poverty (high vs.low) (Table 7). Number of adults in house, number of children in house, smoking before pregnancy, and parity were all positively associated with high poverty neighborhoods (Table 7). Income was inversely associated with high poverty neighborhoods (Table 7). GWG was positively associated with preterm birth and LBW (Table 8). Meeting ACOG guidelines was inversely associated with preterm birth and LBW (Table 8). GWG, BMI, depression during pregnancy, smoking before pregnancy, and smoking during pregnancy were positively associated with risk of SGA (Table 8). Parity, and education were inversely associated with risk of SGA (Table 8).

1. Preterm Birth

We observed no significant association between neighborhood poverty and preterm birth when measured continuously, dichotomously, or using quartiles when unadjusted or adjusted (Table 9a, high poverty vs. low poverty, unadjusted OR: 0.91, 95 %CI 0.56-1.48; adjusted OR: 0.91, 95% CI 0.56-1.59, adjusting for BMI and age).

2. LBW

We observed no significant association between neighborhood poverty and LBW when measured continuously, dichotomously, or using quartiles when unadjusted or adjusted (Table 9b, high poverty vs. low poverty, unadjusted OR: 0.97, 95% CI 0.56-1.67; adjusted OR: 0.99, 95% CI 0.57-1.72, adjusting for BMI and age).

3. SGA

We observed no association between neighborhood poverty and SGA when measured continuously or dichotomously when unadjusted or adjusted (Table 9c). However, women who lived in the highest quartile for neighborhood poverty had twice the odds of SGA (unadjusted OR: 1.94, 95% CI 1.09-3.45; adjusted OR: 2.00, 95% CI 1.11-3.59, adjusted for age and BMI) compared to women who lived in the lowest quartile for neighborhood poverty.

F. Discussion

In summary, in this prospective cohort study among Hispanic prenatal care patients, we found no significant association between neighborhood poverty and either preterm birth or low birthweight among participants. There likewise was no association between neighborhood poverty and SGA when measured continuously or dichotomously. When measured in quartiles (highest quartile 65.1-95.8% below the federal poverty level), neighborhood poverty was associated with twice the odds of SGA (95% CI 1.11-3.59) when adjusting for age and BMI.

Several prior studies examined the relationship between neighborhood poverty and preterm birth (11-12, 42, 59-64, 66, 69, 71) but only two presented results in Hispanic women (59, 68). Those two studies found no association between neighborhood poverty and preterm birth (β= 0.0497, OR = 1.02, 95% CI: 0.91, 1.16) (59, 68). The studies both took place in urban areas, Chicago, IL (59) and Philadelphia, PA (68) and reported only results on Hispanic women, not results on any specific subgroup of Hispanic women. Both studies also used different metrics to ascertain neighborhood poverty with one using a weighted combination of percent of people without a high school diploma, public housing, percent of people unemployed, and places where the median income was below the poverty line (59), and the other study measuring neighborhood change in economic status (68).

Six studies evaluated the association between neighborhood poverty and LBW (11, 48, 62-65) but only one presented results in Hispanic women (48). In this study, Collins et al. found a positive association between neighborhood poverty and LBW for Puerto Rican women compared to women of Mexican descent within every tertile of poverty (OR from 1.9 – 2.2, no p trend reported). However, this analysis differed from ours in that it compared women of Puerto Rican descent to the comparison group of women of Mexican descent. This study did not examine whether women of Puerto Rican descent had higher rates of LBW based on their own neighborhood poverty levels. So while this study examined the broader issue of LBW, it did not measure something comparable to what we did, as our comparison group was low poverty meanwhile poverty was a variable that Collins et al. stratified on.

Five prior studies evaluated the association between neighborhood poverty and SGA (59, 67, 69-71). Only one presented results in Hispanic women (59). In this study among 15,929 Hispanic women, Masi et al. found a positive association between neighborhood poverty and SGA (β =0.182, $p < 0.05$) (59).

1. Limitations

Potential limitations of this study include nondifferential misclassification of exposure, clustering, selection bias, confounding, and generalizability.

a. Nondifferential misclassification of exposure

Neighborhood poverty is based on information about the location of participants' home address at the time of enrollment into the study. Women who moved soon after giving their informed consent, or at any time throughout the study, could live in a different neighborhood than the one used for analysis and therefore be exposed to a different level of neighborhood poverty for all or part of their pregnancy. This could result in a nondifferential misclassification of exposure because it is related solely to the exposure and not the outcome. If this occurred, it would bias the observed association toward the null. However, we do not believe it to be incredibly likely that a woman moves neighborhoods in a way that drastically changes her neighborhood poverty level so we believe this to be a small likelihood.

b. Ecological Elements

Because we were using an ecological element to our exposure, neighborhood poverty not individual poverty, there is a possibility that neighborhood poverty is not the direct cause of the adverse birth outcomes. We collected information on individual income. However, it was not significantly associated with both neighborhood poverty and adverse birth outcomes. As such, we did not adjust for individual income. The aim of this study was not to determine if poverty in general had an effect on adverse birth outcomes, but if living in a neighborhood with high poverty had an effect.

c. Selection Bias

Selection bias is possible but unlikely in this study. This study was a prospective cohort study and women would have to have differential loss to follow-up in order for selection bias to occur. While unlikely, it is not impossible. One plausible scenario would be if women who lived in a high poverty neighborhood were more likely to miss their prenatal visits because they were unable to get

to the visits and for that reason they were also less likely to deliver at the hospital. If these women also had higher rates of adverse birth outcomes as a result of being unable to focus on their health due to monetary concerns, this could result in an underestimate of the odds ratio. This scenario is unlikely because if women fit the described situation, they would not have been recruited into the study in the first place.

d. Confounding

Many potential confounding variables were measured. However, there were two scenarios where confounding could still have an effect on the association. The first scenario is residual confounding and missingness. Confounders were collected for all women but not all women answered all questions relating to confounders. Some variables, such as income, had large levels of missingness. This could result in residual confounding still existing within the data even though the confounder was adjusted. The second scenario relates to uncollected confounders. We did not have information on individual food access. Individual food insecurity is positively associated with minority neighborhoods (96), neighborhood poverty (114), and adverse birth outcomes (11, 66, 72). However, we were unable to control for this due to restrictions in data collection. This could result in an overestimate of the odds ratio of the relationship between neighborhood poverty and adverse birth outcomes.

e. Generalizability

Findings may not be generalizable to women of different races or ethnicities. These adverse birth outcomes have different rates among different racial and ethnic populations, so it is plausible that the association may differ by race or ethnicity. Findings may not be generalizable to women who are at significantly different levels of neighborhood poverty than those in this study. For example, women in other regions may be living in much poorer or much wealthier neighborhoods and getting a different "dose" of neighborhood poverty.

f. Policy Implications

One possible policy implication stems from this discovery. Neighborhood poverty does have an adverse effect on whether a baby is born SGA. If poorer neighborhoods have more money and resources pumped into them, it is possible to better the lives of expectant mothers and their children. Living in a better off neighborhood has a discernable effect on SGA births. The amount of babies born who are SGA could be drastically reduced if policy makers target their monetary interventions in these areas.

G. Conclusion

We found no association between neighborhood-level poverty and preterm birth or LBW in this population. Women who lived in the highest quartile of poverty were twice as likely to deliver SGA babies compared to women who lived in the lowest quartile for poverty.

CHAPTER III

NEIGHBORHOOD CRIME AND ADVERSE BIRTH OUTCOMES

A. Specific Aims and Hypotheses:

Specific Aim: We evaluated the association between neighborhood crime during pregnancy and adverse birth outcomes (preterm birth, low birthweight, and small-for-gestational age (SGA) birth) in a population of Hispanic women

Hypothesis 1a: Women exposed to high levels of neighborhood crime will have an increased risk of adverse birth outcomes compared to women exposed to low levels of neighborhood crime.

Hypothesis 2a: Neighborhood crime will be positively associated with risk of adverse birth outcomes.

Hypothesis 3a: Women exposed to high levels of violent neighborhood crime will have an increased risk of adverse birth outcomes compared to women exposed to low levels of neighborhood crime.

Hypothesis 4a: Violent neighborhood crime will be positively associated with risk of adverse birth outcomes.

We came to the conclusion for these hypotheses based upon prior results from literature (see *Epidemiology* section below).

B. Background and Significance:

1. Introduction: Public Health Impact of Adverse Birth Outcomes

a. Preterm birth

Preterm birth, or premature birth, is defined as birth less than 37 weeks of gestational age (1). Almost half a million children each year are born prematurely (2) with one in every nine U.S.

babies born prematurely in 2012 (1). This number varies by race and ethnicity. Women of Puerto Rican origin have the second highest preterm birth rates (14.5 preterm births per 100 live births), second to women who are non-Hispanic Black (3). The increasing number of people of Hispanic ethnicity living in the U.S. heightens the particular interest in this population (9).

Preterm birth is associated with poor health outcomes later in life such as intellectual disability, cerebral palsy, breathing and respiratory problems, vision problems, hearing loss, and feeding and digestive issues (1). Aside from these debilitating lifelong conditions, preterm birth can result in infant death. As many as 35% of all infant deaths in 2010 occurred in infants born prematurely (2). In addition, cost of care for preterm infants is enormous. In 2005 alone, over $26 billion was spent in healthcare costs as a result of preterm birth (2).

Several maternal risk factors have been established for preterm birth. Some of these include being African American, being of Hispanic ethnicity (1), being at an extreme of maternal age (2), uterine or cervical problems, having a previous preterm birth, experiencing multiple gestation, infection during pregnancy, smoking, alcohol use, and drug use during pregnancy, infection during pregnancy, suffering from high blood pressure, diabetes, clotting disorders (1), possessing low maternal income or socioeconomic status, and enduring stress (2). However, these established risk factors only account for a portion of the cases of preterm birth. The presence of racial, ethnic, and socioeconomic disparities in preterm birth rates (46) has raised the possibility that modifiable environmental, contextual, and neighborhood-level factors may play a role (10, 11, 12, 14).

b. Low birthweight

Low birth weight is defined as weighing less than 5.5 lbs or 2500 grams at birth (4). For every 12 births in the U.S., one baby is born with low birth weight (5). Rates of low birth weight vary by race and ethnicity. Among U.S. Hispanic women, those who are of Puerto Rican descent have the highest rates of giving birth to a low birthweight baby (9.4% compared to 7% for Hispanics overall) (7). When compared to infants born at a normal weight, infants born at a low birth weight are at

risk for more health problems, both in the immediacy and long term. Immediate health outcomes for infants include infection or illness within the first six days of life (4), birth defects, respiratory distress syndrome, bleeding in the brain, heart defects, intestinal problems, retinopathy of prematurity (5), and hydrocephaly (6). Some health outcomes present later in life and include delayed motor skills, delayed social development, learning disabilities (4), diabetes, heart disease, high blood pressure, metabolic syndrome, obesity (5), blindness, deafness, mental retardation, and cerebral palsy (6).

Factors that may increase a mother's risk of giving birth to a baby with low birth weight include smoking during pregnancy, drinking alcohol during pregnancy, lack of sufficient weight gain during pregnancy, extremes of maternal age, socioeconomic factors (low income, low educational level, stress, domestic or other abuse, marital status) (4), preterm birth (5), having a previous preterm birth, exposure to air pollution and drinking water contaminated with lead (4), fetal growth restriction, chronic health conditions, infection during pregnancy, problems with the placenta, and being African American (5). As with preterm birth, these risk factors do not explain the prevalence of low birth weight alone. This observation in conjunction with racial/ethnic disparities in rates of low birth weight leads researchers to examine the role of neighborhood risk factors in risk of low birth weight (10, 11, 14).

c. Small for gestational age (SGA)

Small for gestational age (SGA) is typically defined as a baby weighing in the 10th percentile or lower for a baby of the same gestational age (8). This varies by race and ethnicity from the lowest rates of SGA in White, non-Hispanic women (approximately 8%) to the highest rates of SGA in Black, non-Hispanic women (around 17%) (80). Among U.S. Hispanic women, those who are of Puerto Rican descent have higher rates of all adverse birth outcomes (79) including SGA compared to rates observed when examining Hispanic women overall (overall rate of ~10%) (80).

There are both short- and long-term health effects of being born with growth restriction. Shorter term effects include low birth weight, low blood sugar levels, low body temperature, too

many red blood cells, trouble fighting infections, and trouble breathing. Some of the longer term health effects include heart and blood vessel problems later in life (8).

Maternal risk factors for SGA include problems with the umbilical cord or placenta, high blood pressure during pregnancy, diabetes, anemia, chronic lung or kidney conditions, autoimmune diseases, very low weight, obesity, poor nutrition or weight gain during pregnancy, use of alcohol, drugs, or cigarettes during pregnancy, multiple gestation, infection during pregnancy, birth defects, or genetic problems (8).

However, in spite of the established risk factors for having an SGA baby, these risk factors alone do not explain the prevalence of SGA. This results in other new research that examines neighborhood risk factors that may influence SGA (10,11, 13, 14).

d. Research Goal

Preterm birth, low birthweight, and small-for-gestational age birth are three related factors that have long-term effects on a person's health and well-being. Each factor has been used in prior literature. The purpose of using all three of these as outcome measures is a way of closing a research gap where some prior studies only addressed one or two of the factors but not all three.

2. Physiology of Exposure-Outcome Relationship

The mechanism linking neighborhood crime to adverse birth outcomes is unclear. There are three proposed theories as to how exposure to violent environments may be associated with adverse birth outcomes.

The first is the possibility that when one is in a violent environment, sleep disturbances and other anxiety cause chronic stress (86). In turn, studies have shown that those with high levels of chronic stress have increased rates of PTB and LBW (87-88).

The second mechanism is the possibility that exposure to violence is a chronic environmental stress that leads to hypertension through elevated nervous system activity (89). This

elevated nervous system activity causes a release of corticosteroid hormones which leads to hypertension (89). Hypertension is a risk factor associated with both PTB and LBW (90).

A third possible mechanism is that exposure to crime environments can influence behavior. When one is exposed to a high-stress situation, a person has various coping mechanisms to reduce stress. Smoking cigarettes and consuming alcohol are ways in which some people try to exert control over their lives or alleviate stress when experiencing stressful situations. If a woman tries to utilize these stress-reducing "techniques" during pregnancy, it can lead to adverse birth outcomes as smoking cigarettes and consuming alcohol are both associated with increased PTB and LBW (10).

3. Epidemiology of Neighborhood Crime and Adverse Birth Outcomes

Eleven studies have examined neighborhood-level crime and adverse birth outcomes (10, 12, 40, 42, 53-59) (Table 11). Of these studies, eight were conducted in the U.S (10, 12, 42, 53, 56-8) and three were conducted abroad in Chile (40), Quebec, Canada (54), and Scotland (55). Of the eight studies focused in the U.S., all but one (53) took place in specific cities (i.e., Chicago, IL (57, 59), Durham, NC (56), Philadelphia, PA (12), Raleigh, NC (10, 42), and Washington, DC (58)).

Eight studies were retrospective cohort studies (10, 12, 42, 53-56), one was a prospective cohort study (40), one was a cross-sectional study (57), and one was a retrospective hierarchical analysis (58). Four studies (53, 56, 58-59) included Hispanic participants (ranging from 11.8 – 39.5% of the study population) with one study adjusting for race and ethnicity (56) while the other three separately reported results by race and ethnicity. Four of the remaining studies did not include Hispanic participants at all (10, 12, 42, 57) while another three (all three outside of the U.S.) neither adjusted for nor specified race or ethnicity of participants (40, 54-55).

Studies typically classified political violence, violent crime density, violent crime incidence, and area crime rates as indicators of neighborhood crime (10). Neighborhood crime was the exposure for all studies but the studies differed in their means of classifying exposure. Six studies used a city police database or similar database for crime classification (10, 12, 42, 54, 56, 59), three

used Census Bureau information (53, 57-58), one used a country-wide database (55), and one had researchers individually classify crime (40).

Findings were not consistent. A total of seven studies evaluated the association between neighborhood crime and preterm birth (10, 12, 42, 55-57, 59). In the only study to present results among Hispanics, Masi et al. (28.8% Hispanic) found a positive association (OR: 1.10, $p < 0.05$) between neighborhood violent crime and preterm birth. The remaining studies either found that neighborhood violent crime was positively associated with preterm birth (12) (no reported odds ratio), not associated (55-57) (nonsignificant odds ratios ranging from 0.91 - 1.05), or limited to associations among a particular ethnic or racial background that did not include Hispanic women in analysis (10, 42).

A total of three studies evaluated the association between neighborhood crime and low birthweight (42, 55-56)). None presented results explicitly among Hispanics. There was no association between exposure to neighborhood violent crime and low birthweight in one ethnically diverse study (56), results varied by race among non-Hispanic black and non-Hispanic white women with positive and no association, respectively (42). A study based in Scotland found a positive association between total violent crime and LBW (55) (OR: 1.15, 95% CI 1.01-1.31).

Three studies evaluated the association between neighborhood crime and continuous birthweight (56, 58-59). All three studies included Hispanic women. Masi et al. (28.8% Hispanic) and Kane et al. (6.25% Hispanic) reported separate results for Hispanic women and both found that neighborhood violent crime was inversely associated with birthweight ($\beta = -1.81$ ($p < 0.01$) and $\beta = -24.3$ ($p < 0.05$)). The remaining study found no association after adjusting for race and ethnicity (56).

A total of four studies evaluated the association between neighborhood crime and SGA (54-56, 59). In the only study to present results among Hispanics, Masi et al. (28.8% Hispanic) found that there was a positive association between neighborhood crime and SGA (OR 1.20, $p < 0.05$). The remaining studies found conflicting results with one seeing a positive association (OR: 1.09, 95% CI

1.02-1.16) (55) between neighborhood crime and SGA in a Scottish population, one seeing an inverse association (54) (Beta: -0.15, SE: 0.057), and one seeing no association (56).

Only four studies included Hispanics in their analyses (53, 56, 58-59). Of these studies, only three separated race and ethnicity in their analyses (53, 58-59); The two studies with comparable outcomes looked at births over 20 years before present (58-59). Additionally, these studies evaluated Hispanic women as one group in spite of differences seen in the literature among preterm birth rates based on Hispanic subgroup. This is problematic because racial differences exist in adverse birth outcomes and by assuming that the Hispanic subgroup is homogeneous, effects may be dampened. Prior studies are sparse.

Of the total eleven studies that investigated preterm birth, low birthweight, or SGA, only two studies looked at all three outcomes (55-56) and only one included Hispanics in their analysis (56) but did not separate race or ethnicity within their analysis. This further underscores the need for this research as no prior studies have looked at all three birth outcomes separating on ethnicity, let alone based upon Hispanic subgroup.

4. Summary of Significance and Innovation

This study is the first to our knowledge to examine women of Puerto Rican or Dominican origin specifically. This is important as rates of adverse birth outcomes and exposure to crime differ according to Hispanic subgroup. Therefore, we investigated the association between neighborhood crime and adverse birth outcomes using data from a prospective cohort study of pregnant Hispanic (Puerto Rican and Dominican) women, *Proyecto Buena Salud* (PBS). Given the high prevalence of adverse birth outcomes in this Hispanic subgroup, the growing Hispanic population, and the cost of these outcomes to the U.S. healthcare system, the proposed study will be **significant** because it will evaluate a potential risk factor that is modifiable for birth outcome that has an impact on the future health of children. This **innovative** study will be the first of its kind to study neighborhood crime and adverse birth outcomes in a Hispanic subgroup that is underrepresented in the overall literature.

This study fills a **research gap** by being the first of its kind to our knowledge of examining the effect of neighborhood crime on all three birth outcomes in a subgroup of Hispanic women (Puerto Rican and Dominican).

Of the total eleven studies that investigated preterm birth, low birthweight, or SGA, only two studies looked at all three outcomes (55-56) and only one included Hispanics in their analysis (56) but did not separate race or ethnicity within their analysis. This further underscores the need for this research as no prior studies have looked at all three birth outcomes separating on ethnicity, let alone based upon Hispanic subgroup.

C. Study Design and Methods

1. Study Design

We assessed the association between neighborhood crime and risk of adverse birth outcomes using data from PBS. PBS is a prospective cohort study with a total of n=1610. Participants enrolled in PBS from January 2006 through October 2010. Recruitment occurred in Springfield, Massachusetts at the outpatient clinics of Baystate Health. The study population of Baystate Health is ethnically and socioeconomically diverse. The demographics of the population indicate that 57% claim Hispanic descent, 23% claim non-Hispanic White descent, 17% claim African-American descent, and 3% claim another ethnic descent (91).

Interviewers who were fluent in both English and Spanish recruited patients at a prenatal care visit before participants were 20 weeks of gestation. Interviewers informed patients of the procedures and aims of the study before providing written informed consent. They study was approved by the Institutional Review Boards (IRB) of the University of Massachusetts and Baystate Health. Interviews, each conducted in the language of the patients' choosing (English or Spanish), were performed at the time of recruitment, in mid, and in late pregnancy. Interviewers collected information on sociodemographic factors and health behaviors. Medical records were abstracted after birth for medical and obstetric history (91).

2. Study Population

Women were eligible to participate in PBS if they were of Puerto Rican or Dominican (Caribbean Islanders) heritage. Specifically, women had to be born in the Caribbean Islands, have at least one parent born in the Caribbean Islands, or have two grandparents born in the Caribbean Islands. Women were excluded from the study if they had (a) current medications thought to adversely affect glucose tolerance; (b) multiple gestations; (c) a history of diagnoses of diabetes, hypertension, heart disease, or chronic renal disease; or (d) an age under 16 years or over 40 years old. These women were excluded because these conditions might reflect a different physiological association with gestational diabetes mellitus (91). Additional exclusion criteria for this analysis included if women were missing information on address at time of IRB consent, or missing information on birthweight or gestational age were excluded.

3. Exposure Assessment – Neighborhood Crime

Neighborhood crime was derived using a woman's address at the time of enrollment into the study, and the CrimeRisk data set from Applied Geographic Solutions (AGS). The physical address listed on the informed consent form at the time of entry into the study for each participant was used to determine the subject's physical location for the study for the purposes of assigning a neighborhood. Each woman's address was mapped using ArcGIS, a geographic information system software. Crime information was provided using the AGS CrimeRisk dataset for the specific time period of the study based on census block group. The CrimeRisk dataset includes a standardized index for personal and property crimes derived from years of crime reports from the FBI's Uniform Crime Report (UCR). The types of crime are reported not in total number but in an index. Types of crime include total crime, personal crime, murder, rape, robbery assault, property crime, burglary, larceny, and motor vehicle theft. AGS provides further information on the derivation of the index at http://www.appliedgeographic.com. Neighborhood crime was measured for overall neighborhood crime and violent neighborhood crime both continuously and in quartiles.

4. Validity of Exposure Assessment

There is no "gold standard" for measurement of neighborhood crime, but this method is common in prior studies (10, 42, 56), and AGS provides a structured, straightforward, reliable index for neighborhood crime..

5. Outcome Assessment – Adverse Birth Outcomes

a. Preterm Birth

Researchers abstracted gestational age from medical records based on the best clinical estimate of gestational age. Ultrasound, when available, or last menstrual period helped determine gestational age. Birth before the 37th week of gestation were designated "preterm" births at 37 weeks of gestation or later were considered "term." The study obstetrician confirmed all cases of preterm birth.

b. Low Birthweight (LBW)

Birth weight was abstracted from medical records. LBW was defined as < 2,500 grams.

c. Small-for-Gestational Age (SGA)

SGA will be defined as a baby's weighing in the 10th percentile or lower for a baby of the same gestational age using gestational age-specific infant birthweight reference values from a population-based Hispanic sample (93).

6. Validity of Outcome Assessment

The study obstetrician confirmed all cases of preterm birth and low birth weight. We will be using established cut-off points, consistent with the prior literature, to classify each of these adverse birth outcomes.

7. Covariate Assessment

Researchers collected covariates throughout the study, both during interviews and through medical record abstraction. Covariates collected via interview include: marital status, number of adults and children in the household, smoking before and during early, mid-, and late pregnancy, alcohol consumption during pregnancy, education level, income level, depression levels (Edinburgh Postnatal Depression Scale (93)), acculturation (the Psychological Acculturation Scale (94)), generation in the United States, language preference, perceived stress, and trait anxiety. Covariates abstracted from medical records include: parity, age, BMI, and gestational weight gain. Previous literature informed covariate selection based on being risk factors for neighborhood crime and associated with adverse birth outcomes and potential for confounding.

D. Data Analysis Plan

Specific Aim: We evaluated the association between overall and violent neighborhood crime during pregnancy and adverse birth outcomes (preterm birth, low birthweight, and small-for-gestational age (SGA) birth) in a population of Hispanic women

1. Univariate Analysis

Women were excluded from the study based on the following exclusion criteria:missing address information, pregnancies ended in a spontaneous or therapeutic abortion or stillbirth, missing information gestational age.

2. Bivariate Analysis

Potential confounders were assessed by cross-tabulating covariates by neighborhood crime (Tables 7a, 7b, 7c, 7d) and by each outcome variable (Table 8). Chi-square tests were performed for categorical variables, and t-tests were performed for continuous variables if the distribution was normal. If the distribution was not normal, Wilcoxon tests were performed. In the case of small cell sizes, Fisher's Exact Test will be used.

3. Multivariable Analysis

Multivariable logistic regression was used to model the association between neighborhood crime and each adverse birth outcome (Tables 9a, 9b, 9c, 9d). Covariates were entered into the model individually. Three separate models were constructed with adjusted variables. First, adjusted for age and BMI regardless of whether $p < 0.05$. This was performed so that it could be comparable to previous literature where age and BMI are routinely adjusted. Second, adjusted for if $p < 0.05$ for both exposure and outcome variables. Third, adjusted for if $p < 0.05$ for either exposure or outcome variable. We *a priori* planned to adjust if a variable caused a change of 10% of more to the estimate for outcome variables, however no covariate showed such change. Odds ratios and 95% confidence intervals were reported (Tables 9a, 9b, 9c, 9d).

E. Results

A total of 1627 women had complete information after the first level of exclusion. 212 women were excluded based on missing address information (roughly 13.0% of the remaining sample). 219 women were excluded because their pregnancies ended in a spontaneous or therapeutic abortion or stillbirth (roughly 13.50% of the remaining sample). One woman was excluded because there was missing information on gestational age. The total sample size for this study was 1195. The association between neighborhood crime and each adverse outcome was modeled using unadjusted logistic regression (Tables 9a, 9b, 9c, 9d). Odds ratios and 95% confidence intervals were reported.

Overall, participants were unmarried (89.0%) however the majority had 2 or more adults living in the household (74.2%) (Table 3). The majority of women had a child already living in the house (80.7%), but most women were nulliparous (40.9%). Women were equally split between those born in Puerto Rico or the Dominican Republic (46.8%) and those with a parent born in Puerto Rico or the Dominican Republic (47.5%). A majority of women had low acculturation levels (80.0%) but preferred English to Spanish (75.8%). The sample largely did not smoke or drink either before or during pregnancy with 32.8% smoking before pregnancy and a range of 10.5-14.0% smoking during pregnancy. Very few women reported alcohol consumption during pregnancy (2.8%).

Overall neighborhood crime ranged from 21-419, meaning areas had roughly one-fifth the average crime rate in the United States to roughly four times the average crime rate in the United States. Violent neighborhood crime ranged from 18-2402, meaning areas had roughly one-fifth the average crime rate in the United States to roughly 24 times the average crime rate in the United States. Approximately 10% of the women (n=120) had babies born preterm (Table 4). Approximately 8.2% of women (n=97) had babies born LBW (Table 5). Approximately 12.4% of women (n=146) had babies born SGA (Table 6).

Approximately 10% of the women (n=120) had babies born preterm (Table 4). Approximately 8.2% of women (n=97) had babies born LBW (Table 5). Approximately 12.4% of women (n=146) had babies born SGA (Table 6).

We then evaluated participant characteristics according to quartile of neighborhood crime, quartile of neighborhood crime rate, quartile of violent crime, and quartile of violent crime rate (Tables 7a, 7b, 7c, 7d). Marital status, income, and language preference were significantly inversely associated with all types of crime. Age and BMI were significantly positively associated with all types of crime. Education was inversely associated with all types of crime except overall neighborhood crime rate. Number of children in the household, smoking before pregnancy, and depression were positively associated with both types of violent neighborhood crime but neither type of overall neighborhood crime. Smoking during mid-pregnancy was associated positively with only overall neighborhood crime. Parity, GWG, and meeting physical activity guidelines during mid-pregnancy were associated inversely only with overall violent neighborhood crime. Perceived stress was only associated positively with overall violent neighborhood crime rate.

We then evaluated the association between potential covariates and pregnancy outcomes (Table 8). Age, BMI, and GWG were significantly positively associated with all three outcome variables (preterm birth, LBW, SGA). Marital status and meeting physical activity requirements in early pregnancy were only associated inversely with preterm birth. Smoking during mid-pregnancy

was only associated positively LBW. Smoking before pregnancy and during early pregnancy (positively), education (inversely), and parity (inversely) are only associated with SGA (Table 8).

1. Preterm Birth

We observed no significant association between overall neighborhood crime and preterm birth when measured continuously or using quartiles when unadjusted or adjusted (Table 9a, Highest quartile of neighborhood crime rate vs. lowest quartile of neighborhood crime rate: unadjusted OR: 0.9, 95% CI 0.5-1.5; adjusted OR: 0.9, 95% CI 0.5-1.5, adjusting for marital status, age and BMI).

We observed no significant association between violent neighborhood crime and preterm birth when measured continuously or using quartiles when unadjusted or adjusted (Table 9a, Highest quartile of violent neighborhood crime rate vs. lowest quartile of violent neighborhood crime rate: unadjusted OR: 1.1, 95% CI 0.6-1.8; adjusted OR: 1.1, 95% CI 0.7-1.9, adjusted for marital status, age, BMI, GWG).

2. LBW

We observed no significant association between overall neighborhood crime and LBW when measured continuously or using quartiles when unadjusted or adjusted (Table 9b, Highest quartile of neighborhood crime vs. lowest quartile of neighborhood crime: unadjusted OR: 1.1, 95% CI: 0.6-1.9; adjusted OR: 1.1, 95% CI 0.6-1.9, adjusted for smoking during mid-pregnancy, age, and BMI). We observed no significant association between violent neighborhood crime and LBW when measured continuously or using quartiles when unadjusted or adjusted (Table 9b, Highest quartile of violent neighborhood crime vs. lowest quartile of violent neighborhood crime: unadjusted OR: 0.9, 95% CI: 0.5-1.6, adjusted OR: 0.7, 95% CI 0.3-1.3, adjusted for age, BMI, and GWG).

3. SGA

We observed no significant association between overall neighborhood crime and SGA when measured continuously or by using quartiles when adjusted or unadjusted. However, there was a p

trend of 0.0373 for increasing overall neighborhood crime in quartiles and risk of SGA which was attenuated when adjusting for education, age, and BMI (Table 9c, unadjusted OR: 1.3, 95% CI: 0.8-2.1; adjusted OR: 1.2, 95% CI: 0.7-2.1, p trend: 0.0653).

We observed a positive association between violent neighborhood crime and SGA when measured both continuously and in quartiles (continuous unadjusted OR: 1.6, 95% CI 1.1-2.3; highest quartile unadjusted OR: 2.2, 95% CI: 1.3-3.6) . The association persisted but was slightly attenuated when adjusted for covariates (continuous OR: 1.5, 95% CI: 1.03-2.2; highest quartile OR: 2.1, 95% CI: 1.2-3.4, both adjusted for smoking before pregnancy, smoking during early pregnancy, education, parity, BMI, and GWG).

For every unit increase in violent neighborhood crime, we observed a 50% increased odds of SGA birth in women when adjusting for smoking before pregnancy, smoking during early pregnancy, education levels, parity, age of the mother, pre-pregnancy BMI, and gestational weight gain (Table 9c, OR 1.50, 95% CI 1.03-2.20). Women who lived in the highest quartile of violent neighborhood crime had 2.1 times higher odds of SGA (95% CI: 1.2-3.4, p-trend of 0.0037) compared to women who lived in the lowest quartile of violent neighborhood crime when adjusting for smoking before pregnancy, education levels, age of the mother, and pre-pregnancy BMI.

This is the first study to examine neighborhood crime in women of Puerto Rican and Dominican descent for preterm birth, LBW, and SGA within the same study. While these three outcomes are related, we found disparate results. There was no significant association for the association between overall neighborhood crime and any of the three birth outcomes. There was no significant association between violent neighborhood crime and preterm birth or LBW, but there was a significant positive association between violent neighborhood crime and SGA when measured continuously and in quartiles. This suggests that while these three outcomes are related, perhaps something specific about the mechanism for SGA birth in contradistinction to preterm birth or LBW is related to mothers living in violent neighborhoods during pregnancy.

F. Discussion

In summary, in this prospective cohort study among Hispanic prenatal care patients, we found no significant association between overall and violent neighborhood crime and preterm birth and LBW. There likewise was no association between overall neighborhood crime and SGA. However, we observed a positive association between violent neighborhood crime and SGA both when measured continuously and in quartiles. When measured continuously, violent neighborhood crime was associated with 1.5 times higher odds of SGA (95% CI: 1.03-2.20) when adjusted for smoking before pregnancy, smoking during early pregnancy, education levels, parity, age of the mother, pre-pregnancy BMI, and gestational weight gain. Women who lived in the highest quartile of violent neighborhood crime had over twice the odds of SGA (OR: 2.1, 95% CI: 1.2-3.4, p-trend = 0.0037) compared to women who lived in the lowest quartile of violent neighborhood crime when adjusted for smoking before pregnancy, education levels, age of the mother, and pre-pregnancy BMI.

We did not see a significant association with preterm birth or LBW for women who lived in areas with high overall neighborhood crime. No prior studies examined this relationship.

No previous studies examined the relationship between overall neighborhood crime and preterm birth. However, three prior studies examined the relationship between violent neighborhood crime and preterm birth (10, 42, 55). Consistent with our analysis, all three studies found no significant association between preterm birth and violent crime [OR 1.1, 95% CI 0.8-1.6 (10); OR 1.4, 95% CI 1.0-2.1 (42) OR 1.05, 95% CI 0.96-1.13 (55)]. Two of the three studies (10, 42) only included non-Hispanic White and non-Hispanic Black women while the third study took place in Scotland among non-Hispanic White women (55). One of the US-based studies used multiple measures of neighborhood crime - count and rate within census block group, and proximal crime occurring within 0.5 mile of where participants lived using data from local police departments with the highest tertile as the cut point for high crime (10). The second US-based study used crime reports from a police department adjusting for population density by census block group with the highest

quartile as the cut point for high crime (42). Clemens et al. used the Scottish Index of Multiple Deprivation as a measure of crime (55).

No studies examined the association between overall neighborhood crime and LBW. However, two studies examined the association between violent neighborhood crime and LBW (10, 55). Consistent with our study, one study showed no significant association between violent neighborhood crime and LBW [OR 1.1, 95% CI 0.8-1.6 (10)]. This study was much larger than ours (n=21,881 women, 0% Hispanic) and used multiple measures of neighborhood crime - count and rate within census block group, and proximal crime occurring within 0.5 mile of where participants lived using data from local police departments with the highest tertile as the cut point for high crime (10). The second study showed a slight positive association between violent neighborhood crime and LBW [OR 1.15, 95% CI 1.01-1.31 (55)]. Violent neighborhood crime in this study used the Scottish Index of Multiple Deprivation (55).

We observed that overall neighborhood crime did not have an association with SGA births in this population, however, the suggestion of an association existed given the positive p-trend for overall neighborhood-crime when measured in quartiles. There were no prior studies that examined overall neighborhood crime and SGA.

We found that violent neighborhood crime was positively associated with SGA when measured continuously and in quartiles. Women who lived in the highest quartile of violent crime had over twice the odds of SGA (OR: 2.1, 95% CI: 1.2-3.4, p-trend 0.0037) compared to women who lived in the lowest quartile of violent neighborhood crime when adjusted for smoking before pregnancy, education levels, age of the mother, and pre-pregnancy BMI. Two prior studies examined the association between violent neighborhood crime and SGA (55, 59) among n=21,881 women (0% Hispanic) and 55,130 women, (28.89% Hispanic) respectively. Consistent with our study, both studies showed a positive association between violent neighborhood crime (measured continuously) and SGA [OR 1.09, 95% CI 1.02-1.16, (55); OR 1.20, $p<0.05$ – no CI reported (59)], however our

effect estimate was higher than both studies. Clemens et al. used the Scottish Index of Multiple Deprivation as a measure of crime (55). Masi et al. calculated crime rate in the city of Chicago and log-transformed the rates (59). Masi et al. reported specifically on Hispanic women (59) but did not specify by Hispanic ethnic group.

1. Limitations

Potential limitations of this study include nondifferential misclassification of exposure, clustering, selection bias, information bias, confounding, and generalizability.

a. Nondifferential misclassification of exposure

Neighborhood crime was calculated based on information about the location of participants' home address at the time of enrollment into the study. Women who moved soon after giving their informed consent, or at any time throughout the study, could live in a different neighborhood than the one used for analysis and therefore be exposed to a different level of neighborhood crime for all or part of their pregnancy. This could result in a nondifferential misclassification of exposure because it is related solely to the exposure and not the outcome. If this occurred, it would bias the observed association toward the null. However, we do not believe it to be incredibly likely that a woman moves neighborhoods in a way that drastically changes her neighborhood crime level so we believe this to be a small likelihood.

b. Clustering

Clustering could occur if there were not a broad enough swath of neighborhoods in the study. If clustering occurred, it would result in a loss of power. We performed a sensitivity analysis to determine if clustering occurred in this dataset and no clustering was present.

c. Ecological Elements

Because we were using an ecological element to our exposure, neighborhood crime and violent neighborhood crime not individual crime or individual violent crime victimization, there is a

possibility that neighborhood crime or violent neighborhood crime is not the direct cause of the adverse birth outcomes. The aim of this study was to determine if living in a neighborhood with high overall or violent crime, not individual-level crime victimization, had an effect on birth outcomes.

d. Selection Bias

Selection bias is possible but unlikely in this study. This study was a prospective cohort study and women would have to have differential loss to follow-up in order for selection bias to occur. While unlikely, it is not impossible. One plausible scenario would be if women who lived in a high crime neighborhood were more likely to miss their prenatal visits because they were unable to get to the visits and for that reason they were also less likely to deliver at the hospital. If these women also had higher rates of adverse birth outcomes as a result of being unable to focus on their health due to neighborhood crime concerns, this could result in an underestimate of the odds ratio. This scenario is unlikely because if women fit the described situation, they would not have been recruited into the study in the first place.

e. Confounding

Many potential confounding variables were measured. However, there were two scenarios where confounding could still have an effect on the association. The first scenario is residual confounding and missingness. Confounders were collected for all women but not all women answered all questions relating to confounders. Some variables, such as income, had large levels of missingness. This could result in residual confounding still existing within the data even though the confounder was adjusted. The second scenario relates to uncollected confounders. We did not have information on individual food access. Individual food insecurity is positively associated with minority neighborhoods (96), neighborhood poverty (114), and adverse birth outcomes (11, 66, 72). However, we were unable to control for this due to restrictions in data collection. This could result in an overestimate of the odds ratio of the relationship between neighborhood crime and adverse birth outcomes. We also did not have information on individual-level crime victimization. Whether a

woman was the victim of a crime could be associated with the level of neighborhood crime or violent neighborhood crime and also adverse birth outcomes. This scenario could result in an overestimate of the odds ratio of the odds ratio of the relationship between neighborhood crime and adverse birth outcomes.

f. Generalizability

Findings may not be generalizable to women of different races or ethnicities. These adverse birth outcomes have different rates among different racial and ethnic populations, so it is plausible that the association may differ by race or ethnicity. Findings may not be generalizable to women who are at significantly different levels of neighborhood crime than those in this study. For example, women in other regions may be living in much safer or much more dangerous neighborhoods and getting a different "dose" of neighborhood crime.

g. Threshold Effect

Neighborhood crime and violent neighborhood crime in this study are measured using an index variable. Our variables measure the amount of neighborhood crime compared to the national average of neighborhood crime or violent neighborhood crime instead of absolute instances of neighborhood or violent neighborhood crime. If there is a correlation between the absolute number of instances of neighborhood crime and adverse birth outcomes, our index measure would be unable to detect that.

h. Overall Likely Impact of Limitations

Overall, the likely impact of these limitations trends toward a bias toward the null. This means that for our significant result, the likely magnitude is possibly higher than what we report. However, we have two outcome measures (preterm birth and LBW) for which we see no significant association. This could be a result of the biases within this study. Because of these biases, it is possible that we did not fully accomplish our goal. No study is perfect, but this study does still

provide value in spite of the potential limitations. This study significantly added to the research by examining preterm birth, LBW, and SGA together and doing so specifically in Puerto Rican women when previously no research examined Hispanic women in this context and no studies at all examined a subgroup of Hispanic women.

i. Adverse Birth Outcome Measures

Preterm birth, LBW, and SGA are three outcome measures that are regularly used in prior literature as a proxy for prematurity. No single factor alone is enough to determine if a child has experienced prematurity. A child could be born preterm, but not have LBW or SGA. A child could be born with LBW but not be born preterm or have SGA. And a full-term infant could be born with SGA and not have LBW. An infant can be born with one, two, all three, or none of these factors and each factor can have a different effect on their overall health in the short-term and the long-term. By looking at all three risk factors, we are able to try to get a bigger picture of potential issues that a child may face in life.

j. Policy Implications

The lack of association for overall neighborhood crime and the persistent association between violent neighborhood crime suggests that not all crime is created equally when it comes to stress, particularly in expectant mothers. It is plausible to think that violent neighborhood crimes have higher levels of stress than non-violent neighborhood crimes, especially for this vulnerable population. Policy makers could use this information to target areas with excess violent crime. Using resources to lower levels of crime in areas where violent crime is high would serve multiple purposes. It could not only reduce the violent crime in those areas but also improve the health and wellbeing of the community, specifically expectant mothers and their babies.

G. Conclusion

We found no association between overall and violent neighborhood crime and preterm birth and LBW, or between overall neighborhood crime and SGA. There was a positive association between violent neighborhood crime and SGA both when measured continuously and in quartiles. Violent neighborhood crime was associated with 1.5 times higher odds of SGA when adjusting for smoking before pregnancy, smoking during early pregnancy, education levels, parity, age of the mother, pre-pregnancy BMI, and gestational weight gain. Women who lived in the highest quartile of violent neighborhood crime had over twice the odds of SGA compared to women who lived in the lowest quartile of violent neighborhood crime when adjusting for smoking before pregnancy, education levels, age of the mother, and pre-pregnancy BMI. Violent neighborhood crime is a future area rife with possibility for future research, particularly for SGA.

APPENDIX A

TABLES FOR CHAPTER II

Table 1: Variable Categorization Table		
Name	**Description**	**Type**
Outcome Variables		
PRETERM	Preterm Birth (Dichotomous)	Dichotomous
	0=No	
	1=Yes	
LBW	Low Birth Weight (Dichotomous)	Dichotomous
	0=No	
	1=Yes	
SGA	Small-for-Gestational Age (Dichotomous)	Dichotomous
	0=No	
	1=Yes	
Exposure Variables		
QU1	Neighborhood Poverty	Categorical
	0=1st quartile	
	1=2nd quartile	
	2=3rd quartile	
	3=4th quartile	
FPL10	Neighborhood Poverty (Continuous)	Continuous
POVYNQ	Neighborhood Poverty (Dichotmous)	Dichotomous
Covariates		
married	Marital Status	Categorical
	1= Single/Separated/Divorced/Widowed	
	2=Married	
	3=Refused	
adults	Number of Adults in Household	Categorical
	0=0	
	1=1	
	2=2	
	3=>3	
kids	Number of Children in Household	Categorical
	0=0	
	1=1	
	2=2	
	3=>3	
presmoke	Smoking Before Pregancy	
	0=None	
	1= <=10 cigs/day	
	2= >10 cigs/day	
pregsmoke_early	Smoking During Early Pregnancy	Categorical
	0=None	
	1= <=10 cigs/day	
	2= >10 cigs/day	

pregsmoke_mid	Smoking During Mid-Pregnancy	
	0=None	
	1= <=10 cigs/day	
	2= >10 cigs/day	
pregsmoke_late	Smoking During Late Pregnancy	
	0=None	
	1= <=10 cigs/day	
	2= >10 cigs/day	
pregalc_early	Alcohol Consumption During Early Pregnancy	Dichotomous
	0=no	
	1=yes	
ed	Education	Categorical
	1=Less than high school	
	2=High school graduate or GED	
	3=Post high school	
income	Income	Categorical
	1= <=$15,000	
	2= >$15,000-$30,000	
	3= >$30,000	
	4=don't know/refuse	
eds2_early	Probable Major Depression in Early Pregnancy	Dichotomous
	0=no	
	1=yes	
eds2_mid	Probable Major Depression in mid-Pregnancy	Dichotomous
	0=no	
	1=yes	
eds2_late	Probable Major Depression in Late Pregnancy	Dichotomous
	0=no	
	1=yes	
generation	Generation in US	Categorical
	1=Born in PR/DR	
	2=Parent born in PR/DR	
	3=Grandparent born in PR/DR	
parity	Parity	Categorical
	0=0 live births	
	1=1 live birth	
	2=>=2 live births	
age_gp	Age	Categorical
	1=16-19	
	2=20-24	
	3=25-29	
	4=30+	

BMI		BMI		Categorical	
		1=Underweight/Normal Weight			
		2=Overweight			
		3=Obese			
GWG		Gestational Weight Gain		Categorical	
		0= Within Guidelines			
		1= More than Guidelines			
		2= Less than Guidelines			
ACOG_YN		Meeting ACOG Physical Activity Guidelines		Dichotomous	
		0=yes			
		1=no			
Language		Language Preference		Categorical	
		1=English			
		2=Spanish			
acc_status		Acculturation Level		Categorical	
		1= Low (1-3)			
		2= High (>=3)			
pss		Perceived Stress (Total)		Numeric	
		Sum of Perceived Stress Questions			
ta		Trait Anxiety (Total)		Numeric	
		Sum of Trait Anxiety Questions			

Table 2. Number and Percent in Final Sample; Proyecto Buena Salud, 2006-2010		
Original Study Sample	1627	
Excluded		
Miscarriage	138	1489
Stillbirth	133	1356
Missing Info on Address	170	1186
Missing Info for LBW/SGA & Preterm	1	1185
Missing Pregnancy Stage	1	1184
Final Sample Size		1184

Table 3. Distribution of Neighborhood Poverty Proyecto Buena Salud, 2006-2010.

		Range	M(SD)	N
Neighborhood Poverty				
Neighborhood Poverty		% Below FPL		
	1st Quartile	2.1 - 27.3%	23.1% (6.1)	192
	2nd Quartile	29.9 - 43.4%	37.5% (4.5)	284
	3rd Quartile	44 - 65%	52.5% (8.5)	347
	4th Quartile	65.1 - 95.8%	71.2% (5.2)	361
Neighborhood Poverty		(>65%)	Highest Quartile	
	Yes	204	17%	
	No	980	83%	

Table 4. Distribution of Preterm Birth; Proyecto Buena Salud, 2006-2010.				
	N			
Total Preterm Birth				
Yes	119	10.1	%	
No	1065	89.9	%	

Table 5. Distribution of Low Birthweight; Proyecto Buena Salud, 2006-2010.							
		N					
Total LBW							
	Yes	96	8.19	%			
	No	1075	91.8	%			

Table 6. Distribution of SGA; Proyecto Buena Salud, 2006-2010.					
		N			
Total SGA					
	Yes	146	12.5	%	
	No	1025	87.5	%	

Table 7. Distribution of Covariates according to Neighborhood Poverty; Proyecto Buena Salud, 2006-2010.						
		HI Poverty (65%, fourth quartile)		Not HI Poverty (<65%		p-value
		N	%	N	%	
Marital Status						0.8354
	Single/Separated/Divorced/Widowed	178	87.30%	746	76.10%	
	Married	22	10.70%	95	9.70%	
	Refused	4	1.90%	22	2.24%	
	Missing	0	0.00%	117	11.90%	
Number of Adults in Household		col %				
	1	32	15.70%	243	24.80%	0.0003
	2	101	49.50%	415	42.30%	
	3+	71	34.80%	205	20.90%	
	Missing	0	0.00%	117	11.90%	
Number of Children in Household						<0.0001
	0	10	4.90%	190	19.40%	
	1	63	30.90%	314	32.00%	
	2	71	34.80%	188	19.10%	
	3+	57	27.90%	154	15.70%	
	Missing	3	1.47%	134	13.70%	
Smoking Before Pregnancy						
	None	131	64.20%	588	60.00%	0.0331
	<=10 cigarettes per day	43	21.10%	217	22.10%	
	>10 cigarettes per day	26	12.70%	69	7.00%	
	Missing	4	1.96%	106	10.80%	
Smoking During Pregnancy 1st trimester						
	None	122	59.80%	529	53.98%	0.0996
	<=10 cigarettes per day	25	12.30%	74	7.60%	
	>10 cigarettes per day	1	0.49%	8	0.80%	
	Missing	56	27.50%	369	37.70%	
Smoking During Pregnancy 2nd trimester						
	None	100	49%	477	48.70%	
	<=10 cigarettes per day	18	8.80%	59	6%	
	>10 cigarettes per day	0	0%	5	0.50%	
	Missing	86	42.20%	439	44.80%	
Smoking During Pregnancy 3rd trimester						
	None	112	54.90%	474	48.40%	
	<=10 cigarettes per day	12	5.90%	53	5.40%	
	>10 cigarettes per day	1	0.49%	5	0.50%	
	Missing	79	38.70%	448	45.70%	
Alcohol Consumption During Pregnancy, 1st trimester						FISHERS
	No	143	70.10%	596	60.80%	0.1267
	Yes	6	2.90%	15	1.50%	
	Missing	55	26.96%	369	37.70%	
Alcohol Consumption During Pregnancy, 2nd trimester						
	No	118	57.80%	528	53.90%	
	Yes	0	0.00%	7	0.70%	
	Missing	86	42.20%	445	45.40%	
Alcohol Consumption During Pregnancy, 3rd trimester						
	No	126	61.80%	523	53.40%	
	Yes	0	0.00%	8	0.80%	
	Missing	78	38.20%	449	45.80%	
Education						0.216
	Less than high school	110	53.90%	414	42.20%	
	High school graduate or GED	63	30.90%	286	29.20%	
	Post-high school	31	15.40%	171	17.40%	
	Missing	0	0%	109	11.10%	
Income						
	<=$15,000	61	29.90%	251	25.60%	0.018
	>$15,000 - $30,000	36	17.60%	127	12.96%	
	>$30,000	4	1.96%	65	6.60%	
	Don't know/refuse	101	49.50%	409	41.70%	
	Missing	2	0.98%	118	12.00%	
Probable Major Depression in Early Pregnancy						
	No	113	55.40%	498	50.80%	0.5313
	Yes	31	15.20%	99	10.10%	
	Missing	60	29.40%	383	39.10%	
Probable Major Depression in Mid Pregnancy						
	No	97	47.50%	429	43.80%	
	Yes	19	9.30%	99	10.10%	
	Missing	88	43.10%	452	46.10%	

Probable Major Depression in Late Pregnancy						
	No	110	53.90%	463	47.20%	
	Yes	15	7.40%	62	30.40%	
	Missing	79	38.70%	455	46.40%	
Generation in US						
	Born in PR/DR	101	49.50%	433	44.20%	0.1281
	Parent born in PR/DR	91	44.60%	454	46.30%	
	Granparent born in PR/DR	4	1.96%	62	6.30%	
	Missing	8	3.90%	31	3.20%	
Parity						
	0 live births	70	34.30%	409	41.70%	0.0009
	1 live birth	56	27.50%	201	20.50%	
	2+ live births	78	38.20%	267	27.20%	
	Missing	0	0%	3	0.31%	
Age						
	16-19	65	28.40%	293	31.60%	0.3075
	20-24	101	44.10%	357	38.50%	
	25-29	41	17.90%	159	17.20%	
	30+	22	9.60%	118	12.70%	
	Missing					
BMI						
	Underweight	14	6.10%	60	6.50%	0.7188
	Normal Weight	116	50.40%	432	47.10%	
	Overweight	54	23.50%	212	23.10%	
	Obese	46	20%	213	23.30%	
	Missing					
Gestational Weight Gain						
	Within Guidelines	59	28.90%	250	25.50%	0.3743
	More than Guidelines	89	43.60%	463	47.20%	
	Less than Guidelines	48	23.50%	192	19.60%	
	Missing	8	3.90%	75	7.70%	
Meeting ACOG Physical Activity Guidelines, Part 1						0.1249
	Yes	107	52.50%	411	41.90%	
	No	43	21.10%	211	21.50%	
	Missing	54	26.50%	358	36.50%	
Meeting ACOG Physical Activity Guidelines, Part 2						
	Yes	45	22.10%	206	21.00%	
	No	76	37.30%	356	36.30%	
	Missing	83	40.70%	418	42.70%	
Meeting ACOG Physical Activity Guidelines, Part 3						
	Yes	42	20.60%	202	20.60%	
	No	82	40.20%	325	33.20%	
	Missing	80	39.20%	453	46.20%	
Language Preference						
	English	133	65.20%	714	72.90%	0.0525
	Spanish	57	27.90%	212	21.60%	
	Missing	14	6.90%	54	5.50%	
Acculturation Level						
	Low	151	74.00%	651	66.40%	0.7598
	High	39	19.10%	170	17.30%	
	Missing	14	6.90%	159	16.20%	
Perceived Stress, 1st trimester (Total)						
	Mean (SD)	26.22	7.005	26.19	7.036	
Perceived Stress, 2nd trimester (Total)						
	Mean (SD)	26.08	8.31	25.16	7.15	
Perceived Stress, 3rd trimester (Total)						
	Mean (SD)	23.54	7.56	23.27	7.79	
Trait Anxiety (Total)						
	Mean (SD)	39.49	10.28	39.55	10.38	

Table 8. Distribution of Covariates According to Preterm Birth, LBW, and SGA; Proyecto Buena Salud, 2006-2010.

		Preterm Birth					LBW					SGA				
		No		Yes			No		Yes			No		Yes		
		N	%	N	%	p-value	N	%	N	%	p-value	N	%	N	%	p-value
Marital Status																
	Single/Separated/Divorced/Widowed	841	79.00%	83	69.70%	0.1348	845	78.60%	71	74%	0.7601	801	78.10%	115	78.80%	0.072
	Married	100	9.40%	17	14.30%		107	9.95%	9	9.40%		104	10.10%	12	8.20%	
	Refused	24	2.30%	2	1.70%		23	2.10%	3	3.10%		19	1.90%	7	4.80%	
	Missing	100	9.40%	17	14.30%		100	9.30%	13	13.50%		101	9.90%	12	8.20%	
Number of Adults in Household																
	0	0	0%	0	0%	0.7447	0	0%	0	0%	0.3223					0.5011
	1	252	23.70%	23	19.30%		250	23.30%	23	24.00%		242	23.60%	31	21.20%	
	2	464	43.60%	52	43.70%		477	44.40%	34	35.40%		446	44%	65	44.50%	
	3+	249	23.40%	27	22.70%		248	23.10%	26	27.10%		236	23.00%	38	26.00%	
	Missing	100	9.40%	17	14.30%		100	9.30%	13	13.50%		101	9.90%	12	8.20%	
Number of Children in Household																
	0	182	17.10%	18	15.10%	0.6584	184	17.10%	16	16.70%	0.5267	172	16.80%	28	19.20%	0.2649
	1	346	32.50%	31	26.10%		350	32.60%	23	24.00%		335	32.70%	36	24.70%	
	2	229	21.50%	30	25.20%		234	21.80%	24	25.00%		223	21.80%	35	24.00%	
	3+	191	18%	20	16.80%		189	17.60%	18	18.80%		176	17.20%	31	21.20%	
	Missing	117	11%	20	16.80%		118	11%	15	15.60%		119	11.60%	14	9.60%	
Smoking Before Pregnancy																
	None	655	61.50%	64	53.80%	0.2584	661	61.50%	51	53%	0.1255	635	62.00%	77	52.70%	0.0029
	<=10 cigarettes per day	230	21.60%	30	25.20%		232	21.60%	27	28.10%		223	21.80%	36	24.70%	
	>10 cigarettes per day	89	8.40%	6	5.00%		90	8%	4	4.20%		73	7.10%	21	14.40%	
	Missing	91	8.50%	19	16.00%		92	8.60%	14	14.60%		94	9.20%	12	8.20%	
Smoking During Pregnancy																
	None	581	54.60%	70	58.80%	0.2738	594	55.30%	51	53.10%	0.6364	574	56.00%	71	48.60%	0.04
	<=10 cigarettes per day	86	8.10%	13	10.90%		92	8.60%	7	7%		83	8.10%	16	11%	
	>10 cigarettes per day	9	0.80%	0	0%		8	1%	1	1.00%		6	0.60%	3	2.10%	
	Missing	389	36.50%	36	30.30%		381	35.40%	37	38.50%		362	35.30%	56	38.30%	
Alcohol Consumption During Pregnancy																
	No	660	62%	79	66.40%	0.095	675	62.80%	58	60.40%	0.2831	643	62.80%	90	61.60%	0.1722 Fishers
	Yes	17	2%	4	3.40%	Fishers	19	1.80%	2	2.10%	Fishers	20	2.00%	1	0.70%	
	Missing	388	36.40%	36	30.30%		381	35.40%	36	37.50%		362	35.30%	55	37.70%	
Education																
	Less than high school	473	44.40%	51	42.90%	0.6835	477	44.40%	42	44%	0.4416	438	42.70%	81	56%	0.0162
	High school graduate or GED	314	29.50%	35	29.40%		317	29.50%	30	31.30%		315	30.70%	32	21.90%	
	Post-high school	186	17.50%	16	13.40%		189	17.60%	11	11.50%		179	17.40%	21	21.90%	
	Missing	92	8.60%	17	14.30%		92	8.60%	13	13.50%		93	9.10%	12	8.20%	
Income																
	<=$15,000	294	27.60%	28	23.50%	0.8374	299	27.80%	21	21.90%	0.4758	277	27.00%	43	29.50%	0.2083
	>$15,000 - $30,000	148	13.90%	15	12.60%		151	14.00%	12	12.50%		146	14%	17	11.60%	
	>$30,000	63	5.90%	6	5.00%		65	6.00%	3	3.10%		64	6.20%	4	2.70%	
	Don't know/refuse	457	42.90%	53	44.50%		458	42.60%	46	47.90%		435	42.50%	69	47.30%	
	Missing	103	9.70%	17	14.30%		102	9.50%	14	14.60%		103	10%	13	8.90%	
Probable Major Depression in Pregnancy																
	No	541	51%	70	58.80%	0.7144	556	51.70%	50	52.10%	0.9683	537	52.40%	69	47.30%	0.0471
	Yes	119	11%	11	9.20%		122	11.30%	8	8.30%		110	10.70%	20	13.70%	
	Missing	405	38%	38	31.90%		397	36.90%	38	39.60%		378	36.90%	57	39%	
Generation in US																
	Born in PR/DR	472	44.30%	62	52.10%	0.2862	483	44.90%	45	46.90%	0.5107	469	45.80%	59	40.40%	0.3586
	Parent born in PR/DR	496	46.60%	49	41.20%		494	45.90%	47	49.00%		465	45.40%	76	52.10%	
	Granparent born in PR/DR	61	5.70%	5	4.20%		63	5.90%	3	3.10%		58	5.70%	8	5.50%	
	Missing	36	3.40%	3	2.50%		35	3.30%	1	1%		33	3.20%	3	2.10%	
Parity																
	0 live births	431	40.50%	48	40.30%	0.6709	428	39.80%	45	46.90%	0.396	396	38.60%	77	52.70%	0.0052
	1 live birth	325	30.50%	32	26.90%		329	30.60%	25	26%		320	31.20%	34	23.30%	
	2+ live births	307	28.80%	38	31.90%		315	29.30%	26	27.00%		306	30%	35	24%	
	Missing	2	0.19%	1	1.70%		3	0.30%	0	0%		3	0.30%	0	0.00%	
Age																
	16-19	319	30.70%	39	33%	0.1468	321	29.90%	31	32.30%	0.5202	305	29.70%	47	32.2%	0.1635
	20-24	422	40.70%	36	30.50%		422	39.30%	32	33.30%		390	38.00%	64	43.80%	
	25-29	176	17%	24	20.30%		183	17.00%	15	15.60%		178	17.40%	20	12.70%	
	30+	121	11.70%	19	16.10%		125	11.60%	15	15.60%		129	12.60%	11	7.50%	
	Missing	0	0.00%	0	0%		0	0%	0	0%		0	0%	0	0%	
BMI																
	Underweight	64	6.20%	10	8.40%	0.2606	64	6.00%	8	8.30%	0.3916	56	5.50%	16	11.00%	0.0326
	Normal Weight	498	48.30%	50	42.00%		493	45.90%	49	51.00%		471	46.00%	71	48.60%	
	Overweight	232	22.50%	34	28.60%		244	22.70%	19	19.80%		234	22.80%	29	19.90%	
	Obese	236	22.90%	23	19.30%		241	22.40%	16	16.70%		232	22.60%	25	17.10%	
	Missing	0	0%	2	1.70%		0	0%	0	0%		0	0%	0	0%	
Gestational Weight Gain																
	Within Guidelines	271	25.40%	38	31.90%	<0.0001	272	25.30%	33	34.40%	<0.001	258	25.20%	47	32.20%	0.0004
	Less than Guidelines	203	19.10%	37	31.10%		203	18.90%	33	34.40%		193	18.80%	43	29.50%	
	More than Guidelines	521	48.90%	31	26.10%		526	48.90%	22	23%		499	48.70%	49	33.60%	
	Missing	70	6.60%	13	10.90%		74	6.90%	8	8.30%		75	7.30%	7	4.80%	
Meeting ACOG Physical Activity Guidelines						0.0253					0.0371					0.5932
	No	471	44.20%	47	39.50%		480	44.70%	35	36.50%		453	44.20%	62	42.50%	
	Yes	216	20.30%	38	31.90%		228	21.20%	24	25.00%		223	21.80%	29	19.90%	
	Missing	378	35.50%	34	28.60%		367	34.10%	37	38.50%		349	34.00%	55	37.70%	
Language Preference																
	English	764	71.70%	83	69.70%	0.3215	772	71.80%	64	66.70%	0.2145	734	72%	102	69.90%	0.4997
	Spanish	237	22.20%	32	26.90%		242	22.50%	27	28.10%		232	23%	37	25.30%	
	Missing	64	6%	4	3.40%		61	5.70%	5	5.20%		59	5.80%	7	4.80%	
Acculturation Level																
	Low	726	68.20%	76	63.90%	0.1794	735	68.40%	60	62.50%	0.3418	695	67.80%	100	68.50%	0.5735
	High	196	18.40%	13	10.90%		196	18.20%	12	12.50%		183	17.90%	25	17.10%	
	Missing	143	13.40%	30	25.20%		144	13.40%	24	25%		147	14.30%	21	14.40%	
Perceived Stress (Total)																
	Mean (SD)	26.19		26.21		0.6568	26.21		26.22		0.4928	26.18		26.39		0.5467
		7.019		7.12			7.05		7.05			7.07		6.9		
Trait Anxiety (Total)																
	Mean (SD)	39.58		39.14		0.7049	39.59		39.57		0.8012	39.5		40.23		0.4771
		10.34		10.48			10.31		11.18			10.37		10.42		

Table 9a. Unadjusted and Adjusted Relative Risks and Confidence Intervals for Neighborhood Poverty and Preterm Birth; Proyecto Buena Salud, 2006-2010.

				Preterm Birth					
		Cases		Unadjusted		Adjusted (BMI, age)		Adjusted (presmoke, age, bmi)	
			(%)	OR	95% CI	OR	95%CI	OR	95%CI
Neighborhood Poverty		119	10%	0.95	(0.787-1.148)	0.939	(0.776-1.136)		
Neighborhood Poverty									
	1st Quartile	17	8.80%	1.0	Referent	1	Referent	1.0	Referent
	2nd Quartile	35	12.30%	**0.576**	**(0.338-0.983)**	0.598	(0.349-1.024)	0.633	(0.361-1.11)
	3rd Quartile	26	7.40%	0.912	(0.564-1.474)	0.953	(0.586-1.550)	1.045	(0.613-1.783)
	4th Quartile	41	11.40%	0.691	(0.375-1.273)	0.722	(0.990-1.066)	0.759	(0.403-1.431)
Neighborhood Poverty									
	Dichotomous	119	10%	0.909	(0.557-1.483)	0.914	(0.559-1.493)	0.94	(0.429-2.060)
	***								
	Adjusted: FPL10		none						
	Adjusted: qu1		presmoke, education, acc status, age, bmi, (pss1+pss3)						
	Adjusted: Dichotomous		age, bmi, pss1, pss2						

Table 9b. Unadjusted and Adjusted Relative Risks and Confidence Intervals for Neighborhood Poverty and LBW; Proyecto Buena Salud, 2006-2010.

				LBW					
		Cases		Unadjusted		Adjusted (BMI, age)		Adjusted	
		N=1172	(%)	OR	95% CI	OR	95%CI	OR	95%CI
Neighborhood Poverty		96	8.20%	1.005	(0.816-1.239)	1.003	(0.812-1.237)		
Neighborhood Poverty									
	1st Quartile	16	8.40%	1.0	Referent	1	Referent	1.0	Referent
	2nd Quartile	26	9.30%	0.668	(0.370-1.207)	0.693	(0.381-1.26)	0.772	(0.418-1.425)
	3rd Quartile	22	6.40%	0.969	(0.563-1.667)	0.996	(0.574-1.729)	1.208	(0.674-2.167)
	4th Quartile	32	9%	0.907	(0.473-1.741)	0.939	(0.486-1.816)	1.049	(0.537-2.052)
Neighborhood Poverty									
	Dichotomous	96	8.20%	0.966	(0.559-1.669)	0.99	(0.571-1.715)	0.597	(0.248-1.436)
Adjusted: FPL10		none							
Adjusted: qu1		presmoke, income, acc_status, age, bmi (pss1, pss2, pss3)							
Adjusted: Dichotomous		pss1, pss2, age, bmi							

Table 9b. Unadjusted and Adjusted Relative Risks and Confidence Intervals for Neighborhood Poverty and LBW; Proyecto Buena Salud, 2006-2010.

				LBW					
		Cases		Unadjusted		Adjusted (BMI, age)		Adjusted	
		N=1172	(%)	OR	95% CI	OR	95%CI	OR	95%CI
Neighborhood Poverty		96	8.20%	1.005	(0.816-1.239)	1.003	(0.812-1.237)		
Neighborhood Poverty									
	1st Quartile	16	8.40%	1.0	Referent	1	Referent	1.0	Referent
	2nd Quartile	26	9.30%	0.668	(0.370-1.207)	0.693	(0.381-1.26)	0.772	(0.418-1.425)
	3rd Quartile	22	6.40%	0.969	(0.563-1.667)	0.996	(0.574-1.729)	1.208	(0.674-2.167)
	4th Quartile	32	9%	0.907	(0.473-1.741)	0.939	(0.486-1.816)	1.049	(0.537-2.052)
Neighborhood Poverty									
	Dichotomous	96	8.20%	0.966	(0.559-1.669)	0.99	(0.571-1.715)	0.597	(0.248-1.436)
Adjusted: FPL10		none							
Adjusted: qu1		presmoke, income, acc_status, age, bmi (pss1, pss2, pss3)							
Adjusted: Dichotomous		pss1, pss2, age, bmi							

Table 10. Power to Detect an Effect of Neighborhood Poverty on Pretem Birth for a Range of Relative Risks with 95% Confidence; Proyecto Buena Salud, 2006-2010

Relative Risk	Power
1.7	94%
1.6	86.10%
1.55	80%
1.5	73.60%
1.4	55.30%

Table 11. Literature Review Table.

Author	Year	Study Design	Race/Ethnicity	Location	Exposure - tool	Exposure - measured	Outcome -tool	Outcome - measured	Direction	magnitude	Relevant confounders?
Bloch	2011	Cohort	Black/White	Philadelphia	Crime Stats Database 2004	Aggravated assault w gun	birth records	Preterm Birth (<37 weeks)	+	p < 0.0001 difference b/w	
		(retrospective)	Not Hispanic		(Philly PD Public Records)	domestic abuse				neighborhood categories	
											worse neighborhoods had most
											PTB but not linear relationship
Messer	2006	Cohort	non-hispanic	Raleigh, NC	City of Raleigh NC crime reports	Neighborhood-level crime:	Birth records	PTB: <37 weeks & weighs		White Women || Black women referent -- low	individual (maternal age, education,
et al		(retrospective)	Black/White			count and rate in block group		<3,888 g [<1% missing]		*PTB / LBW violent crime w/in 0.5 mi*	marital status)
						separated into tertiles		LBW: <2500 g [no missing]	~	Med: 1.0 (0.8, 1.3) // 1.0 (0.7, 1.4) || 0.9 (0.7, 1.2) // 0.9 (0.6, 1.1)	neighborhood level (deprivation
						Proximal crime: count of crime			~	High: 1.1 (0.8, 1.6) // 1.0 (0.7, 1.5) || 0.9 (0.7, 1.3) // 1.0 (0.7, 1.3)	score)
						w/in 0.5 mi radius & distance in feet				*PTB / LBW distance in feet*	
						to nearest crime			~	Med: 1.1 (0.9, 1.5) // 0.9 (0.7, 1.2) || 1.1 (0.9, 1.4) // 1.0 (0.7, 1.3)	
									~	Far: 1.1 (0.9, 1.5) // 1.0 (0.7, 1.3) || 0.9 (0.7, 1.2) // 0.9 (0.7, 1.1)	
										PTB / LBW violent crime count	
									~ | ++	Med: 0.9 (0.8, 1.2) // 1.0 (0.8, 1.3) || 1.7 (1.2, 2.4) // 1.6 (1.1, 2.4)	
									~	High: 1.1 (0.8, 1.5) // 1.0 (0.7, 1.4) || 1.2 (0.9, 1.8) // 1.2 (0.8, 1.7)	
										PTB / LBW violent crime rate	
									~ | +~	Med: 1.0 (0.7, 1.2) // 1.0 (0.7, 1.3) || 1.3 (1.0, 1.8) // 1.2 (0.9, 1.7)	
									~+ | ~	High: 1.3 (0.9, 1.9) // 1.5 (1.0, 2.3) || 1.1 (0.8, 1.6) // 1.2 (0.8, 1.7)	
Clemens	2016	Cohort	White (Scottish)	Scotland	Scottish Index of Multiple	Crime across Scotland as total	Scottish Longitudinal Study	PTB: moderate (32-36 wk),	null	Moderately PTB - 1.05 (0.96, 1.13)	
et al		(prospective)		2006-2009	Deprivation - crime domain	violent crime and rates	census records	very (<32 wk)	null	Very PTB - 0.91 (0.75, 1.09)	
							administrative data	SGA: lowest decile for sex	+	LBW - 1.15 (1.01, 1.31)	
								at gestational age	+	SGA - 1.09 (1.02, 1.16)	
								LBW: <2500 g			
Kane	2011	retrospective	White, black, hispanic	Washington,	Violent Crime data from MPD	tract-level violent crime counts	Birth files from DOH	Birthweight - continuous		Hispanic	% black, % in poverty, % female HOH
		hierarchical		D.C.	Census bureau	(homicide, rape, robbery, assault w				Birthweight: 2106.68 (t = 25.67)	with children, % public assistance,
		analysis?		2000-2002		deadly weapon)				Structural disadvantage: -98.34 (p <0.1)	% 25+ w/o hs diploma, % immigrant,
						violence "uncertainty"				Crime: -1.81 (p < 0.01)	%Latino, count of hospitals, count
										Disadvantage x total crime: -0.12 (p < 0.1)	of schools, libraries, rec facilities,
										Disadvantage x violence uncertainty: -20.21 (p < 0.01)	places of worship, senior centers
										Intercept: 3218.30 (p < 0.01), Level 1 Residual 37575.64 (p < 0.01)	
Messer	2005	Cohort	non-Hispanic black/white	Wake County,	Raleigh crime reports (1999-2001)	biolent, theft, property, vice	Birth Records	PTB: <37 wk & <3,888 g		Violent crime Rate: white || Black, referent = low	Individual: maternal age, race,
et al		(retrospective)		NC		population density-adjusted block-		<1% missing data	~/~+	Medium: 0.9 (0.7 - 1.1) || 1.3 (0.9 - 1.9)	education, marital status.
				1999-2001		group crime rates in quartiles			~/~	High: 1.0 (0.8 - 1.4) || 1.2 (0.9 - 1.7)	neighborhood: deprivation score,
									~+/+	Very High: 1.5 (0.9 - 2.6) || 1.4 (1.0 - 2.1)	police substation locatin
Auger et	2008	Cohort	Not specified but in Montreal	Montreal,	Montreal Police District report for	total crimes committed, violent	Birth registry	SGA - below 10th percent for birth		Neighborhood Perception Index (high = favorable, low = referent)	maternal age, education, marital
al		(retrospective)		Quebec	Crimes	crimes, theft, vice.		weight within gestational age by sex	-	High: beta = -0.15 (SE: 0.057)	status, county of birth (CA or else),
				1997-2001	Random digit dial survey	1997 phone survey by research dept		for Canadian referent values	-	High-int: beta = -0.11 (SE: 0.055)	birth year of baby, birth category
						of Montreal PD on neighborhood			-	Intermed: beta = -0.09 (SE: 0.053)	(firstborn or born within <12 mo,
						security perception.			-	Low-int: beta = -0.019 (SE: 0.057)	18-35 mo, >=36 mo
						grouped into quintiles					Immigrant density, deprivation,
											residential stability
Masi et	2007	Cohort	White, Black, Hispanic	Chicago, IL	Chicago Police Department violent	murder, sexual assault, robbery,	Illinois Dept of Public	Birthweight (continuous)		Hispanic	
al		(retrospective)		births in 1991	crime file	aggravated assault	Health Elecronic Birth	Preterm birth (<37 wk gestation)	+	Birthweight: -24.3 (p < 0.05) [more crime = more LBW]	
						calculated rate and log-transformed	Certificate Database	SGA (<10th %ile for Gestational age)	+	Preterm Birth: -0.032 [odds 1.10?]	
									+	SGA: 0.149 (p < 0.05) [odds 1.20]	
Giurgescu	2012	cross-sectional	Black	Chicago, IL	Self-report questionnaire - perceived	Self-reported questionnaires	Clinical diagnosis	Preterm birth (<37 wk gestation)	~	Violent crime: OR - 0.685 (0.30-1.56)	maternal age, gravidity, marital status,
et al				2007	crime	completed 24-72 hours after birth			~	Perceived crime: OR - 1.091 (0.80-1.05)	maternal education, employment,
					Census Bureau- crime	violent crime within a 0.5 mi radius					household income,
Miranda	2012	cohort	white/black/hispanic (adjusted for)	Durham, NC	Crime Analysis Lab of Durham Police	Description, address of all crime.	Birth records	Birth weight (continuous)	~+ish	Birthweight: beta: 3.03 (-10.06, 16.12)	maternal age (categorical), maternal
et al		(retrospective)		2008	Department	assigned a crime count to each		Birth weight %ile (continuous)	~	Birthweight %ile: beta: 0.08 (-0.39, 0.56)	education (categorical), birth order
						census block		Preterm Birth (<37 weeks gestation)	~	PTB: OR - 1.00 (0.94, 1.07)	(1st or >1st), sex, race/ethnicity
								LBW (<2500 g)	~	SGA: OR - 1.00 (0.96, 1.05)	
								SGA (<10th %ile for GA)	~	LBW: OR - 0.99 (0.95, 1.04)	

APPENDIX B

TABLES FOR CHAPTER III

Table 1: Variable Categorization Table

Name	Description	Type	Units
Outcome Variables			
PRETERM	Preterm Birth (Dichotomous)	Dichotomous	
	0=No		
	1=Yes		
LBW	Low Birth Weight (Dichotomous)	Dichotomous	
	0=No		
	1=Yes		
SGA	Small-for-Gestational Age (Dichotomous)	Dichotomous	
	0=No		
	1=Yes		
Exposure Variables			
OVERALL	Neighborhood Crime (Continuous)	Continuous	
OVERALLQ1	Neighborhood Crime (Quartiles)	Categorical	
	0=1st quartile		
	1=2nd quartile		
	2=3rd quartile		
	3=4th quartile		
CRIMERATE	Neighborhood Crime Rate (Continuous)	Continuous	
CRQ1	Neighborhood Crime Rate (Quartiles)	Categorical	
	0=1st quartile		
	1=2nd quartile		
	2=3rd quartile		
	3=4th quartile		
VIOLENT	Neighborhood Violent Crime (Continuous)	Continuous	
VIOLENTQ1	Neighborhood Violent Crime (Quartiles)	Categorical	
	0=1st quartile		
	1=2nd quartile		
	2=3rd quartile		
	3=4th quartile		
VIOLENTRATE	Neighborhood Violent Crime Rate (Continuous)	Continuous	
VRQ1	Neighborhood Violent Crime Rate (Quartiles)	Categorical	
	0=1st quartile		
	1=2nd quartile		
	2=3rd quartile		
	3=4th quartile		
Covariates			
married	Marital Status	Categorical	
	1= Single/Separated/Divorced/Widowed		
	2=Married		
	3=Refused		
adults	Number of Adults in Household	Categorical	
	0=0		
	1=1		
	2=2		
	3=≥3		
kids	Number of Children in Household	Categorical	
	0=0		
	1=1		
	2=2		
	3=≥3		
presmoke	Smoking Before Pregancy		
	0=None		
	1= <=10 cigs/day		
	2= >10 cigs/day		
pregsmoke_early	Smoking During Early Pregnancy	Categorical	
	0=None		
	1= <=10 cigs/day		
	2= >10 cigs/day		
pregsmoke_mid	Smoking During Mid-Pregnancy		
	0=None		
	1= <=10 cigs/day		
	2= >10 cigs/day		
pregsmoke_late	Smoking During Late Pregnancy		
	0=None		
	1= <=10 cigs/day		
	2= >10 cigs/day		

pregalc_early	Alcohol Consumption During Early Pregnancy	Dichotomous
	0=no	
	1=yes	
ed	Education	Categorical
	1=Less than high school	
	2=High school graduate or GED	
	3=Post high school	
income	Income	Categorical
	1= <=$15,000	
	2= >$15,000-$30,000	
	3= >$30,000	
	4=don't know/refuse	
eds2_early	Probable Major Depression in Early Pregnancy	Dichotomous
	0=no	
	1=yes	
eds2_mid	Probable Major Depression in mid-Pregnancy	Dichotomous
	0=no	
	1=yes	
eds2_late	Probable Major Depression in Late Pregnancy	Dichotomous
	0=no	
	1=yes	
generation	Generation in US	Categorical
	1=Born in PR/DR	
	2=Parent born in PR/DR	
	3=Grandparent born in PR/DR	
parity	Parity	Categorical
	0=0 live births	
	1=1 live birth	
	2=>=2 live births	
age_gp	Age	Categorical
	1=16-19	
	2=20-24	
	3=25-29	
	4=30+	
BMI	BMI	Categorical
	1=Underweight/Normal Weight	
	2=Overweight	
	3=Obese	
GWG	Gestational Weight Gain	Categorical
	0= Within Guidelines	
	1= More than Guidelines	
	2= Less than Guidelines	
ACOG_YN	Meeting ACOG Physical Activity Guidelines	Dichotomous
	0=yes	
	1=no	
Language	Language Preference	Categorical
	1=English	
	2=Spanish	
acc_status	Acculturation Level	Categorical
	1= Low (1-3)	
	2= High (>=3)	
pss	Perceived Stress (Total)	Numeric
	Sum of Perceived Stress Questions	
ta	Trait Anxiety (Total)	Numeric
	Sum of Trait Anxiety Questions	

Table 2. Number and Percent in Final Sample; Proyecto Buena Salud, 2006-2010		
Original Study Sample	1627	
Excluded		
Missing information on address	212	13%
Spontaneous or therapeutic abortion or stillbirth	219	13.50%
Missing information on gestational age	1	0.001%
Final Sample Size	1195	

Table 3. Distribution of Neighborhood Crime; Proyecto Buena Salud, 2006-2010.

		Range	M(SD)	N	%
OVERALL	Neighborhood Crime (Continuous)	21-419	219.76 (74.54)		
OVERALLQ1	Neighborhood Crime (Quartiles)				
	0=1st quartile	21-171	117 (40.07)	294	24.70%
	1=2nd quartile	176-228	205.5 (17.44)	303	25.50%
	2=3rd quartile	229-270	247.12 (14.96)	302	25.40%
	3=4th quartile	272-419	310.24 (27.34)	291	24.50%
CRIMERATE	Neighborhood Crime Rate (Continuous)	9.16-787.59	177.27 (103.63)		
CRQ1	Neighborhood Crime Rate (Quartiles)				
	0=1st quartile	9.16-104.41	70.2 (25.2)	293	24.6%
	1=2nd quartile	104.87-159.74	131.21 (17.12)	316	26.60%
	2=3rd quartile	164.36-220.06	188.33 (14.17)	279	23.50%
	3=4th quartile	220.60-787.59	318.46 (88.46)	302	25.40%
VIOLENT	Neighborhood Violent Crime (Continuous)	18-2402	1287.86 (524.10)		
VIOLENTQ1	Neighborhood Violent Crime (Quartiles)				
	0=1st quartile	18-878	544.18 (226.66)	298	25%
	1=2nd quartile	879-1407	1168.6 (148.63)	299	25.10%
	2=3rd quartile	1420-1727	1560.34 (84.44)	293	24.60%
	3=4th quartile	1743-2402	1880.48 (143.1)	300	25.20%
VIOLENTRATE	Neighborhood Violent Crime Rate (Continuous)	7.50-3486.21	1048.7 (682.13)		
VRQ1	Neighborhood Violent Crime Rate (Quartiles)				
	0=1st quartile	7.5-638.51	355.13 (180.54)	296	24.90%
	1=2nd quartile	647.1-839.05	727.53 (60.87)	306	25.70%
	2=3rd quartile	855.81-1389.04	1112.6 (178.04)	285	24.00%
	3=4th quartile	1415.99-3486.21	1991.06 (538.96)	303	25.50%

Table 3. Distribution of Covariates (total); Proyecto Buena Salud, 2006-2010.

		Totals	Percent
Marital Status			
	Single/Separated/Divorced/Widowed	910	89.04
	Married	112	10.96
		1022	
Number of Adults in Household			
	1	270	25.74
	2	505	48.14
	3+	274	26.12
		1049	
Number of Children in Household			
	0	199	19.32
	1	369	35.83
	2	257	24.95
	3+	205	19.90
		1030	
Smoking Before Pregancy			
	None	710	67.23
	<=10 cigarettes per day	255	24.15
	>10 cigarettes per day	91	8.62
		1056	
Smoking During Early Pregnancy			
	None	655	85.96
	<=10 cigarettes per day	98	12.86
	>10 cigarettes per day	9	1.18
		762	
Smoking During Mid-Pregnancy			
	None	170	88.54
	<=10 cigarettes per day	21	10.94
	>10 cigarettes per day	1	0.52
		192	
Smoking During Late Pregnancy			
	None	17	89.47
	<=10 cigarettes per day	2	10.53
	>10 cigarettes per day	0	0.00
Alcohol Consumption During Early Pregnancy			
	No	742	97.25
	Yes	21	2.75
		763	
Education			
	Less than high school	513	48.58
	High school graduate or GED	342	32.39
	Post-high school	201	19.03
		1056	
Income			
	<=$15,000	318	26.72
	>$15,000 - $30,000	160	13.45
	>$30,000	70	5.88
	Don't know/refuse	642	53.95
		1190	
Probable Major Depression in Early Pregnancy			
	No	612	82.26
	Yes	132	17.74
		0	
Probable Major Depression in mid-Pregnancy		0	
	No	145	79.67
	Yes	37	20.33

Ever Depressed?		0		0.00
	No	772		82.04
	Yes	169		17.96
		0		
Generation in US		0		
	Born in PR/DR	526		46.76
	Parent born in PR/DR	534		47.47
	Granparent born in PR/DR	65		5.78
		0		
Parity		0		
	0 live births	486		40.94
	1 live birth	358		30.16
	2+ live births	343		28.90
		0		
Age		0		
	N	1164		
	Mean	91		
	SD	20.2		
		0		
BMI		0		
	N	1155		
	Mean	103.3		
	SD	45.3		
		0		
Gestational Weight Gain		0		
	Within Guidelines	314		28.29
	Less than Guidelines	242		21.80
	More than Guidelines	554		49.91
		0		
Meeting ACOG Physical Activity Guidelines (Early)		0		0.00
	No	521		67.23
	Yes	254		32.77
		0		
Meeting ACOG Physical Activity Guidelines (mid)		125		62.50
	No	75		37.50
	Yes	0		
		0		
Meeting ACOG Physical Activity Guidelines (late)		0		
	No	11		68.75
	Yes	5		31.25
		0		
Language Preference		0		
	English	851		75.85
	Spanish	271		24.15
		0		
Acculturation Level		0		
	Low	798		80.04
	High	199		19.96
		0		
Perceived Stress (Ever)		0		
	No	704		73.95
	Yes	248		26.05
		0		
Trait Anxiety (Ever)		0		
	No	796		76.32
	Yes	247		23.68

Table 4. Distribution of Preterm Birth; Proyecto Buena Salud, 2006-2010.						
			N			
Total Preterm Birth						
	Yes		120		10.05%	
	No		1074		89.95%	
						N=1194

Table 5. Distribution of Low Birthweight; Proyecto Buena Salud, 2006-2010.							
		N					
Total LBW							
	Yes	97		8.21%			
	No	1085		91.79%			
						n=1182	

Table 6. Distribution of SGA; Proyecto Buena Salud, 2006-2010.					
		N			
Total SGA					
	Yes	146		12.35%	
	No	1036		87.65%	
					n=1182

Table 7. Distribution of Covariates according to Neighborhood Crime (total); Proyecto Buena Salud, 2006-2010.

		1st Quartile Crime		2nd Quartile Crime		3rd Quartile Crime		4th Quartile Crime		p-value
		N	%	N	%	N	%	N	%	
Marital Status										
	Single/Separated/Divorced/Widowed	198	81.50%	241	90.30%	234	91.00%	237	92.90%	**0.002**
	Married	45	18.50%	26	9.70%	23	9%	18	7.10%	
Number of Adults in Household										
	1	60	24.20%	69	25.30%	67	25%	74	28.50%	0.4096
	2	125	50.40%	130	47.60%	120	44.80%	130	50%	
	3+	63	25.40%	74	27.10%	81	30.20%	56	21.50%	
Number of Children in Household										
	0	56	22.90%	52	19.60%	47	17.90%	44	17.10%	0.0838
	1	90	36.70%	98	36.80%	85	32.40%	96	37.40%	
	2	47	19.20%	69	25.90%	65	24.80%	76	29.60%	
	3+	52	21.20%	47	17.70%	65	24.80%	41	16%	
Smoking Before Pregancy										
	None	187	73.10%	178	65.40%	172	64.90%	173	65.80%	0.2928
	<=10 cigarettes per day	54	21.10%	72	26.50%	66	24.90%	63	24%	
	>10 cigarettes per day	15	5.90%	22	8.10%	27	10.20%	27	10.30%	
Smoking During Early Pregnancy										
	None	156	90.20%	176	86.30%	158	80.20%	165	87.80%	0.1245
	<=10 cigarettes per day	17	9.80%	25	12.30%	35	17.80%	21	11.20%	
	>10 cigarettes per day	0	0.00%	3	1.50%	4	2%	2	1.10%	
Smoking During Mid-Pregnancy										
	None	51	94.40%	44	88.00%	34	75.60%	41	95.40%	**0.023**
	<=10 cigarettes per day	3	5.60%	5	10.00%	11	24.40%	2	4.70%	
	>10 cigarettes per day	0	0.00%	1	2.00%	0	0.00%	0	0.00%	
Smoking During Late Pregnancy										
	None	7	100%	2	100.00%	2	66.70%	6	85.70%	0.4201
	<=10 cigarettes per day	0	0	0	0.00%	1	33.30%	1	14.30%	
	>10 cigarettes per day	0	0	0	0.00%	0	0.00%	0	0.00%	
Alcohol Consumption During Early Pregnancy										
	No	171	98.80%	198	97.50%	192	96.50%	181	96.30%	0.4222
	Yes	2	1.20%	5	2.50%	7	3.50%	7	3.70%	
Education										
	Less than high school	103	41%	130	47.50%	141	52.60%	139	52.90%	**0.0117**
	High school graduate or GED	86	34.30%	86	31.40%	92	34.30%	78	29.70%	
	Post-high school	62	24.70%	58	21.20%	35	13.10%	46	22.90%	
Income										
	<=$15,000	58	19.70%	90	29.70%	87	28.80%	83	28.50%	**<0.001**
	>$15,000 - $30,000	54	18.40%	42	13.90%	37	12.30%	27	9.30%	
	>$30,000	29	9.90%	21	6.90%	10	3.30%	10	3.40%	
	Don't know/refuse	153	52.00%	150	49.50%	168	55.60%	171	58.80%	
Probable Major Depression in Early Pregnancy										
	No	142	86.10%	173	86.10%	153	78.50%	144	78.70%	0.067
	Yes	23	13.90%	28	13.90%	42	21.50%	39	21.30%	
Probable Major Depression in mid-Pregnancy										
	No	42	82%	37	78.70%	32	74.40%	34	82.90%	0.7403
	Yes	9	17.70%	10	21.30%	11	25.60%	7	17.10%	
Ever Depressed?										
	No	190	85.60%	211	84.70%	188	78%	183	79.90%	0.0902
	Yes	32	14.40%	38	15.30%	53	22%	46	20.10%	
Generation in US										
	Born in PR/DR	118	42.10%	140	48.60%	128	45.20%	140	51.10%	0.3088
	Parent born in PR/DR	148	52.90%	130	45.10%	135	47.70%	121	44.20%	
	Granparent born in PR/DR	14	5%	18	6.30%	20	7.10%	13	4.70%	
Parity										
	0 live births	131	44.60%	124	41.20%	117	38.90%	114	39.20%	0.0691
	1 live birth	87	29.60%	100	33.20%	77	25.60%	94	32.30%	
	2+ live births	76	25.90%	77	25.60%	107	35.60%	83	28.50%	
Age										
	N	289		298		294		283		**<0.001**
	Mean	23.6		22.7		22.5		22.2		
	SD	5.7		5.1		4.7		4.7		
BMI										
	N	286		295		292		282		**<0.001**
	Mean	26.6		26		25.4		25.3		
	SD	7		6.5		25.3		6.5		
Gestational Weight Gain										
	Within Guidelines	70	25.50%	74	26.10%	91	32.40%	79	29.30%	0.2435
	Less than Guidelines	67	24.40%	55	19.40%	55	19.60%	65	24.10%	
	More than Guidelines	138	50.20%	155	54.60%	135	48%	126	46.70%	
Meeting ACOG Physical Activity Guidelines (Early)										
	No	117	67.20%	135	64.30%	134	67.30%	135	70.30%	0.6469
	Yes	57	32.80%	75	35.70%	65	32.70%	57	29.70%	
Meeting ACOG Physical Activity Guidelines (mid)		39	70.90%	28	56.00%	32	64.00%	26	57.80%	0.386
	No	16	29.10%	22	44.00%	18	36.00%	19	42.20%	
	Yes									
Meeting ACOG Physical Activity Guidelines (late)										
	No	5	83.30%	1	100.00%	2	66.70%	3	50.00%	0.5649
	Yes	1	16.70%	0	0.00%	1	33.30%	3	50.00%	
Language Preference										
	English	219	79.90%	225	77.10%	221	77%	186	69.10%	**0.023**
	Spanish	55	20.10%	67	23%	66	23%	83	30.90%	
Acculturation Level										
	Low	185	78.70%	214	79.60%	194	78.90%	205	83%	0.6021
	High	50	21.30%	55	20.50%	52	21.10%	42	17.00%	
Perceived Stress (Ever)										
	No	176	78.20%	189	74.70%	169	69.80%	170	73.30%	0.2224
	Yes	49	21.80%	64	25.30%	73	30.20%	62	26.70%	
Trait Anxiety (Ever)										
	No	192	78.70%	221	79.20%	191	72.60%	192	74.70%	0.2209
	Yes	52	21.30%	58	20.80%	72	27.40%	65	25.30%	

Table 7. Distribution of Covariates according to Neighborhood Crime (rate); Proyecto Buena Salud, 2006-2010.

		1st Quartile Crime		2nd Quartile Crime		3rd Quartile Crime		4th Quartile Crime		p-value
		N	%	N	%	N	%	N	%	
Marital Status										
	Single/Separated/Divorced/Widowed	214	85.90%	240	87.60%	218	87.90%	238	94.80%	**0.0075**
	Married	35	14.10%	34	12.40%	30	12.10%	13	5.20%	
Number of Adults in Household										
	1	71	27.70%	71	25.90%	52	20.80%	76	29.20%	0.2336
	2	124	48.40%	128	45.20%	130	52%	123	47.30%	
	3+	61	23.80%	84	29.80%	68	27.20%	61	23.50%	
Number of Children in Household										
	0	48	19.10%	64	22.90%	38	15.70%	49	19.10%	0.3674
	1	101	40.20%	95	33.90%	85	35.10%	88	34.20%	
	2	60	23.90%	62	22.10%	64	26.50%	71	27.60%	
	3+	42	16.70%	59	21.10%	55	22.70%	49	19.10%	
Smoking Before Pregancy										
	None	189	72.40%	189	66.10%	158	63.20%	174	67.20%	0.2541
	<=10 cigarettes per day	52	19.90%	76	26.60%	69	27.60%	58	22.40%	
	>10 cigarettes per day	20	7.70%	21	7.30%	23	9.20%	27	10.40%	
Smoking During Early Pregnancy		167	86.50%	170	87.60%	159	84.60%	159	85%	0.9785
	None	24	12.40%	22	11.30%	26	13.80%	26	13.90%	
	<=10 cigarettes per day	2	1%	2	1.00%	3	1.60%	2	1.10%	
	>10 cigarettes per day									
Smoking During Mid-Pregnancy										
	None	36	90%	55	90.20%	38	84.40%	41	89.10%	0.7318
	<=10 cigarettes per day	4	10%	5	8.20%	7	15.60%	5	10.90%	
	>10 cigarettes per day	0	0%	1	2%	0	0%	0	0%	
Smoking During Late Pregnancy										
	None	5	100%	4	100%	5	100%	3	60%	0.0997
	<=10 cigarettes per day	0	0%	0	0%	0	0%	2	40%	
	>10 cigarettes per day									
Alcohol Consumption During Early Pregnancy										
	No	189	98.40%	193	98%	181	95.80%	179	96.80%	0.3745
	Yes	3	1.60%	4	2%	8	4.20%	6	3.20%	
Education										
	Less than high school	118	45.90%	133	46.50%	127	50.20%	135	51.90%	0.6458
	High school graduate or GED	82	31.90%	96	33.60%	82	32.40%	82	31.50%	
	Post-high school	57	22.20%	57	19.90%	44	17.40%	43	16.50%	
Income										
	<=$15,000	68	23.20%	84	26.60%	82	29.40%	84	27.80%	**0.004**
	>$15,000 - $30,000	55	18.80%	40	12.70%	38	13.60%	27	8.90%	
	>$30,000	26	8.90%	20	6.30%	13	4.70%	11	3.60%	
	Don't know/refuse	144	49.20%	172	54.40%	146	52.30%	180	59.60%	
Probable Major Depression in Early Pregnancy										
	No	152	82.60%	165	86.40%	150	80.20%	145	79.70%	0.3058
	Yes	32	17.40%	26	13.60%	37	19.80%	37	20.30%	
Probable Major Depression in mid-Pregnancy										
	No	30	76.90%	45	79%	36	83.70%	34	79.10%	0.886
	Yes	9	23.10%	12	21.10%	7	16.30%	9	20.90%	
Ever Depressed										
	No	186	81.90%	212	84.80%	212	84.80%	191	81.30%	0.5539
	Yes	41	18.10%	38	15.20%	38	15.20%	44	18.70%	
Generation in US										
	Born in PR/DR	118	42.30%	128	43.10%	134	50.40%	146	51.60%	0.0952
	Parent born in PR/DR	141	50.50%	155	52.20%	114	42.90%	124	43.80%	
	Granparent born in PR/DR	20	7.20%	14	4.70%	18	6.80%	13	4.60%	
Parity										
	0 live births	120	41%	134	42.70%	108	38.70%	124	41.20%	0.8161
	1 live birth	94	32.10%	85	27.10%	86	30.80%	93	30.90%	
	2+ live births	79	27%	95	30.30%	85	30.50%	84	27.90%	
Age										
	N	290		308		273		302		**<0.001**
	Mean	23.4		22.8		23		21.9		
	SD	5.6		4.9		5.4		4.3		
BMI										
	N	286		305		272		292		**<0.001**
	Mean	26		26.2		25.8		25.3		
	SD	7		6.1		6.4		6.4		
Gestational Weight Gain										
	Within Guidelines	75	27.50%	75	25.30%	75	28.50%	89	32.00%	0.1068
	Less than Guidelines	67	24.50%	52	17.60%	60	22.80%	63	22.70%	
	More than Guidelines	131	48%	169	57.10%	128	48.70%	126	45.30%	
Meeting ACOG Physical Activity Guidelines (early)										
	No	124	62.60%	130	66.30%	128	67%	139	72.00%	0.3533
	Yes	71	36.40%	66	33.70%	63	33%	54	28.00%	
Meeting ACOG Physical Activity Guidelines (mid)										
	No	26	55.30%	43	71.70%	28	63.60%	28	57.10%	0.2828
	Yes	21	44.70%	17	28.30%	16	36.40%	21	42.90%	
Language Preference										
	English	223	81.70%	239	78.60%	184	69.70%	205	73.00%	**0.0044**
	Spanish	50	18.30%	65	21.40%	80	30.30%	76	27.10%	
Acculturation Level										
	Low	186	77.20%	223	81.70%	194	79.50%	195	81.60%	0.5519
	High	55	22.80%	50	18.30%	50	20.50%	44	18.40%	
Perceived Stress (Ever)										
	No	179	76.50%	186	74.10%	178	75.70%	161	69.40%	0.2981
	Yes	55	23.50%	65	25.90%	57	24.30%	71	30.60%	
Trait Anxiety (Ever)										
	No	195	77.40%	219	78.20%	186	74.10%	196	75.40%	0.6774
	Yes	57	22.60%	61	21.80%	65	25.90%	64	24.60%	

Table 7. Distribution of Covariates according to Violent Crime (total); Proyecto Buena Salud, 2006-2010.

		1st Quartile Crime		2nd Quartile Crime		3rd Quartile Crime		4th Quartile Crime		p-value
		N	%	N	%	N	%	N	%	
Marital Status										
	Single/Separated/Divorced/Widowed	202	80.80%	233	87.60%	229	91.20%	246	96.50%	**<0.0001**
	Married	48	19.20%	33	12.40%	22	8.80%	9	3.50%	
Number of Adults in Household										
	1	69	26.70%	66	24.40%	69	27.20%	66	24.80%	0.4666
	2	119	46.10%	146	53.90%	118	46.50%	122	45.90%	
	3+	70	27.10%	59	21.80%	67	26.40%	78	29.30%	
Number of Children in Household										
	0	57	22.40%	59	22.40%	35	13.90%	48	18.50%	**0.0119**
	1	95	37.40%	99	37.50%	90	35.70%	85	32.70%	
	2	55	21.70%	64	24.20%	64	25.40%	74	28.50%	
	3+	47	18.50%	42	15.90%	63	25.00%	53	20.40%	
Smoking Before Pregancy										
	None	190	71.20%	180	66.40%	170	67.50%	170	63.90%	**0.024**
	<=10 cigarettes per day	62	23.20%	68	25.10%	61	24.20%	64	24.10%	
	>10 cigarettes per day	15	5.60%	23	8.50%	21	8.30%	32	12.00%	
Smoking During Early Pregnancy										
	None	157	88.70%	180	88.20%	154	84.60%	164	82.40%	**0.0264**
	<=10 cigarettes per day	19	10.70%	24	11.80%	23	12.60%	32	16.10%	
	>10 cigarettes per day	1	0.60%	0	0.00%	5	2.80%	3	1.50%	
Smoking During Mid-Pregnancy										
	None	53	91.40%	42	91.30%	45	88.20%	30	81.80%	0.2521
	<=10 cigarettes per day	4	6.90%	4	8.70%	6	11.80%	7	18.90%	
	>10 cigarettes per day	1	1.70%	0	0.00%	0	0.00%	0	0.00%	
Smoking During Late Pregnancy										
	None	4	100.00%	5	100.00%	3	75.00%	5	83.30%	0.265
	<=10 cigarettes per day	0	0.00%	0	0.00%	1	25.00%	1	16.70%	
	>10 cigarettes per day	0	0.00%	0	0.00%	0	0.00%	0	0.00%	
Alcohol Consumption During Early Pregnancy										
	No	174	98.90%	199	97.60%	175	95.60%	194	97.00%	0.3049
	Yes	2	1.10%	5	2.50%	8	4.40%	6	3.00%	
Education										
	Less than high school	108	41.50%	113	41.40%	132	51.60%	160	59.90%	**<0.0001**
	High school graduate or GED	82	31.50%	99	36.30%	93	36.30%	68	25.50%	
	Post-high school	70	26.90%	61	22.30%	31	12.10%	39	14.60%	
Income										
	<=$15,000	62	20.80%	86	28.80%	87	29.70%	83	27.70%	**<0.0001**
	>$15,000 - $30,000	55	18.50%	48	16.10%	34	11.60%	23	7.70%	
	>$30,000	29	9.70%	20	6.70%	9	3.10%	12	4.00%	
	Don't Know/Refuse	152	51.00%	145	48.50%	163	55.60%	182	60.70%	
Probable Major Depression in Early Pregnancy										
	No	144	85.20%	179	89.50%	133	74.30%	156	79.60%	**0.007**
	Yes	25	14.80%	21	10.50%	46	25.70%	40	20.40%	
Probable Major Depression in mid-Pregnancy										
	No	49	87.50%	33	76.70%	35	74.50%	28	77.80%	0.3601
	Yes	7	12.50%	10	23.30%	12	25.50%	8	22.20%	
Ever Depressed										
	No	196	86.00%	217	87.50%	171	74.70%	188	79.70%	**0.0008**
	Yes	32	14.00%	31	12.50%	58	25.30%	48	20.30%	
Generation in US										
	Born in PR/DR	117	41.50%	148	51.60%	137	50.20%	124	43.80%	0.1356
	Parent born in PR/DR	151	53.60%	121	42.20%	121	44.30%	141	49.80%	
	Granparent born in PR/DR	14	5.00%	18	6.30%	15	5.50%	18	6.40%	
Parity										
	0 live births	135	45.50%	122	41.10%	95	32.40%	134	44.70%	**0.0076**
	1 live birth	90	30.30%	96	32.30%	93	31.70%	79	26.30%	
	2+ live births	72	24.20%	79	26.60%	105	35.80%	87	29.00%	
Age										
	N	293		292		285		294		**<0.001**
	Mean	23.5		23.2		22.8		21.6		
	SD	5.6		5.4		4.9		4.3		
BMI										
	N	287		292		283		293		**<0.001**
	Mean	26		27.1		25.4		24.8		
	SD	6.4		7.4		6.2		5.6		
Gestational Weight Gain										
	Within Guidelines	71	25.70%	76	27.00%	84	31.10%	83	29.40%	**0.0201**
	Less than Guidelines	68	24.60%	43	15.30%	60	22.20%	71	25.20%	
	More than Guidelines	137	49.60%	163	57.80%	126	46.70%	128	45.40%	
Meeting ACOG Physical Activity Guidelines (early)										
	No	116	64.80%	146	69.50%	132	70.20%	127	64.10%	0.4582
	Yes	63	35.20%	64	30.50%	56	29.80%	71	35.90%	
Meeting ACOG Physical Activity Guidelines (mid)										
	No	43	71.70%	26	55.30%	36	72.00%	20	46.50%	**0.0203**
	Yes	17	28.30%	21	44.70%	14	28.00%	23	53.50%	
Meeting ACOG Physical Activity Guidelines (late)										
	No	2	66.70%	5	100.00%	2	66.70%	2	40.00%	0.2398
	Yes	1	33.30%	0	0.00%	1	33.30%	3	60.00%	
Language Preference										
	English	227	81.70%	213	75.00%	187	69.00%	224	77.50%	**0.0056**
	Spanish	51	18.40%	71	25.00%	84	31.00%	65	22.50%	
Acculturation Level										
	Low	190	76.90%	212	80.90%	193	81.10%	203	81.20%	0.5717
	High	57	23.10%	50	19.10%	45	18.90%	47	18.80%	
Perceived Stress (Total)										
	No	180	77.90%	191	76.10%	163	71.20%	170	70.50%	0.1824
	Yes	51	22.10%	60	23.90%	66	28.80%	71	29.50%	
Trait Anxiety (Total)										
	No	205	80.70%	217	78.90%	182	73.10%	192	72.50%	0.0614
	Yes	49	19.30%	58	21.10%	67	26.90%	73	27.60%	

Table 7. Distribution of Covariates according to Violent Crime (rate); Proyecto Buena Salud, 2006-2010.

		1st Quartile Crime		2nd Quartile Crime		3rd Quartile Crime		4th Quartile Crime		p-value
		N	%	N	%	N	%	N	%	
Marital Status										
	Single/Separated/Divorced/Widowed	206	82.70%	239	88.50%	227	89.40%	238	95.60%	**<0.0001**
	Married	43	17.30%	31	11.50%	27	10.60%	11	4.40%	
Number of Adults in Household										
	1	72	28.00%	63	23.00%	59	22.60%	76	29.60%	0.151
	2	120	46.70%	145	52.90%	120	46%	120	46.70%	
	3+	65	25.30%	66	24.10%	82	31.40%	61	23.70%	
Number of Children in Household										
	0	58	23.00%	51	19.00%	43	16.70%	47	18.60%	**0.0141**
	1	96	38.10%	97	36.20%	92	35.80%	84	33.20%	
	2	57	22.60%	73	27.20%	61	23.70%	66	26.10%	
	3+	41	16.30%	47	17.50%	61	23.70%	66	22.10%	
Smoking Before Pregancy										
	None	192	72.70%	179	65.30%	174	65.90%	165	65.00%	**0.0132**
	<=10 cigarettes per day	50	18.90%	78	28.50%	71	26.90%	56	22.10%	
	>10 cigarettes per day	22	8.30%	17	6.20%	19	7.20%	33	13.00%	
Smoking During Early Pregnancy										
	None	160	87.90%	173	85.20%	167	87.00%	155	83.80%	0.1864
	<=10 cigarettes per day	19	10.40%	30	14.80%	24	12.50%	25	13.50%	
	>10 cigarettes per day	3	1.70%	0	0.00%	1	0.50%	5	2.70%	
Smoking During Mid-Pregnancy										
	None	47	94.00%	42	85.70%	42	89.40%	39	84.80%	0.5218
	<=10 cigarettes per day	3	6.00%	6	12.20%	5	10.60%	7	15.20%	
	>10 cigarettes per day	0	0.00%	1	2.00%	0	0.00%	0	0.00%	
Smoking During Late Pregnancy										
	None	4	100.00%	5	100.00%	4	100.00%	4	66.70%	0.1837
	<=10 cigarettes per day	0	0.00%	0	0.00%	0	0.00%	2	33.30%	
	>10 cigarettes per day	0	0.00%	0	0.00%	0	0.00%	0	0.00%	
Alcohol Consumption During Early Pregnancy										
	No	177	97.80%	202	98.50%	186	96.40%	177	96.20%	0.4262
	Yes	4	2.20%	3	1.50%	7	3.60%	7	3.80%	
Education										
	Less than high school	108	41.90%	125	45.30%	139	52.50%	141	54.90%	**0.0017**
	High school graduate or GED	80	31.00%	99	35.90%	88	33.20%	75	29.20%	
	Post-high school	70	27.10%	52	18.80%	38	14.30%	41	16.00%	
Income										
	<=$15,000	63	21.30%	87	28.40%	78	27.40%	90	29.70%	**< 0.001**
	>$15,000 - $30,000	54	18.20%	43	14.10%	35	12.30%	28	9.20%	
	>$30,000	32	10.80%	16	5.20%	11	3.90%	11	3.60%	
	Don't Know/Refuse	147	49.70%	160	52.30%	161	56.50%	174	57.40%	
Probable Major Depression in Early Pregnancy										
	No	145	83.30%	171	86.40%	158	83.20%	138	75.80%	**0.0395**
	Yes	29	16.70%	27	13.60%	32	16.80%	44	24.20%	
Probable Major Depression in mid-Pregnancy										
	No	40	81.60%	40	85.10%	29	69.10%	36	81.80%	0.2587
	Yes	9	18.40%	7	14.90%	13	31.00%	8	18.20%	
Ever Depressed										
	No	188	83.20%	216	86.40%	189	80.80%	179	77.50%	**0.0411**
	Yes	38	22.50%	34	13.60%	45	19.20%	52	22.50%	
Generation in US										
	Born in PR/DR	121	43.10%	131	45.20%	132	48.90%	142	50.00%	0.6491
	Parent born in PR/DR	145	51.60%	140	48.30%	122	45.20%	127	44.70%	
	Granparent born in PR/DR	15	5.30%	19	6.60%	16	5.90%	15	5.30%	
Parity										
	0 live births	128	43.40%	129	42.30%	109	38.40%	120	39.60%	0.3338
	1 live birth	91	30.90%	79	25.90%	9	34.20%	91	30.00%	
	2+ live births	76	25.80%	97	31.80%	78	27.50%	92	30.40%	
Age										
	N	292		297		281		294		**<0.01**
	Mean	23.8		22.7		22.5		22.1		
	SD	5.7		5		5		4.5		
BMI										
	N	286		297		280		292		**<0.01**
	Mean	26		26		26.1		25.2		
	SD	6.6		6.4		6.9		6		
Gestational Weight Gain										
	Within Guidelines	69	25.00%	85	29.90%	72	26.60%	88	31.50%	0.273
	Less than Guidelines	65	23.60%	50	17.60%	62	22.90%	65	23.30%	
	More than Guidelines	142	51.50%	149	52.50%	137	50.60%	126	45.20%	
Meeting ACOG Physical Activity Guidelines (early)										
	No	122	65.20%	134	66.30%	144	71.60%	121	65.40%	0.4818
	Yes	65	34.80%	68	33.70%	57	28.40%	64	34.60%	
Meeting ACOG Physical Activity Guidelines (mid)										
	No	37	66.10%	32	60.40%	28	66.70%	28	57.10%	0.7249
	Yes	19	33.90%	21	39.60%	14	33.30%	21	42.90%	
Meeting ACOG Physical Activity Guidelines (late)										
	No	2	66.70%	5	100.00%	2	66.70%	2	40.00%	0.2398
	Yes	1	33.30%	0	0.00%	1	33.30%	3	60.00%	
Language Preference										
	English	223	81.10%	222	75.80%	201	73.90%	205	72.70%	**0.019**
	Spanish	52	18.90%	71	24.20%	71	26.10%	77	27.30%	
Acculturation Level										
	Low	191	77.30%	221	84.70%	197	78.50%	189	79.40%	0.1657
	High	56	22.70%	40	15.30%	54	21.50%	49	20.60%	
Perceived Stress (Total)										
	No	176	76.20%	202	79.80%	168	70.00%	158	69.30%	**0.0216**
	Yes	55	23.80%	51	20.20%	72	30.00%	70	30.70%	
Trait Anxiety (Total)										
	No	198	78%	219	79.90%	194	75.50%	185	71.70%	0.1395
	Yes	56	22.10%	55	20.10%	63	24.50%	73	28.30%	

Table 8. Distribution of Covariates According to Preterm Birth, LBW, and SGA; Proyecto Buena Salud, 2006-2010.

		Preterm Birth					LBW					SGA				
		No		Yes			No		Yes			No		Yes		
		N	%	N	%	p-value	N	%	N	%	p-value	N	%	N	%	p-value
Marital Status																
	Single/Separated/Divorced/Widowed	826	89.70%	83	83%	**0.0422**	833	89.10%	69	88.50%	0.8634	790	88.90%	112	90.32%	0.6262
	Married	95	10.30%	17	17%		102	10.90%	9	11.50%		99	11.10%	12	9.70%	
Number of Adults in Household																
	1	247	26.10%	23	22.60%	0.505	247	25.80%	21	25.90%	0.2573	239	26.30%	29	22.10%	0.4684
	2	453	47.90%	51	50%		467	48.70%	33	40.70%		437	48.10%	63	48.10%	
	3+	246	26.00%	28	27.50%		245	90.10%	27	33.30%		233	25.60%	39	29.80%	
Number of Children in Household																
	0	181	19.50%	18	18.20%	0.7387	183	19.40%	16	20.30%	0.6185	171	19.20%	28	21.50%	0.3072
	1	336	36.10%	32	32.30%		342	36.30%	23	29.10%		328	36.80%	37	28.50%	
	2	228	24.50%	29	29.30%		233	24.70%	23	29.10%		221	24.80%	35	26.90%	
	3+	185	19.90%	20	20.20%		184	19.50%	17	21.50%		171	19.20%	30	23.10%	
Smoking Before Pregancy																
	None	645	67.50%	64	64%	0.2719	653	67.50%	50	62.50%	0.135	627	68.50%	76	58%	**0.0029**
	<=10 cigarettes per day	225	23.60%	30	30%		228	23.60%	26	32.50%		220	24%	34	26%	
	>10 cigarettes per day	85	8.90%	6	6%		86	8.90%	4	5%		69	7.50%	21	16%	
Smoking During Early Pregnancy																
	None	583	86.10%	71	84.50%	0.4418	597	85.80%	52	86.70%	0.8986	577	86.80%	72	79.10%	**0.0473**
	<=10 cigarettes per day	85	12.60%	13	15.50%		91	13.10%	7	11.70%		82	12.30%	16	17.60%	
	>10 cigarettes per day	9	1.30%	0	0%		8	1.20%	1	1.70%		6	0.90%	3	3.30%	
Smoking During Mid-Pregnancy																
	None	161	89.40%	9	75%	0.2663	154	90.60%	13	68.40%	**0.011**	143	89.90%	24	80%	0.2224
	<=10 cigarettes per day	18	10%	3	25%		15	8.80%	6	31.60%		15	9.40%	6	20%	
	>10 cigarettes per day	1	0.60%	0	0%		1	0.60%	0	0.00%		1	0.60%	0	0%	
Smoking During Late Pregnancy																
	None	16	88.90%	1	100%	0.72	13	86.70%	3	100%	0.5023	14	87.50%	2	100%	60%
	<=10 cigarettes per day	2	11.10%	0	0%	small cells	2	13.30%	0	0%	small cells	2	12.50%	0	0%	small cells
	>10 cigarettes per day	0	0%	0	0%		0	0%	0	0%		0	0%	0	0%	
Alcohol Consumption During Early Pregnancy																
	No	661	97.50%	80	95.20%	0.2338	677	97.30%	59	96.70%	0.8024	645	97%	91	98.90%	0.2931
	Yes	17	2.50%	4	4.80%		19	2.70%	2	3.30%		20	3%	1	1.10%	
Education																
	Less than high school	462	48.50%	51	50%	0.6525	467	48.30%	41	50.60%	0.4191	429	46.80%	79	60.30%	**0.0138**
	High school graduate or GED	306	32.10%	35	34.30%		311	32.20%	29	35.80%		309	33.70%	31	23.70%	
	Post-high school	185	19.40%	16	15.70%		188	19.50%	11	13.60%		178	19.40%	21	16%	
Income																
	<=$15,000	290	27.10%	28	23.30%	0.6831	295	27.30%	21	21.70%	0.238	273	56.60%	43	68.30%	0.141
	>$15,000 - $30,000	144	13.50%	15	12.50%		148	13.70%	12	12.40%		144	29.90%	16	25.40%	
	>$30,000	64	6.00%	6	5.00%		66	6.10%	3	3.10%		65	13.50%	4	6.40%	
	Don't know/refuse	571	53.40%	71	59.20%		571	52.90%	61	62.90%						
Probable Major Depression in Early Pregnancy		541	81.90%	71	86.60%	0.2881	556	81.80%	51	86.40%	0.3684	537	82.70%	70	77.80%	0.2492
	No	120	19.20%	11	13.40%		124	18.20%	8	13.60%		112	17.30%	20	22.20%	
	Yes	185	19.40%	16	15.70%		188	19.50%	11	13.60%		178	19.40%	21	16%	
Probable Major Depression in mid-Pregnancy																
	No	140	80.90%	5	55.60%	0.0652	134	81.20%	10	62.50%	0.0764	126	81.80%	18	66.70%	0.0717
	Yes	33	19.10%	4	44.40%		31	18.80%	6	37.50%		28	18.20%	9	33.30%	
Ever Depressed in Pregnancy																
	No	695	82%	77	83.70%	0.6794	701	81.90%	64	82%	0.9722	675	82.80%	90	75.60%	0.057
	Yes	153	18%	15	16.30%		155	18.10%	14	18%		140	17.20%	29	24.40%	
Generation in US																
	Born in PR/DR	464	46%	62	53.90%	0.2574	476	46.50%	44	47.80%	0.5473	462	47.30%	58	42%	0.489
	Parent born in PR/DR	485	48.10%	48	41.70%		485	47.40%	45	48.90%		458	46.90%	72	52.20%	
	Granparent born in PR/DR	60	6%	5	4.40%		62	6.10%	3	3.20%		57	5.80%	8	5.80%	
Parity																
	0 live births	437	41%	49	41.20%	0.6476	434	40.30%	46	47.40%	0.3754	403	39.20%	77	52.70%	**0.0075**
	1 live birth	325	30.50%	32	26.90%		330	30.60%	25	25.80%		321	31.20%	34	23.30%	
	2+ live births	305	28.60%	38	31.90%		313	29.10%	26	26.80%		304	29.60%	35	24%	
Age																
	N	1044		119		**0.01**	1058		94		**0.01**	1010		142		**0.01**
	Mean	22.7		23.4			22.8		22.9			22.9		21.9		
	Sd	5		5.9			5.1		5.2			5.2		4.4		
BMI																
	N	1036		118		**0.01**	1049		93		**0.01**	1001		141		**0.01**
	Mean	25.9		25.3			25.9		24.6			26		24.6		
	SD	6.6		5.8			6.4		5.6			6.4		6.2		
Gestational Weight Gain																
	Within Guidelines	276	27.50%	38	35.50%	**<0.0001**	277	27.50%	33	37.10%	**<0.001**	263	27.40%	47	33.80%	**0.0002**
	Less than Guidelines	204	20.40%	38	35.50%		204	20.20%	34	38.20%		194	20.20%	44	31.70%	
	More than Guidelines	522	52.10%	31	29%		528	52.30%	22	24.70%		502	52.40%	48	34.50%	
Meeting ACOG Physical Activity Guidelines (early)																
	No	473	68.80%	47	54.70%	**0.0087**	483	68%	35	58.30%	0.1243	456	67.30%	62	67.40%	0.9794
	Yes	215	31.30%	39	45.40%		227	32%	25	41.70%		222	32.70%	30	32.60%	
Meeting ACOG Physical Activity Guidelines (mid)																
	No	117	62.20%	8	66.70%	0.7585	116	64.80%	7	41.20%	0.0541	110	65.10%	13	48.20%	0.0909
	Yes	71	37.80%	4	33.30%		63	35.20%	10	58.80%		59	34.90%	14	51.80%	
Meeting ACOG Physical Activity Guidelines (late)																
	No	11	73.30%	0	0.00%	0.1256	8	66.70%	2	66.70%	1	8	61.50%	2	100.00%	0.2827
	Yes	4	26.70%	1	100.00%	small cells	4	33.30%	1	33.30%	small cells	2	38.50%	0	0.00%	small cells
Language Preference																
	English	766	76.20%	84	72.40%	0.3648	775	76.10%	65	70.70%	0.2478	738	75.90%	102	73.40%	0.5135
	Spanish	239	23.80%	32	27.60%		244	24%	27	29.40%		234	24.10%	37	26.60%	
Acculturation Level																
	Low	721	79.60%	76	84.40%	0.2711	732	79.70%	59	83.10%	0.4955	692	79.80%	99	81.20%	0.7306
	High	185	20.40%	14	15.60%		186	20.30%	12	16.90%		175	20.20%	23	18.90%	
Perceived Stress (Ever)																
	No	641	74.40%	63	70.80%	0.4639	645	74.10%	52	70.30%	0.4777	609	73.60%	88	74.60%	0.8287
	Yes	221	25.60%	26	29.20%		226	26%	22	29.70%		218	26.40%	30	25.40%	
Trait Anxiety (Ever)																
	No	720	75.90%	76	81.70%	0.2048	724	75.60%	63	82.90%	0.1497	693	76.40%	94	74%	0.5541
	YEs	229	24.10%	17	18.30%		234	24.40%	13	17.10%		214	23.60%	33	26%	

Table 9. Unadjusted and Adjusted Relative Risks and Confidence Intervals for Neighborhood Crime and Preterm Birth; Proyecto Buena Salud, 2006-2010.

				Preterm Birth									
		Cases		Unadjusted		Adjusted*		Adjusted**		Adjusted***		Adjusted****	
		N	(%)	OR	95% CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Neighborhood Crime (Continuous)		120	10.10%	0.98	(0.8-1.3)	0.998	(0.8 - 1.3)	1.004	(0.8-1.3)	0.998	(0.8-1.3)		
Neighborhood Crime (Quartiles)													
0=1st quartile	1st Quartile	33	11.20%	1.0	Referent	1.0	Referent	1	Referent	1	Referent		
1=2nd quartile	2nd Quartile	28	9.20%	0.8	(0.5-1.4)	0.8	(0.5-1.4)	0.9	(0.5-1.5)	0.9	(0.5-1.5)		
2=3rd quartile	3rd Quartile	28	9.30%	0.8	(0.5-1.4)	0.8	(0.5-1.5)	0.9	(0.5-1.5)	0.9	(0.5-1.5)		
3=4th quartile	4th Quartile	31	10.70%	0.9	(0.6-1.6)	1	(0.6-1.6)	1	(0.6-1.7)	0.9	(0.5-1.6)		
	test for trend			p = 0.8389		p = 0.9009		p = 0.9495		p = 0.8569			
Neighborhood Crime Rate (Continuous)		120	10.10%	1.1	(0.9-1.3)	1.1	(0.9-1.3)	1.1	(0.9-1.3)	1.04	(0.9-1.3)		
Neighborhood Crime Rate (Quartiles)													
0=1st quartile	1st Quartile	34	11.60%	1.0	Referent	1.0	Referent	1	Referent	1	Referent		
1=2nd quartile	2nd Quartile	22	10.20%	0.6	(0.3-1.0)	0.6	(0.3-1.1)	0.6	(0.3-1.1)	0.6	(0.3-1.03)		
2=3rd quartile	3rd Quartile	33	11.90%	1	(0.6-1.7)	1.1	(0.6-1.8)	1.1	(0.7-1.8)	1.1	(0.6-1.8)		
3=4th quartile	4th Quartile	31	10.30%	0.9	(0.5-1.5)	0.9	(0.5-1.5)	0.9	(0.5-1.5)	0.9	(0.5-1.5)		
	test for trend			p = 0.8935		p = 0.8043		p = 0.8043		p = 0.8674			
Neighborhood Violent Crime (Continuous)		120	10.10%	1.01	(0.7-1.5)	1.03	(0.7-1.5)	0.9	(0.6-1.4)	0.8	(0.5-1.3)		
Neighborhood Violent Crime (Quartiles)													
0=1st quartile	1st Quartile	35	11.70%	1.0	Referent	1.0	Referent	1	Referent	1	Referent		
1=2nd quartile	2nd Quartile	23	7.70%	0.6	(0.4-1.1)	0.7	(0.4-1.1)	0.7	(0.4-1.2)	**0.4**	**(0.2-0.8)**		
2=3rd quartile	3rd Quartile	30	10.20%	0.9	(0.5-1.4)	0.9	(0.5-1.5)	0.9	(0.5-1.5)	0.7	(0.4-1.3)		
3=4th quartile	4th Quartile	32	10.70%	0.9	(0.5-1.5)	0.9	(0.5-1.5)	0.9	(0.5-1.5)	0.7	(0.4-1.4)		
	test for trend			p = 0.9281		p = 0.9593		p = 0.9731		p = 0.6182			
Neighborhood Violent Crime Rate (Continuous)		120	10.10%	1.1	(0.8-1.4)	1.1	(0.8-1.5)	1.1	(0.8-1.5)	1.1	(0.8-1.6)		
Neighborhood Violent Crime Rate (Quartiles)													
0=1st quartile	1st Quartile	31	10.50%	1.0	Referent	1.0	Referent	1	Referent	1	Referent		
1=2nd quartile	2nd Quartile	25	8.20%	0.8	(0.4-1.3)	0.8	(0.6-1.4)	0.8	(0.5-1.4)	0.7	(0.4-1.3)		
2=3rd quartile	3rd Quartile	30	10.50%	1	(0.6-1.7)	1.1	(0.6-1.8)	1.1	(0.6-1.9)	0.8	(0.4-1.5)		
3=4th quartile	4th Quartile	34	11.20%	1.1	(0.6-1.8)	1.1	(0.7-1.9)	1.1	(0.7-1.9)	1	(0.5-1.9)		
	test for trend			p = 0.5509		p = 0.4772		p = 0.4822		p = 0.8435			
*	Adjusted for Age and BMI												
**	Adjusted for p < 0.05		Total Crime: marital status, age, bmi										
			Crime Rate: marital status, age, bmi										
			Violent Crime: marital status, age, bmi, gwg										
			Violent Crime Rate: marital status, age, bmi										
***	Adjusted for if **any** p < 0.05		Total Crime: marital status, smoking during mid-pregnancy, education, income, age, bmi, language, gwg, PA early pregnancy										
			Crime Rate: marital status, income, age, bmi, language, gwg, PA early pregnancy										
			Violent Crime: marital status, kids, smoking before pregnancy, smoking early pregnancy, education, income, depression early pregnancy,										
			ever depressed, parity, age, bmi, gwg, PA mid pregnancy, language, PA early pregnancy										
			Violent Crime Rate: marital status, kids, smoking before pregnancy, education, income, depression early pregnancy, ever depressed, age, bmi, language, stress										
****	Adjusted for 10%+ change		None										

Table 9. Unadjusted and Adjusted Relative Risks and Confidence Intervals for Neighborhood Crime and LBW; Proyecto Buena Salud, 2006-2010.

				LBW									
		Cases		Unadjusted		Adjusted*		Adjusted**		Adjusted***		Adjusted***	
		N	(%)	OR	95% CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Neighborhood Crime (Continuous)		97	8.20%	1.1	(0.8-1.4)	1.1	(0.8-1.4)	1.1	(0.8-1.5)	0.996	(0.7-1.4)		
Neighborhood Crime (Quartiles)													
0=1st quartile	1st Quartile	27	9.40%	1.0	Referent	1.0	Referent	1	Referent	1	Referent		
1=2nd quartile	2nd Quartile	19	6.30%	0.6	(0.4-1.2)	0.7	(0.4-1.3)	0.7	(0.4-1.3)	0.7	(0.4-1.4)		
2=3rd quartile	3rd Quartile	22	7.40%	0.8	(0.4-1.4)	0.8	(0.4-1.5)	0.8	(0.5-1.5)	0.9	(0.5-1.6)		
3=4th quartile	4th Quartile	29	10.10%	1.1	(0.6-1.9)	1.1	(0.6-1.9)	1.1	(0.6-1.9)	0.9	(0.5-1.7)		
	test for trend			p = 0.6585		p = 0.7213		p = 0.674		p = 0.9779			
Neighborhood Crime Rate (Continuous)		97	8.20%	0.98	(0.8-1.2)	0.98	(0.8-1.2)			0.9	(0.7-1.2)		
Neighborhood Crime Rate (Quartiles)													
0=1st quartile	1st Quartile	30	10.30%	1.0	Referent	1.0	Referent			1	Referent		
1=2nd quartile	2nd Quartile	19	6.10%	0.566	(0.3-1.03)	0.6	(0.3-1.1)			**0.5**	**(0.3-0.95)**		
2=3rd quartile	3rd Quartile	25	9.10%	0.87	(0.5-1.5)	0.9	(0.5-1.5)			0.8	(0.4-1.4)		
3=4th quartile	4th Quartile	23	7.70%	0.722	(0.4-1.3)	0.7	(0.4-1.3)			0.6	(0.3-1.1)		
	test for trend			p = 0.5001		p = 0.4777				p = 0.2433			
Neighborhood Violent Crime (Continuous)		97	8.20%	1.01	(0.7-1.5	1	(0.7-1.5)	0.9	(0.6-1.4)	0.7	(0.4-1.2)		
Neighborhood Violent Crime (Quartiles)													
0=1st quartile	1st Quartile	27	9.10%	1.0	Referent	1.0	Referent	1	Referent	1	Referent		
1=2nd quartile	2nd Quartile	23	7.80%	0.8	(0.5-1.5)	0.8	(0.4-1.5)	0.8	(0.4-1.5)	**0.5**	**(0.2-0.98)**		
2=3rd quartile	3rd Quartile	22	7.60%	0.8	(0.5-1.5)	0.8	(0.5-1.5)	0.8	(0.5-1.5)	0.6	(0.3-1.1)		
3=4th quartile	4th Quartile	25	8.50%	0.9	(0.5-1.6)	0.9	(0.5-1.6)	0.9	(0.5-1.6)	0.7	(0.3-1.3)		
	test for trend			p = 0.7495		p = 0.7011		p = 0.6755		p = 0.2724			
Neighborhood Violent Crime Rate (Continuous)		97	8.20%	0.9	(0.7-1.3)	0.9	(0.7-1.3)			0.8	(0.5-1.1)		
Neighborhood Violent Crime Rate (Quartiles)													
0=1st quartile	1st Quartile	25	8.50%	1.0	Referent	1.0	Referent			1	Referent		
1=2nd quartile	2nd Quartile	28	9.30%	1.1	(0.6-1.9)	1.1	(0.6-1.9)			0.8	(0.4-1.6)		
2=3rd quartile	3rd Quartile	22	7.80%	0.9	(0.5-1.7)	1	(0.5-1.8)			0.7	(0.3-1.4)		
3=4th quartile	4th Quartile	22	7.30%	0.9	(0.5-1.6)	0.8	(0.5-1.6)			0.5	(0.2-1.1)		
	test for trend			p = 0.4914		p = 0.5202				p = 0.0677			
*	Adjusted for Age and BMI												
**	Adjusted for p < 0.05			Total Crime: Smoking mid pregnancy, age, bmi									
				Crime Rate: age, bmi									
				Violent Crime: age, bmi, gwg									
				Violent Crime Rate: age, bmi									
***	Adjusted for if **any** p < 0.05			Total Crime: Marital status, smoking mid pregnancy, education, income, age, bmi, language, gwg									
				Crime Rate: marital status, income, age, bmi, language, smoking mid pregnancy, gwg									
				Violent Crime: marital status, kids, smoking before pregnancy, smoking early pregnancy, education, income,									
				depression early pregnancy, ever depressed, parity, age, bmi, gwg, PA mid pregnancy, language, smoking mid pregnancy									
				Violent Crime Rate: marital status, kids, smoking before pregnancy, education, income, depression early pregnancy,									
				ever depressed, age, bmi, language, stress, smoking mid pregnancy, gwg									
****	Adjusted for 10%+ change			none									

Table 9. Unadjusted and Adjusted Relative Risks and Confidence Intervals for Neighborhood Crime and SGA; Proyecto Buena Salud, 2006-2010.

				SGA									
		Cases		Unadjusted		Adjusted (BMI, age)		Adjusted (p < 0.05)		Adjusted (any p < 0.(		Adjusted (10% change)	
		N	(%)	OR	95% CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Neighborhood Crime (Continuous)		146	12.40%	1.2	(0.98-1.6)	1.2	(0.96-1.6)	1.2	(0.9-1.6)	1.1	(0.9-1.4)		
Neighborhood Crime (Quartiles)													
0=1st qua	1st Quartile	34	11.80%	1.0	Referent	1.0	Referent	1.0	Referent	1.0	Referent		
1=2nd qua	2nd Quartile	22	7.3%	0.6	(0.3-1.03)	0.6	(0.3-1.1)	0.6	(0.3-1.1)	0.6	(0.3-1.1)		
2=3rd qua	3rd Quartile	47	15.70%	1.4	(0.9-2.2)	1.5	(0.9-2.4)	1.4	(0.9-2.3)	1.5	(0.9-2.5)		
3=4th qua	4th Quartile	43	14.9%	1.3	(0.8-2.1)	1.3	(0.8-2.1)	1.2	(0.7-2.1)	1.1	(0.7-1.9)		
	test for trend			**p = 0.0373**		p = 0.0518		p = 0.0653		p = 0.1438			
Neighborhood Crime Rate (Continuous)		146	12.40%	1.1	(0.9-1.3)	1.1	(0.9-1.3)			1.01	(0.8-1.2)		
Neighborhood Crime Rate (Quartiles)													
0=1st qua	1st Quartile	38	13.10%	1.0	Referent	1.0	Referent			1.0	Referent		
1=2nd qua	2nd Quartile	31	10%	0.7	(0.4-1.2)	0.7	(0.4-1.2)			0.7	(0.4-1.1)		
2=3rd qua	3rd Quartile	33	12%	0.9	(0.6-1.5)	0.9	(0.5-1.5)			0.8	(0.5-1.4)		
3=4th qua	4th Quartile	44	14.70%	1.1	(0.7-1.8)	1.1	(0.7-1.8)			1.02	(0.6-1.7)		
	test for trend			p = 0.4047		p = 0.5157				p = 0.7528			
Neighborhood Violent Crime (Continuous		146	12.40%	1.6	(1.1-2.3)	1.5	(1.1-2.2)	1.5	(1.03-2.2)	1.2	(0.8-1.9)		
Neighborhood Violent Crime (Quartiles)													
0=1st qua	1st Quartile	28	9.50%	1.0	Referent	1.0	Referent	1.0	Referent	1.0	Referent		
1=2nd qua	2nd Quartile	31	10.50%	1.1	(0.7-1.9)	1.1	(0.6-1.9)	1.1	(0.6-1.9)	0.9	(0.5-1.7)		
2=3rd qua	3rd Quartile	32	11.00%	1.2	(0.7-2.0)	1.1	(0.7-2.0)	1.2	(0.7-2.1)	0.8	(0.4-1.5)		
3=4th qua	4th Quartile	55	18.60%	**2.2**	**(1.3-3.6)**	**2**	**(1.2-3.3)**	**2.1**	**(1.2-3.4)**	**1.8**	**(1.02-3.1)**		
	test for trend			**p = 0.0013**		**p = 0.0041**		**p = 0.0037**		**p = 0.0348**			
Neighborhood Violent Crime Rate (Contin		146	12.40%	1.2	(0.9-1.5)	1.2	(0.9-1.5)	1.1	(0.9-1.5)	0.999	(0.7-1.4)		
Neighborhood Violent Crime Rate (Quartiles)													
0=1st qua	1st Quartile	30	10.20%	1.0	Referent	1.0	Referent	1.0	Referent	1.0	Referent		
1=2nd qua	2nd Quartile	39	13%	1.3	(0.8-2.2)	1.3	(0.7-2.1)	1.2	(0.7-2.0)	1.04	(0.6-1.9)		
2=3rd qua	3rd Quartile	32	11.40%	1.1	(0.7-1.9)	1.1	(0.6-1.8)	1.02	(0.6-1.8)	0.7	(0.4-1.4)		
3=4th qua	4th Quartile	45	15%	1.6	(0.95-2.6)	1.5	(0.9-2.4)	1.4	(0.8-2.3)	1.1	(0.6-1.9)		
	test for trend			p = 0.129		p = 0.1945		p = 0.2746		p = 0.8616			
*	Adjusted for Age and BMI												
**	Adjusted for p < 0.05	Total Crime: education, age, bmi											
		Crime Rate: age, bmi											
		Violent Crime: smoking before pregnancy, smoking early pregnancy, education, parity, age, bmi, gwg,											
		Violent Crime Rate: smoking before pregnancy, education, age, bmi											
***	Adjusted for if **any** p < 0.05	Total Crime: marital status, smoking mid pregnancy, education, income, age, bmi, language, smoking before pregnancy, smoking early pregnancy, parity, gwg											
		Crime Rate: marital status, income, age, bmi, language, smoking before pregnancy, smoking early pregnancy, education, parity, gwg											
		Violent Crime: marital status, kids, smoking before pregnancy, smoking early pregnancy, education, income, depression early pregnancy, ever depressed, parity, age, bmi, gwg, PA mid pregnancy, language											
		Violent Crime Rate: marital status, kids, smoking before pregnancy, education, income, depression early pregnancy, ever depressed, age, bmi, language, stress, smoking early pregnancy, parity, gwg											
****	Adjusted for 10%+ change												

Table 10. Power to Detect an Effect of Neighborhood Crime on Pretem Birth for a Range of Relative Risks with 95% Confidence; Proyecto Buena Salud, 2006-2010

Relative Risk	Power
1.7	94%
1.6	86.10%
1.55	80%
1.5	73.60%
1.4	55.30%

Table 11. Literature Review Table.

Author	Year	Study Design	Race/Ethnicity	Location	Exposure - tool	Exposure - measured	Outcome -tool	Outcome - measured	Direction	magnitude	Relevant confounders?
Bloch	2011	Cohort	Black/White	Philadelphia	Crime Stats Database 2004	Aggravated assault w gun	birth records	Preterm Birth (<37 weeks)	+	p < 0.0001 difference b/w	
		(retrospective)	Not Hispanic		(Philly PD Public Records)	domestic abuse				neighborhood categories	
											worse neighborhoods had most
											PTB but not linear relationship
Messer	2006	Cohort	non-hispanic	Raleigh, NC	City of Raleigh NC crime reports	Neighborhood-level crime:	Birth records	PTB: <37 weeks & weighs		White Women | | Black women referent -- low	individual (maternal age, education,
et al		(retrospective)	Black/White			count and rate in block group		<3,888 g [<1% missing]		*PTB / LBW violent crime w/in 0.5 mi*	marital status)
						separated into tertiles		LBW: <2500 g [no missing]	~	Med: 1.0 (0.8, 1.3) // 1.0 (0.7, 1.4) || 0.9 (0.7, 1.2) // 0.9 (0.6, 1.1)	neighborhood level (deprivation
						Proximal crime: count of crime			~	High: 1.1 (0.8, 1.6) // 1.0 (0.7, 1.5) || 0.9 (0.7, 1.3) // 1.0 (0.7, 1.3)	score)
						w/in 0.5 mi radius & distance in feet				*PTB / LBW distance in feet*	
						to nearest crime			~	Med: 1.1 (0.9, 1.5) // 0.9 (0.7, 1.2) || 1.1 (0.9, 1.4) // 1.0 (0.7, 1.3)	
									~	Far: 1.1 (0.9, 1.5) // 1.0 (0.7, 1.3) || 0.9 (0.7, 1.2) // 0.9 (0.7, 1.1)	
										PTB / LBW violent crime count	
									~ | ++	Med: 0.9 (0.8, 1.2) // 1.0 (0.8, 1.3) || 1.7 (1.2, 2.4) // 1.6 (1.1, 2.4)	
									~	High: 1.1 (0.8, 1.5) // 1.0 (0.7, 1.4) || 1.2 (0.9, 1.8) // 1.2 (0.8, 1.7)	
										PTB / LBW violent crime rate	
									~ | +~	Med: 1.0 (0.7, 1.2) // 1.0 (0.7, 1.3) || 1.3 (1.0, 1.8) // 1.2 (0.9, 1.7)	
									~+ | ~	High: 1.3 (0.9, 1.9) // 1.5 (1.0, 2.3) || 1.1 (0.8, 1.6) // 1.2 (0.8, 1.7)	
Clemens	2016	Cohort	White (Scottish)	Scotland	Scottish Index of Multiple	Crime across Scotland as total	Scottish Longitudinal Study	PTB: moderate (32-36 wk),	null	Moderately PTB - 1.05 (0.96, 1.13)	
et al		(prospective)		2006-2009	Deprivation - crime domain	violent crime and rates	census records	very (<32 wk)	null	Very PTB - 0.91 (0.75, 1.09)	
							administrative data	SGA: lowest decile for sex	+	LBW - 1.15 (1.01, 1.31)	
								at gestational age	+	SGA - 1.09 (1.02, 1.16)	
								LBW: <2500 g			
Kane	2011	retrospective	White, black, hispanic	Washington,	Violent Crime data from MPD	tract-level violent crime counts	Birth files from DOH	Birthweight - continuous		Hispanic	% black, % in poverty, % female HOH
		hierarchical		D.C.	Census bureau	(homicide, rape, robbery, assault w				Birthweight: 2106.68 (t = 25.67)	with children, % public assistance,
		analysis?		2000-2002		deadly weapon)				Structural disadvantage: -98.34 (p <0.1)	% 25+ w/o hs diploma, % immigrant,
						violence "uncertainty"				Crime: -1.81 (p < 0.01)	%Latino, count of hospitals, count
										Disadvantage x total crime: -0.12 (p < 0.1)	of schools, libraries, rec facilities,
										Disadvantage x violence uncertainty: -20.21 (p < 0.01)	places of worship, senior centers
										Intercept: 3218.30 (p < 0.01), Level 1 Residual 37575.64 (p < 0.01)	
Messer	2005	Cohort	non-Hispanic black/white	Wake County,	Raleigh crime reports (1999-2001)	biolent, theft, property, vice	Birth Records	PTB: <37 wk & <3,888 g		Violent crime Rate: white | | Black, referent = low	Individual: maternal age, race,
et al		(retrospective)		NC		population density-adjusted block-		<1% missing data	~/~+	Medium: 0.9 (0.7 - 1.1) || 1.3 (0.9 - 1.9)	education, marital status.
				1999-2001		group crime rates in quartiles			~/~	High: 1.0 (0.8 - 1.4) | | 1.2 (0.9 - 1.7)	neighborhood: deprivation score,
									~+/+	Very High: 1.5 (0.9 - 2.6) | | 1.4 (1.0 -2.1)	police substation locatin
Auger et	2008	Cohort	Not specified but in Montreal	Montreal,	Montreal Police District report for	total crimes committed, violent	Birth registry	SGA - below 10th percent for birth		Neighborhood Perception Index (high =favorable, low = referent)	maternal age, education, marital
al		(retrospective)		Quebec	Crimes	crimes, theft, vice.		weight within gestational age by sex	-	High: beta = -0.15 (SE: 0.057)	status, county of birth (CA or else),
				1997-2001	Random digit dial survey	1997 phone survey by research dept		for Canadian referent values	-	High-int: beta = -0.11 (SE: 0.055)	birth year of baby, birth category
						of Montreal PD on neighborhood			-	Intermed: beta = -0.09 (SE: 0.053)	(firstborn or born within <12 mo,
						security perception.			-	Low-int: beta = -0.019 (SE: 0.057)	18-35 mo, >=36 mo
						grouped into quintiles					Immigrant density, deprivation,
											residential stability
Masi et	2007	Cohort	White, Black, Hispanic	Chicago, IL	Chicago Police Department violent	murder, sexual assault, robbery,	Illinois Dept of Public	Birthweight (continuous)		Hispanic	
al		(retrospective)		births in 1991	crime file	aggravated assault	Health Elecronic Birth	Preterm birth (<37 wk gestation)	+	Birthweight: -24.3 (p < 0.05) [more crime = more LBW]	
						calculated rate and log-transformed	Certificate Database	SGA (<10th %ile for Gestational age)	+	Preterm Birth: -0.032 [odds 1.10?]	
									+	SGA: 0.149 (p < 0.05) [odds 1.20]	
Giurgescu	2012	cross-sectional	Black	Chicago, IL	Self-report questionnaire - perceived	Self-reported questionnaires	Clinical diagnosis	Preterm birth (<37 wk gestation)	~	Violent crime: OR - 0.685 (0.30-1.56)	maternal age, gravidity, marital status,
et al				2007	crime	completed 24-72 hours after birth			~	Perceived crime: OR - 1.091 (0.80-1.05)	maternal education, employment,
					Census Bureau- crime	violent crime within a 0.5 mi radius					household income,
Miranda	2012	cohort	white/black/hispanic (adjusted for)	Durham, NC	Crime Analysis Lab of Durham Police	Description, address of all crime.	Birth records	Birth weight (continuous)	~+ish	Birthweight: beta: 3.03 (-10.06, 16.12)	maternal age (categorical), maternal
et al		(retrospective)		2008	Department	assigned a crime count to each		Birth weight %ile (continuous)	~	Birthweight %ile: beta: 0.08 (-0.39, 0.56)	education (categorical), birth order
						census block		Preterm Birth (<37 weeks gestation)	~	PTB: OR - 1.00 (0.94, 1.07)	(1st or >1st), sex, race/ethnicity
								LBW (<2500 g)	~	SGA: OR - 1.00 (0.96, 1.05)	
								SGA (<10th %ile for GA)	~	LBW: OR - 0.99 (0.95, 1.04)	

BIBLIOGRAPHY

For Chapter I

1. Centers for Disease Control and Prevention. National Prematurity Awareness Month. (2014, November 10). Retrieved October 4, 2015 from http://www.cdc.gov/Features/PrematureBirth/
2. Centers for Disease Control and Prevention. Preterm Birth. (2014, December 23). Retrieved October 4, 2015 from http://www.cdc.gov/reproductivehealth/maternalinfanthealth/PretermBirth.htm
3. Martin, J.A. Preterm Births – United States, 2007. (2011, January 14). Retrieved October 4, 2015 from http://www.cdc.gov/mmwr/preview/mmwrhtml/su6001a16.htm
4. Centers for Disease Control and Prevention. Reproductive and Birth Outcomes: Low Birth weight and the Environment. (2016, October 26). Retrieved December 15, 2016 from https://ephtracking.cdc.gov/resources/rss/showRbLBWGrowthRetardationEnv.action
5. March Of Dimes. Low birthweight. (2014, October). Retrieved December 15, 2016 from http://www.marchofdimes.org/baby/low-birthweight.aspx
6. Goldenberg, R.L. & Culhane, J.F. "Low birth weight in the United States." *The American Journal of Clinical Nutrition*. 2007; 85(suppl): 584S-90S. (http://ajcn.nutrition.org/content/85/2/584S.full)
7. http://www.childtrends.org/indicators/low-and-very-low-birthweight-infants/ &http://www.childtrends.org/wp-content/uploads/2014/07/57_appendix1.pdf
8. Berry, J. & Holloway, B. Fetal Growth Restriction (FGR). (2016) Retrieved December 15, 2016 from https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentTypeID=90&ContentID=P02462
9. Krogstad, J.M. & Lopez, M.H. "Hispanic population reaches record 55 million, but growth has cooled." *PewResearchCenter* (2015, June 25). Retrieved December 21, 2016 from http://www.pewresearch.org/fact-tank/2015/06/25/u-s-hispanic-population-growth-surge-cools/
10. Messer, L.C, Kaufman, J.S., Dole, N., Herring, A., & Laraia, B.A. "Violent crime exposure classification and adverse birth outcomes: a geographically-defined cohort study." *International Journal of Health Geographics*. (2006); 5:22. DOI: 10.1186/1476-072X-5-22
11. Meng, G., Thompson, M.E., & Hall, G.B. "Pathways of neighbourhood-level socio-economic determinants of adverse birth outcomes." *International Journal of Health Geographics*. (2013); 12:32
12. Bloch, J.R. "Using Geographical Information Systems to Explore Disparities in Preterm Birth Rates Among Foreign-born and U.S.-born Black Mothers." *Journal of Obstetric, Gynecologic, and Neonatal Nursing*. (2011); 40:544-554
13. Mitchel, E.A, Robinson, E., Clark, P.M, Becroft, D.M.O, Glavish, N., Pattison, N.S., Pryor, J.E., Thompson, J.M.D., Wild, C.J. "Maternal nutritional risk factors for small for gestational age babies in a developed country: a case-control study." *Archives of Disease in Childhood Fetal Neonatal Edition*: 2004; 89F431-F435.
14. Ma, X., Liu, J., Hardia, J.W., Zhao, G., & Liese A.D. "Neighborhood Food Access and Birth Outcomes in South Carolina." *Maternal Child Health Journal*. (2016) 20: 187-195.
15. Ostfeld, R.S., Glass, G.E., & Keesing, F. "Spatial epidemiology: an emerging (or re-emerging) discipline." *TRENDS in Ecology and Evolution* (2006); 20:6
16. Cook, J.T., Black, M., Chilton, M., Cutts, D., de Cuba, S.E., Heeren, T.C., Rose-Jacobs, R., Sandel, M., Casey, P.H., Coleman, S., Weiss, I., Frank, D.A. "Are Food Insecurity's Health Impacts Underestimated in the U.S. Population? Marginal Food Security Also Predicts Adverse Health Outcomes in Young U.S. Children and Mothers." *American Society for Nutrition* (2013); 4:51-61

17. Johnson, D.B., Quinn, E., Sitaker, M., Ammerman, A., Byker, C., Dean, W., Fleishhacker, S., Kolodinsky, J., Pinard, C., Pitts, S.B.J., Sharkey, J. "Developing an agenda for research about policies to improve access to healthy foods in rural communities: a concept mapping study." *BMC Public Health.* (2014); 14:592
18. Sharkey, .R., Johnson, C.M., Dean, W.R, Horel, S.A. "Focusing on fast food restaurants alone underestimates the relationship between neighborhood deprivation and exposure to fast food in a large rural area." *Nutrition Journal.* (2001); 10:10
19. Boulos, M.N.K. "Towards evidence-based, GIS-driven national spatial health information infrastructure and surveillance services in the United Kingdom." *International Journal of Health Geographics.* (2004); 3:1
20. Bell, N., Shuurman, N., Hayes, M.V. "Using GIS-based methods of multicriteria analysis to construct socio-economic deprivation indices." *International Journal of Health Geographics.* (2007); 6:17
21. Freedman, D.A & Bell, B.A "Access to Healthful Foods among an Urban Food Insecure Population: Perceptions versus Reality." *Journal of Urban Health: Bulletin of the New York Academy of Medicine* (2009); 86:6
22. Salmon, L. "Food security for infants and young children: an opportunity for breastfeeding policy?" *International Breastfeeding Journal.* (2015); 10:7
23. Wadhwa, P.D., Entringer, S., Buss, C., Lu, M.C. "The Contribution of Maternal Stress to Preterm Birth: Issues and Considerations." *Clinics in Perinatology.* (2011); 38(3): 351-384).
24. Holford, T.R., Ebisu, K., McKay, L.A, Gent, J.F., Triche, E.W., Bracken, M.B. Leaderer B.P. "Integrated Exposure Modeling: A Model Using GIS and GLM." *Stat Med.* (2010); 29(1):116-129
25. Shoff, C., Yang, T., Matthews, S.A.. "What has geography got to do with it? Using GWR to explore place-specific associations with prenatal care utilization." *Geojournal.* (2012); 77(3): 331-341.
26. James, P., Arcaya, M.C., Parker, D.M., Tucker-Seeley, R. "Do minority and poor neighborhoods have higher access to fast-food restaurants in the United States?" *Health Place.* (2014); 29:10-17
27. Lyseen, A.K., Nohr, C., Sorensen, E.M., Gudes, O., Geraghty, E.M., Shaw, N.T., Bivona-Tellez, C. "A Review and Framework for Categorizing Current Research and Development in Health Related Geographical Information Systems (GIS) Studies." *IMIA Yearbook of Medical Informatics.* (2014): 110-24
28. Wu, G., Bazer, F.W., Cudd, T.A., Meininger, C.J., Spencer, T.E. "Maternal Nutrition and Fetal Development." *The Journal of Nutrition.* (2004); 134:2169-2172
29. Laraia, B.A., Siega-Riz, A.M., Kaufman, J.S., Johnes, S.J. "Proximity of supermarkets is positively associated with diet quality index for pregnancy." *Preventive Medicine.* (2004); 29:869-875
30. Sram, R.J., Binkova, B., Lnenickova, Z., Solansky, I., Dejmek, J. "The impact of plasma folate levels of mothers and newborns on intrauterine growth retardation and birth weight." *Mutation Research.* (2005); 591:302-310.
31. Liese, A.D., Barnes, T.L., Lamichhane, A.P, Hibbert, J.D., Colabianchi, N., Laweson, A.B. "Characterizing the Food Retail Environment: Impact of Count Type and Geospatial Error in Two Secondary Data Sources." *J Nutr Educ Behav.* (2013). 45(5):435-442
32. Liese, A.D., Colabianchi, N., Lamichhane, A.P, Barnes, T.L, HIbbert, J.D., Porter, D.E., Nichols, M.D., Lawson, A.B. "Validation of 3 Food Outlet Databases: Completeness and Geospatial Accuracy in Rural and Urban Food Environments." *American Journal of Epidemiology.* (2010); 172:11.
33. O'Campo, P., Xue, S., Wang, MC., Caughy, MOB. "Neighborhood risk factors for low birth weight in Baltimore: a multilevel analysis." *American Journal of Public Health.* (1997); 87:1113-18

34. Roberts, EM. "Neighborhood social environments and the distribution of low birthweight in Chicago." *American Journal of Public Health.* (1997); 87:597-603
35. Pearl M., Braveman, P., Abrams B. "The relationship of neighborhood socioeconomic characterstics to birthweight among 5 ethnic groups in California." *American Journal f Public Health.* (2001): 91; 1808-14
36. Rauh, VA, Andrews, HF, Garfinkel, RS. "The contribution of maternal age to racial disparities in birthweight: a multilevel perspective." *American Journal of Public Health.* (2001), 91: 1815-1824
37. Buka, SL, Brennan, RT, Rich-Edwards, JW, Raudenbush, SW, Earls, F. "Neighborhood support and the birth weight of urban infants." *American Journal of Epidemiology.* (2003); 157:1-8.
38. Krieger, N, Chen, JT., Waterman, PD, Soobader, MJ, Subramanian, SV, Carson R. "Choosing area based socioeconomic measures to monitor social inequalities in low birth weight and childhood lead poisoning: The Public Health Disparities Geocoding Project (US)." *Journal of Epidemiology and Community Health.* (2003); 57: 186-199.
39. Morenoff, JD. "Neighborhood mechanisms and the spatial dynamics of birthweight." *American Journal of Sociology.* (2003); 108:976-1017
40. Zapata, BC, Rebolledo, A, Atalah, E., Newman, B, King, MC. "The influence of social and political violence on the risk of pregnancy complications." *American Journal of Public Health.* (1992); 82:685-690
41. Collins, JW, David, R. "Urban violence and African-American pregnancy outcome: an ecologic study." *Ethnicity and Disease.* (1997); 7:184-190
42. Messer, LC, Kaufman, S, Dole, N., Savitz, DA, Laraia, BA. "The neighborhood crime and deprivation environment and preterm birth." *Annals of Epidemiology.* (2006); 16(6):455-62
43. Lilliecreutz, C., Laren, J., Sydsjo, G, Josefsson, A. "Effect of maternal stress during pregnancy on the risk for preterm birth." *BMC Pregnancy Childbirth.* (2016); 16:5. Retrieved from https://www-ncbi-nlm-nih-gov.silk.library.umass.edu/pmc/articles/PMC4714539/
44. Knight, AK & Smith, AK. "Epigenetic Biomarkers of Preterm Birth and Its Risk Factors." *Genes.* (2016); 7(4). Retrieved from https://www-ncbi-nlm-nih-gov.silk.library.umass.edu/pubmed/27089367
45. Koullali, B, Oudijk, MA, Nijman, TAJ, Mol, BW, & Pajrkt, E. "Risk assessment and management to prevent preterm birth." *Seminars in Fetal and Neonatal Medicine.* (2016) 21:80-88.
46. Ncube, CN, Enquobahrie DA, Ablert, SM, Herrick, AL, Burke, JG. "Association of neighborhood context with offspring risk of preterm birth and low birthweight: A systematic review and meta-analysis of population-based studies." *Soc Sci Med.* (2016) 153:156-64
47. Frey, HA, Klebanoff, MA. "The epidemiology, etiology, and costs of preterm birth." *Seminars in Fetal Neonatal Medicine.* (2016); 21(2):68-73.
48. Collins JW Jr, Shay DK. "Prevalence of low birthweight among Hispanic infants with United States-born and foreign-born mothers: the effect of urban poverty." *American Journal of Epidemiology.* (1994); 139:184-192
49. Cantrell, J, Anesetti-Rothermel, A, Pearson, JL, Xiao H, Vallone, D, Kirchner, TR. "The impact of the tobacco retail outlet environment on adult cessation and differences by neighborhood poverty." *Addicition.* (2015); 110(1):152-61
50. Cole, H, Duncan, DT, Ogedegbe, G., Bennett, S., Ravenell, J. "Neighborhood Socioeconomic Disadvantage; Neighborhood Racial Composition; and Hypertension Stage, Awareness, and Treatment among Hypertensive Black Men in New York City: Does Nativity Matter?" *Journal of Racial and Ethnic Health Disparities.* (2016) epub ahead of print
51. Burke-Miller, JK, Weber, K, Cohn, SE, Hershow, RC, Sha, BE, French, AL, Cohen, MH. "Neighborhood community characteristics associated with HIV disease outcomes in a cohort of urban women living with HIV." *AIDS Care.* (2016); 28(10):1274-9

52. Wang, R., Dong, Y., Weng, J., Kontos, EZ, Chervin, RD, Rosen, CL, Marcus, CL, Redline, S. "Associations among Neighborhood, Race, and Sleep Apnea Severity in Children. A Six-City Analysis." *Annals of the American Thoracic Society.* (2017); 14(1):76-84.
53. Galin, J, Abrams, B, Leonard, SA, Matthay, EC, Goin, DE, Ahern, J. "Living in Violent Neighbourhoods is Associated with Gestational Weight Gain Outside the Recommended Range." *Paediatric and Perinatal Epidemiology*. (2016); 31: 37-46.
54. Auger, N, Daniel, M, Platt, RW, Wu, Y, Luo, Z, Chionere, R. "Association between perceived security of the neighborhood and small-for-gestational-age birth." *Paediatric and Perinatal Epidemiology*. (2008); 22: 467-77.
55. Clemens, T, and Dibben, C. "Living in stressful neighbourhoods during pregnancy: an observational study of crime rates and birth outcomes." *European Journal of Public Health*. (2016); 1-6.
56. Miranda, ML, Messer, LC, Kroeger, GL. "Associations between the Quality of the Residential Built Environment and Pregnancy Outcomes among Women in North Carolina." *Environmental Health Perspectives*. (2012); 120(3): 471-77
57. Giurgescu, C, Zenk, SN, Dancy, BL, Park, CG, Dieber, W, Block, R. "Relationships among Neighborhood Environment, Racial Discrimination, Psychological Distress, and Preterm Birth in African American Women."*JOGNN*. (2012); 41(6): E51-61
58. Kane, RJ. "The ecology of unhealthy places: Violence, birthweight, and the importance of territoriality in structurally disadvantaged communities." *Social Science & Medicine.* (2011); 73: 1585-92.
59. Masi, CM, Hawkley, LC, Piotrowski, ZH, Picket, KE. "Neighborhood economic disadvantage, violent crime, group density, and pregnancy outcomes in a diverse, urban population." *Social Science & Medicine.* (2007); 65: 2440-57.
60. Messer, LC, Vinikoor, LC, Laraia, BA, Kaufman, JS, Eyster, J, Holzman, C., Culhane, J, Elo, I, Burke, JG, O'Campo, P. "Socioeconomic domains and associations with preterm birth." *Social Science & Medicine.* (2008); 67: 1247-57
61. Margerison-Zilko, C, Cubbin, C, Jun, J, Marchi, K, Fingar, K, Braveman, P. "Beyond the Cross-Sectional: Neighborhood Poverty Histories and Preterm Birth." *American Journal of Public Health*. (2015); 105:1174-80.
62. Wallace, M, Harville, E, Theall, K, Webber, L, Chen, W, Berenson, G. "Neighborhood Poverty, Allostatic Load, and Birth Outcomes in African American and White Women: Findings from the Bogalusa Heart Study." *Health Place*. (2014); 24: 260-66.
63. Nkansah-Amankra, S., Dhawain, A, Hussey, JR, Luchok, KJ. "Maternal Social Support and Neighborhood Income Inequality as Predictors of Low Birth Weight and Preterm Birth Outcome Dispariries: Analysis of South Carolina Pregnancy Risk Assessment and Monitoring System Survey, 2000-2003." *Maternal and Child Health Journal.* (2010); 14:774-85.
64. Janevic, T, Stein, Cr, Savitz, DA, Kaufman, JS, Mason, SM, Herring, AH. "Neighborhood deprivation and adverse birth outcomes among diverse ethnic groups." *Annals of Epidemiology*. (2010); 20(6): 445-51.
65. Cubbin, C, Marchi, K, Lin, M, Bell, T, Marshall, H, Miller, C, Braveman, P. "Is Neighborhood Deprivation Independently Associated with Maternal and Infant Health? Evidence from Florida and Washington." *Maternal and Child Health Journal.* (2008); 12:61-74.
66. Ma, X, Fleischer, NL, Liu, J, Hardin, JW, Zhao, G, Liese, AD. "Neighborhood deprivation and preterm birth: an application of propensity score matching." *Annals of Epidemiology*. (2015); 25:120-25.
67. Wentz, AW, Messer, LC, Nguyen, T, Boone-Heinonen. "Small and large size for gestaional age and neighborhood deprivation measured within increasing proximity to homes." *Health Place*. (2014); 30:98-106.
68. Huynh, M, Marko AR. "Gentrification and Preterm Birth in New York City, 2008-2010." *Journal of Urban Health: Bulletin of the New York Academy of Medicine*. (2013); 91(1):211-20.

69. Elo, I, Culhane, J, Kohler I, O'Campo, P, Burke, J, Messer, L, Kaufman, J, Laraia, B, Eyster, J, Holzman, C. "Neighbourhood deprivation and small-for-gestational term births in the United States." *Paediatric and Perinatal Epidemiology*. (2009); 23(1):87-96.
70. Sundquist, J., Sundquist, K, Johansson, S, Li, X, Winkleby, M. "Mothers, places and small for gestational age births: a cohort study." *Arch dis Child*. (2011); 96: 380-85.
71. Bertin, M, Viel, J., Monfort, C., Cordier, S, Chevrier, C. "Socioeconomic Disparities in Adverse Birth Outcomes in Adverse Birth Outcomes in Urban and Rural Contexts: a French Mother-Child Cohort." *Paediatric and Perinatal Epidemiology*. (2015); 29: 426-35.
72. Lane, SD, Keefe, RH, Rubinstein, R, Levandowski, BA, Webster, N, Cibula, DA, Boahene, AK, Dele-Michael, O, Carter, D, Jones, T, Wojtowycz, M, Brill, J. "Structural violence, urban retail food markets, and low birth weight." *Health & Place*. (2008); 14:415-23.
73. Lyseen, AK, Nohr, C, Sorensen, EM, Gudes, O, Geraghty, EM, Shaw, NT, Bivona-Tellez, C. "A Review and Framework for Categorizing Current Research and Development in Health Related Geographical Information Systems (GIS) Studies." *IMIA Yearbook of Medical Informatics* (2014); 110-24.
74. Bell, N, Schuurman, N, Hayes, MV. "Using GIS-based methods of multicriteria analysis to construct socio-economic deprivation indices." *International Journal of Health Geographics*. (2007); 6:17.
75. Holford, TR, Ebisu, K, McKay, LA, Gent, JF, Triche, EW, Bracken, MB, Leaderer, BP. "Integrated Exposure Modeling: A Model Using GIS and GLM." (2010); 29(1): 116-29.
76. Shoff, C., Yang, T., Matthews, S.A. "What has geography got to do with it? Using GWR to explore place-specificc associations with prenatal care utilization." *GeoJournal*. (2012); 77(3): 331-41.m
77. ESRI. "What is GIS?" Retrieved February 9, 2017 from http://www.esri.com/what-is-gis
78. National Geographic. "GIS (geographic information system). Retrieved February 9, 2017 from http://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/
79. Engel, T, Alexander, GR, Leland, NL. "Pregnancy Outcomes of U.S.-born Puerto Ricans: The Role of Maternal Nativity Status." *American Journal of Preventive Medicine*. (1995); 11: 34-39.
80. Centers for Disease Control and Prevention. "QuickStats: Percentage of Small-for-Gestational Age Births, by Race and Hispanic Ethnicity --- United States, 2005." *Morbidity and Mortality Weekly Report*. (2008); 57(50); 1359. Retrieved February 13, 2017 from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5750a5.htm
81. Galea, S. and Link, B.G. "Six Paths for the Future of Social Epidemiology." *American Journal of Epidemiology*. (2013); 178(6): 843-49.
82. Berman, L.A., Kawachi, I., "A Historical Framework for Social Epidemiology." *Social Epideimology*. New York: Oxford University Press. (2000): 3-12.
83. Krieger, N. "A glossary for social epidemiology." *Journal of Epidemiology: Community Health*. (2001); 55(10): 693-700.
84. Diez-Roux, A.V. "Bringing Context Back into Epidemiology: Variables and Fallacies in Multilevel Analysis." *American Journal of Public Health*. (1998); 88(2): 216-22.
85. Goldberger, J., Wheeler, G.A., Sydenstrycker, E. "A study of the relation of family income and other economic factors to pellagra incidence in seven cotton mill villages of South Carolina in 1916." *Public Health Rep*. (1920); 35: 2673-2714.

For Chapters II & III

1. Centers for Disease Control and Prevention. National Prematurity Awareness Month. (2014, November 10). Retrieved October 4, 2015 from http://www.cdc.gov/Features/PrematureBirth/
2. Centers for Disease Control and Prevention. Preterm Birth. (2014, December 23). Retrieved October 4, 2015 from http://www.cdc.gov/reproductivehealth/maternalinfanthealth/PretermBirth.htm

3. Martin, J.A. Preterm Births – United States, 2007. (2011, January 14). Retrieved October 4, 2015 from http://www.cdc.gov/mmwr/preview/mmwrhtml/su6001a16.htm
4. Centers for Disease Control and Prevention. Reproductive and Birth Outcomes: Low Birth weight and the Environment. (2016, October 26). Retrieved December 15, 2016 from https://ephtracking.cdc.gov/resources/rss/showRbLBWGrowthRetardationEnv.action
5. March Of Dimes. Low birthweight. (2014, October). Retrieved December 15, 2016 from http://www.marchofdimes.org/baby/low-birthweight.aspx
6. Goldenberg, R.L. & Culhane, J.F. "Low birth weight in the United States." *The American Journal of Clinical Nutrition*. 2007; 85(suppl): 584S-90S. (http://ajcn.nutrition.org/content/85/2/584S.full)
7. http://www.childtrends.org/indicators/low-and-very-low-birthweight-infants/ &http://www.childtrends.org/wp-content/uploads/2014/07/57_appendix1.pdf
8. Berry, J. & Holloway, B. Fetal Growth Restriction (FGR). (2016) Retrieved December 15, 2016 from https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentTypeID=90&ContentID=P02462
9. Krogstad, J.M. & Lopez, M.H. "Hispanic population reaches record 55 million, but growth has cooled." *PewResearchCenter* (2015, June 25). Retrieved December 21, 2016 from http://www.pewresearch.org/fact-tank/2015/06/25/u-s-hispanic-population-growth-surge-cools/
10. Messer, L.C, Kaufman, J.S., Dole, N., Herring, A., & Laraia, B.A. "Violent crime exposure classification and adverse birth outcomes: a geographically-defined cohort study." *International Journal of Health Geographics*. (2006); 5:22. DOI: 10.1186/1476-072X-5-22
11. Meng, G., Thompson, M.E., & Hall, G.B. "Pathways of neighbourhood-level socio-economic determinants of adverse birth outcomes." *International Journal of Health Geographics*. (2013); 12:32
12. Bloch, J.R. "Using Geographical Information Systems to Explore Disparities in Preterm Birth Rates Among Foreign-born and U.S.-born Black Mothers." *Journal of Obstetric, Gynecologic, and Neonatal Nursing*. (2011); 40:544-554
13. Mitchel, E.A, Robinson, E., Clark, P.M, Becroft, D.M.O, Glavish, N., Pattison, N.S., Pryor, J.E., Thompson, J.M.D., Wild, C.J. "Maternal nutritional risk factors for small for gestational age babies in a developed country: a case-control study." *Archives of Disease in Childhood Fetal Neonatal Edition*: 2004; 89F431-F435.
14. Ma, X., Liu, J., Hardia, J.W., Zhao, G., & Liese A.D. "Neighborhood Food Access and Birth Outcomes in South Carolina." *Maternal Child Health Journal*. (2016) 20: 187-195.
15. Ostfeld, R.S., Glass, G.E., & Keesing, F. "Spatial epidemiology: an emerging (or re-emerging) discipline." *TRENDS in Ecology and Evolution* (2006); 20:6
16. Cook, J.T., Black, M., Chilton, M., Cutts, D., de Cuba, S.E., Heeren, T.C., Rose-Jacobs, R., Sandel, M., Casey, P.H., Coleman, S., Weiss, I., Frank, D.A. "Are Food Insecurity's Health Impacts Underestimated in the U.S. Population? Marginal Food Security Also Predicts Adverse Health Outcomes in Young U.S. Children and Mothers." *American Society for Nutrition* (2013); 4:51-61

17. Johnson, D.B., Quinn, E., Sitaker, M., Ammerman, A., Byker, C., Dean, W., Fleishhacker, S., Kolodinsky, J., Pinard, C., Pitts, S.B.J., Sharkey, J. "Developing an agenda for research about policies to improve access to healthy foods in rural communities: a concept mapping study." *BMC Public Health*. (2014); 14:592
18. Sharkey, .R., Johnson, C.M., Dean, W.R, Horel, S.A. "Focusing on fast food restaurants alone underestimates the relationship between neighborhood deprivation and exposure to fast food in a large rural area." *Nutrition Journal*. (2001); 10:10
19. Boulos, M.N.K. "Towards evidence-based, GIS-driven national spatial health information infrastructure and surveillance services in the United Kingdom." *International Journal of Health Geographics*. (2004); 3:1
20. Bell, N., Shuurman, N., Hayes, M.V. "Using GIS-based methods of multicriteria analysis to construct socio-economic deprivation indices." *International Journal of Health Geographics*. (2007); 6:17
21. Freedman, D.A & Bell, B.A "Access to Healthful Foods among an Urban Food Insecure Population: Perceptions versus Reality." *Journal of Urban Health: Bulletin of the New York Academy of Medicine* (2009); 86:6
22. Salmon, L. "Food security for infants and young children: an opportunity for breastfeeding policy?" *International Breastfeeding Journal*. (2015); 10:7
23. Wadhwa, P.D., Entringer, S., Buss, C., Lu, M.C. "The Contribution of Maternal Stress to Preterm Birth: Issues and Considerations." *Clinics in Perinatology*. (2011); 38(3): 351-384).
24. Holford, T.R., Ebisu, K., McKay, L.A, Gent, J.F., Triche, E.W., Bracken, M.B. Leaderer B.P. "Integrated Exposure Modeling: A Model Using GIS and GLM." *Stat Med*. (2010); 29(1):116-129
25. Shoff, C., Yang, T., Matthews, S.A.. "What has geography got to do with it? Using GWR to explore place-specific associations with prenatal care utilization." *Geojournal*. (2012); 77(3): 331-341.
26. James, P., Arcaya, M.C., Parker, D.M., Tucker-Seeley, R. "Do minority and poor neighborhoods have higher access to fast-food restaurants in the United States?" *Health Place*. (2014); 29:10-17
27. Lyseen, A.K., Nohr, C., Sorensen, E.M., Gudes, O., Geraghty, E.M., Shaw, N.T., Bivona-Tellez, C. "A Review and Framework for Categorizing Current Research and Development in Health Related Geographical Information Systems (GIS) Studies." *IMIA Yearbook of Medical Informatics*. (2014): 110-24
28. Wu, G., Bazer, F.W., Cudd, T.A., Meininger, C.J., Spencer, T.E. "Maternal Nutrition and Fetal Development." *The Journal of Nutrition*. (2004); 134:2169-2172
29. Laraia, B.A., Siega-Riz, A.M., Kaufman, J.S., Johnes, S.J. "Proximity of supermarkets is positively associated with diet quality index for pregnancy." *Preventive Medicine*. (2004); 29:869-875
30. Sram, R.J., Binkova, B., Lnenickova, Z., Solansky, I., Dejmek, J. "The impact of plasma folate levels of mothers and newborns on intrauterine growth retardation and birth weight." *Mutation Research*. (2005); 591:302-310.
31. Liese, A.D., Barnes, T.L., Lamichhane, A.P, Hibbert, J.D., Colabianchi, N., Laweson, A.B. "Characterizing the Food Retail Environment: Impact of Count Type and Geospatial Error in Two Secondary Data Sources." *J Nutr Educ Behav*. (2013). 45(5):435-442
32. Liese, A.D., Colabianchi, N., Lamichhane, A.P, Barnes, T.L, HIbbert, J.D., Porter, D.E., Nichols, M.D., Lawson, A.B. "Validation of 3 Food Outlet Databases:

Completeness and Geospatial Accuracy in Rural and Urban Food Environments." *American Journal of Epidemiology*. (2010); 172:11.
33. O'Campo, P., Xue, S., Wang, MC., Caughy, MOB. "Neighborhood risk factors for low birth weight in Baltimore: a multilevel analysis." *American Journal of Public Health*. (1997); 87:1113-18
34. Roberts, EM. "Neighborhood social environments and the distribution of low birthweight in Chicago." *American Journal of Public Health*. (1997); 87:597-603
35. Pearl M., Braveman, P., Abrams B. "The relationship of neighborhood socioeconomic characterstics to birthweight among 5 ethnic groups in California." *American Journal f Public Health*. (2001): 91; 1808-14
36. Rauh, VA, Andrews, HF, Garfinkel, RS. "The contribution of maternal age to racial disparities in birthweight: a multilevel perspective." *American Journal of Public Health*. (2001), 91: 1815-1824
37. Buka, SL, Brennan, RT, Rich-Edwards, JW, Raudenbush, SW, Earls, F. "Neighborhood support and the birth weight of urban infants." *American Journal of Epidemiology*. (2003); 157:1-8.
38. Krieger, N, Chen, JT., Waterman, PD, Soobader, MJ, Subramanian, SV, Carson R. "Choosing area based socioeconomic measures to monitor social inequalities in low birth weight and childhood lead poisoning: The Public Health Disparities Geocoding Project (US)." *Journal of Epidemiology and Community Health*. (2003); 57: 186-199.
39. Morenoff, JD. "Neighborhood mechanisms and the spatial dynamics of birthweight." *American Journal of Sociology*. (2003); 108:976-1017
40. Zapata, BC, Rebolledo, A, Atalah, E., Newman, B, King, MC. "The influence of social and political violence on the risk of pregnancy complications." *American Journal of Public Health*. (1992); 82:685-690
41. Collins, JW, David, R. "Urban violence and African-American pregnancy outcome: an ecologic study." *Ethnicity and Disease*. (1997); 7:184-190
42. Messer, LC, Kaufman, S, Dole, N., Savitz, DA, Laraia, BA. "The neighborhood crime and deprivation environment and preterm birth." *Annals of Epidemiology*. (2006); 16(6):455-62
43. Lilliecreutz, C., Laren, J., Sydsjo, G, Josefsson, A. "Effect of maternal stress during pregnancy on the risk for preterm birth." *BMC Pregnancy Childbirth*. (2016); 16:5. Retrieved from https://www-ncbi-nlm-nih-gov.silk.library.umass.edu/pmc/articles/PMC4714539/
44. Knight, AK & Smith, AK. "Epigenetic Biomarkers of Preterm Birth and Its Risk Factors." *Genes*. (2016); 7(4). Retrieved from https://www-ncbi-nlm-nih-gov.silk.library.umass.edu/pubmed/27089367
45. Koullali, B, Oudijk, MA, Nijman, TAJ, Mol, BW, & Pajrkt, E. "Risk assessment and management to prevent preterm birth." *Seminars in Fetal and Neonatal Medicine*. (2016) 21:80-88.
46. Ncube, CN, Enquobahrie DA, Ablert, SM, Herrick, AL, Burke, JG. "Association of neighborhood context with offspring risk of preterm birth and low birthweight: A systematic review and meta-analysis of population-based studies." *Soc Sci Med*. (2016) 153:156-64
47. Frey, HA, Klebanoff, MA. "The epidemiology, etiology, and costs of preterm birth." *Seminars in Fetal Neonatal Medicine*. (2016); 21(2):68-73.

48. Collins JW Jr, Shay DK. "Prevalence of low birthweight among Hispanic infants with United States-born and foreign-born mothers: the effect of urban poverty." *American Journal of Epidemiology*. (1994); 139:184-192
49. Cantrell, J, Anesetti-Rothermel, A, Pearson, JL, Xiao H, Vallone, D, Kirchner, TR. "The impact of the tobacco retail outlet environment on adult cessation and differences by neighborhood poverty." *Addicition*. (2015); 110(1):152-61
50. Cole, H, Duncan, DT, Ogedegbe, G., Bennett, S., Ravenell, J. "Neighborhood Socioeconomic Disadvantage; Neighborhood Racial Composition; and Hypertension Stage, Awareness, and Treatment among Hypertensive Black Men in New York City: Does Nativity Matter?" *Journal of Racial and Ethnic Health Disparities*. (2016) epub ahead of print
51. Burke-Miller, JK, Weber, K, Cohn, SE, Hershow, RC, Sha, BE, French, AL, Cohen, MH. "Neighborhood community characteristics associated with HIV disease outcomes in a cohort of urban women living with HIV." *AIDS Care*. (2016); 28(10):1274-9
52. Wang, R., Dong, Y., Weng, J., Kontos, EZ, Chervin, RD, Rosen, CL, Marcus, CL, Redline, S. "Associations among Neighborhood, Race, and Sleep Apnea Severity in Children. A Six-City Analysis." *Annals of the American Thoracic Society.* (2017); 14(1):76-84.
53. Galin, J, Abrams, B, Leonard, SA, Matthay, EC, Goin, DE, Ahern, J. "Living in Violent Neighbourhoods is Associated with Gestational Weight Gain Outside the Recommended Range." *Paediatric and Perinatal Epidemiology*. (2016); 31: 37-46.
54. Auger, N, Daniel, M, Platt, RW, Wu, Y, Luo, Z, Chionere, R. "Association between perceived security of the neighborhood and small-for-gestational-age birth." *Paediatric and Perinatal Epidemiology*. (2008); 22: 467-77.
55. Clemens, T, and Dibben, C. "Living in stressful neighbourhoods during pregnancy: an observational study of crime rates and birth outcomes." *European Journal of Public Health*. (2016); 1-6.
56. Miranda, ML, Messer, LC, Kroeger, GL. "Associations between the Quality of the Residential Built Environment and Pregnancy Outcomes among Women in North Carolina." *Environmental Health Perspectives*. (2012); 120(3): 471-77
57. Giurgescu, C, Zenk, SN, Dancy, BL, Park, CG, Dieber, W, Block, R. "Relationships among Neighborhood Environment, Racial Discrimination, Psychological Distress, and Preterm Birth in African American Women."*JOGNN*. (2012); 41(6): E51-61
58. Kane, RJ. "The ecology of unhealthy places: Violence, birthweight, and the importance of territoriality in structurally disadvantaged communities." *Social Science & Medicine*. (2011); 73: 1585-92.
59. Masi, CM, Hawkley, LC, Piotrowski, ZH, Picket, KE. "Neighborhood economic disadvantage, violent crime, group density, and pregnancy outcomes in a diverse, urban population." *Social Science & Medicine*. (2007); 65: 2440-57.
60. Messer, LC, Vinikoor, LC, Laraia, BA, Kaufman, JS, Eyster, J, Holzman, C., Culhane, J, Elo, I, Burke, JG, O'Campo, P. "Socioeconomic domains and associations with preterm birth." *Social Science & Medicine*. (2008); 67: 1247-57
61. Margerison-Zilko, C, Cubbin, C, Jun, J, Marchi, K, Fingar, K, Braveman, P. "Beyond the Cross-Sectional: Neighborhood Poverty Histories and Preterm Birth." *American Journal of Public Health*. (2015); 105:1174-80.
62. Wallace, M, Harville, E, Theall, K, Webber, L, Chen, W, Berenson, G. "Neighborhood Poverty, Allostatic Load, and Birth Outcomes in African American

and White Women: Findings from the Bogalusa Heart Study." *Health Place*. (2014); 24: 260-66.
63. Nkansah-Amankra, S., Dhawain, A, Hussey, JR, Luchok, KJ. "Maternal Social Support and Neighborhood Income Inequality as Predictors of Low Birth Weight and Preterm Birth Outcome Dispariries: Analysis of South Carolina Pregnancy Risk Assessment and Monitoring System Survey, 2000-2003." *Maternal and Child Health Journal*. (2010); 14:774-85.
64. Janevic, T, Stein, Cr, Savitz, DA, Kaufman, JS, Mason, SM, Herring, AH. "Neighborhood deprivation and adverse birth outcomes among diverse ethnic groups." *Annals of Epidemiology*. (2010); 20(6): 445-51.
65. Cubbin, C, Marchi, K, Lin, M, Bell, T, Marshall, H, Miller, C, Braveman, P. "Is Neighborhood Deprivation Independently Associated with Maternal and Infant Health? Evidence from Florida and Washington." *Maternal and Child Health Journal*. (2008); 12:61-74.
66. Ma, X, Fleischer, NL, Liu, J, Hardin, JW, Zhao, G, Liese, AD. "Neighborhood deprivation and preterm birth: an application of propensity score matching." *Annals of Epidemiology*. (2015); 25:120-25.
67. Wentz, AW, Messer, LC, Nguyen, T, Boone-Heinonen. "Small and large size for gestaional age and neighborhood deprivation measured within increasing proximity to homes." *Health Place*. (2014); 30:98-106.
68. Huynh, M, Marko AR. "Gentrification and Preterm Birth in New York City, 2008-2010." *Journal of Urban Health: Bulletin of the New York Academy of Medicine*. (2013); 91(1):211-20.
69. Elo, I, Culhane, J, Kohler I, O'Campo, P, Burke, J, Messer, L, Kaufman, J, Laraia, B, Eyster, J, Holzman, C. "Neighbourhood deprivation and small-for-gestational term births in the United States." *Paediatric and Perinatal Epidemiology*. (2009); 23(1):87-96.
70. Sundquist, J., Sundquist, K, Johansson, S, Li, X, Winkleby, M. "Mothers, places and small for gestational age births: a cohort study." *Arch dis Child*. (2011); 96: 380-85.
71. Bertin, M, Viel, J., Monfort, C., Cordier, S, Chevrier, C. "Socioeconomic Disparities in Adverse Birth Outcomes in Adverse Birth Outcomes in Urban and Rural Contexts: a French Mother-Child Cohort." *Paediatric and Perinatal Epidemiology*. (2015); 29: 426-35.
72. Lane, SD, Keefe, RH, Rubinstein, R, Levandowski, BA, Webster, N, Cibula, DA, Boahene, AK, Dele-Michael, O, Carter, D, Jones, T, Wojtowycz, M, Brill, J. "Structural violence, urban retail food markets, and low birth weight." *Health & Place*. (2008); 14:415-23.
73. Lyseen, AK, Nohr, C, Sorensen, EM, Gudes, O, Geraghty, EM, Shaw, NT, Bivona-Tellez, C. "A Review and Framework for Categorizing Current Research and Development in Health Related Geographical Information Systems (GIS) Studies." *IMIA Yearbook of Medical Informatics* (2014); 110-24.
74. Bell, N, Schuurman, N, Hayes, MV. "Using GIS-based methods of multicriteria analysis to construct socio-economic deprivation indices." *International Journal of Health Geographics*. (2007); 6:17.
75. Holford, TR, Ebisu, K, McKay, LA, Gent, JF, Triche, EW, Bracken, MB, Leaderer, BP. "Integrated Exposure Modeling: A Model Using GIS and GLM." (2010); 29(1): 116-29.

76. Shoff, C., Yang, T., Matthews, S.A. "What has geography got to do with it? Using GWR to explore place-specificc associations with prenatal care utilization." *GeoJournal.* (2012); 77(3): 331-41.m
77. ESRI. "What is GIS?" Retrieved February 9, 2017 from http://www.esri.com/what-is-gis
78. National Geographic. "GIS (geographic information system). Retrieved February 9, 2017 from http://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/
79. Engel, T, Alexander, GR, Leland, NL. "Pregnancy Outcomes of U.S.-born Puerto Ricans: The Role of Maternal Nativity Status." *American Journal of Preventive Medicine.* (1995); 11: 34-39.
80. Centers for Disease Control and Prevention. "QuickStats: Percentage of Small-for-Gestational Age Births, by Race and Hispanic Ethnicity --- United States, 2005." *Morbidity and Mortality Weekly Report.* (2008); 57(50); 1359. Retrieved February 13, 2017 from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5750a5.htm
81. Galea, S. and Link, B.G. "Six Paths for the Future of Social Epidemiology." *American Journal of Epidemiology.* (2013); 178(6): 843-49.
82. Berman, L.A., Kawachi, I., "A Historical Framework for Social Epidemiology." *Social Epideimology.* New York: Oxford University Press. (2000): 3-12.
83. Krieger, N. "A glossary for social epidemiology." *Journal of Epidemiology: Community Health.* (2001); 55(10): 693-700.
84. Diez-Roux, A.V. "Bringing Context Back into Epidemiology: Variables and Fallacies in Multilevel Analysis." *American Journal of Public Health.* (1998); 88(2): 216-22.
85. Goldberger, J., Wheeler, G.A., Sydenstrycker, E. "A study of the relation of family income and other economic factors to pellagra incidence in seven cotton mill villages of South Carolina in 1916." *Public Health Rep.* (1920); 35: 2673-2714.
86. Pynoos, R.R. "Traumatic stress and developmental psychopathy in children and adolescents. *American Psychiatric Press Review of Psychiatry Volume 12.* (1993)
87. Beydoun, H, Saftlast, A.F. "Physical and mental health outcomes of prenatal maternal stress in human and animal studies: A review of recent evidence." *Pediatric and Perinatal Epidemiology.* (2008); 22: 438-66.
88. Lu, M., Halfon, N. "Racial and ethnic disparities in birth outcomes: a life-course perspective." *Maternal and Child Health Journal.* (2003); 7(1): 13-30.
89. Wilson, D.K., Kliewer, W., Sica, D.A. "The relationship between exposure to violence and blood pressure mechanisms." *Current Hypertension Reports.* (2004); 6: 321-36
90. Wang, J, Zeng, Y, et al. "Risk Factors for Low Birth Weight and Preterm Birth: A Population-based Case-control Study in Wuhan, China." *J Huazhong Univ Sci Technol.* (2017); 37(2): 286-92.
91. Chasan-Taber, L., Fortner, R.T., Gollenberg, A., Buonnaccorsi, J., Dole, N., & Markenson, G. (2010). "A Prospective Cohort Study of Modifiable Risk Factors for Gestational Diabetes among Hispanic Women: Design and Baseline Characteristics." *Journal of Women's Health*, 19(1): 117-24.
92. Alexander, G.R., Kogan, M.D., Himes, J.H. "1994-1996 U.S. singleton birth weight percentiles for gestational age by race, Hispanic origin, and gender." *Maternal and Child Health Journal.* (1999); 3(4): 225-31.

93. Cox, J.L, Holden, J.M., Sagovsky, R. "Detection of postnatal depression. Development of the 10-item Edinburgh postnatal depression scale." *British Journal of Psychiatry.* (1987); 150: 782-86.
94. Tropp, L.R., Erkut, S., Coll, C.G., Alarcon, O., & Vazquez Garcia, H.A. "Psychological acculturation: Development of a new measure for Puerto Ricans on the U.S. mainland." *Educational and Psychological Measurement.* (1999); 59(2), 351-367.
95. Martin, J.A. Preterm Births – United States, 2007. (2011, January 14). Retrieved October 4, 2015 from http://www.cdc.gov/mmwr/preview/mmwrhtml/su6001a16.htm
96. Camp, N.L. "Food insecurity and food deserts." *The Nurse Practitioner.* (2015); 40(8): 32-36.
97. Furr-Holden, C.D.M., Milam, A.J., et al. "Not in My BackYard: A Comparative Analysis of Crime Around Publicly Funded Drug Treatment Centers, Liquor Stores, Convenience Stores, and Corner Stores in One Mid-Atlantic City." *Journal of Studies on Alcohol and Drugs.* (2016); 17-24.
98. Walker, R.E., Keane, C.R., Burke, J.G. "Disparities and access to healthy food in the United States: A review of food deserts literature." *Health & Place.* (2010); 876-84.