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**THE SILENT WOMB-
STILLBIRTH: A STUDY OF BIO-PSYCHO-SOCIAL RISK**

A Dissertation Presented

By

Linda Mae Belsten

To

The Graduate School

In Partial Fulfillment of the

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In

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Stillbirth is one of the most common adverse outcomes of pregnancy. Yet, there is little research that examines common risk factors for stillbirth in terms of the timing of stillbirth. This study examined ten bio-psycho-social variables considered to be risk factors for stillbirth (Maternal Age, Race, Socioeconomic Status, Level of Education, Marital Status, Licit and Illicit Drug Use, Obesity, Diabetes, Hypertension, and Adequacy of Pre-natal Care) and their relationship to the estimated gestational age (EGA) when stillbirth occurs. The nominal, dependent variable, the EGA of stillbirth, was dichotomized into two categories: 1) Early Stillbirth which equaled stillbirth 20 to 28 weeks EGA, and 2) Late Stillbirth, which equaled stillbirth after 28 weeks EGA. Data were collected via a retrospective review of the obstetrical medical records of 231 singleton stillbirths that occurred between January 2000 and December 2005, in two tertiary-care publicly funded hospitals located on Long Island, in New York State.

Although the study sample was not a probability sample, rather a population of subjects, the data analysis involved descriptive statistics and two logistic regression models. Due to the sample being treated as a population, the results of the analysis are not statistically inferential in nature, and therefore cannot be freely generalized to other pregnant women in the greater obstetrical population.

After obtaining the results of the logistic regression, as the variables Race and Diabetes showed the most variation in relation to the EGA of stillbirth, the association between these risk factors and the dependent variable became the focus of this study. Specifically, the results suggest that in this population black women were at an increased risk (Odds Ratio 2.24) of experiencing an Early Stillbirth instead of a Late Stillbirth compared with women who were not black. The results also suggest that the women in this study diagnosed with diabetes during their pregnancy were at an increased risk (Odds Ratio 2.27) of experiencing a Late Stillbirth instead of an Early Stillbirth compared with women without diabetes during their pregnancy.

Although the results of this study represent association, not causation, and cannot be inferred outside of its population, it can be said that the findings suggest that future research might focus on racism and discrimination in relation to the EGA of stillbirth. They also suggest that future research might concentrate on methods of intervention (such as reducing the number of women who are over-weight and obese prior to pregnancy), the goal being a reduction in the prevalence of gestational diabetes as it relates to the EGA of stillbirth.

These results may have several policy and program implications. In terms of prevention and early detection of chronic diseases, it would be beneficial to implement

universal health insurance as this will ease access to health care for all women throughout their lifetime. It would also be beneficial to develop and implement universal policies and programs to improve working and social conditions (e.g. paid and extended family leave after an infant is born, safe and affordable childcare services, flexible work schedules, and job security) to optimize the long-term health of women, children, and families. Last, but not least, the results suggest that it would be prudent to promote greater investments in women's health in terms of time, money and research.

DEDICATION

To my children,

Jacob, Matthew, Elizabeth, and Jonathan

For you and all that you are, I am eternally grateful and proud; and for your unfailing love and patience, I thank you.

Momma

TABLE OF CONTENTS

Contents	Page
Abstract	iii
List of Tables	ix
I. Introduction and Background	1
Research Question	7 and 46
Literature Review	9
Research Theoretical Frame of Reference	30
II. Methods	37
Research Design	37
Data Collection Tool	39
Sample	39
Method	41
Definition of Variables and Level of Measurement	41
Data Analysis.....	45
III. Results	48
Descriptive Statistics	48
Logistic Regression	61
IV. Discussion and Interpretation	67
V. Summary	77
Policy and Program Implications	80
Strengths and Limitations	83

Future Research	87
Conclusion	93
References	95
Appendix A- Glossary of Terms	114
Appendix B- Research Tool	118

LIST OF TABLES

Table	Title	Page
1	Bio-Psycho-Social Risk Factors by Key Publication	4
2	Medical Risk Factors by Key Publication	5
3	Maternal Age	51
4	Race of Mother	52
5	Socioeconomic Status (Payer Source)	53
6	Marital Status	54
7	Obesity/Body Mass Index	55
8	Adequacy of Prenatal Care	56
9	Level of Education	57
10	Licit and Illicit Drug Use/Abuse	58
11	Diabetes	59
12	Hypertension	60
13	Estimated Gestational Age of Stillbirth: Early and Late	61
14	Logistic Regression Analysis: Model One	62
15	Logistic Regression Analysis: Model Two	65

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CHAPTER ONE

INTRODUCTION AND BACKGROUND

A stillbirth is one of the most common adverse outcomes of pregnancy (Goldenberg, 2004). Of the approximately 6.2 million pregnancies in the United States each year, 4 million (63%) result in a live birth. About 20% of pregnancies are induced terminations (abortions), and 16%, or close to 1 million pregnancies end in fetal death (Martin and Hoyert, 2002). Based upon the standards of the World Health Organization (WHO), fetal death is an inclusive term encompassing stillbirth, spontaneous abortions, and miscarriages (Martin and Hoyert, 2002).

In the US, stillbirth occurs in nearly 1% (or 7 per 1000) of all births, and accounts for nearly 50% of perinatal mortality (defined as fetal deaths from 20 weeks gestation, and infant death through one year of life) (Ventura, 2001; Buck and Johnson, 2002). In the year 2002, the number of reported stillbirths in the US was nearly 27,000 (Goldenberg, 2004). Nearly half of these stillbirths occurred after 27 weeks of amenorrhea (since the time of a woman's last menstrual period) and 20% (approximately 5000) occurred at or later than term (38 to 44 weeks gestation or fetal life). For the majority of these fetal deaths, the etiology was unexplained (Froen, 2001; Hankins et al, 2002).

In many countries world-wide, especially in the most developed ones, there has been a significant reduction in stillbirths over the past several decades. For example, from 1970 to 1998, the US stillbirth rate fell from 14.0 to 6.7 per 1000 births (Martin and Hoyert, 2002). Much of this decrease has occurred with near-term or term stillbirths (36 to 40 weeks of fetal life), and was mostly due to improvements in medical care (Goldenberg, 2004). Despite these changes, stillbirth still accounts for almost half of all

perinatal mortality in the U.S.

Defining Stillbirth

For the purposes of this research, a stillbirth is defined using the common US definition, which is fetal death occurring at greater or equal to 20 weeks of fetal life or a birth weight greater than 350 grams (Martin & Hoyert, 2002). Stillbirths are traditionally divided into three categories: 1) Early pre-term, usually 20 to 28 weeks estimated gestational age (EGA) or estimated number of weeks of fetal life; 2) late pre-term from 28 through 37 weeks EGA; and 3) those occurring at term or after (38 to 44 weeks of fetal life) (Goldenberg, 2004). Stillbirths are also classified according to their timing in relationship to labor: ante-natal (before the onset of labor) or intra-partum (during labor).

The primary objective of the present study is to examine the variation in specific bio-psycho-social risk factors for stillbirth (Maternal Age, Race, Socioeconomic Status, Marital Status, Obesity, Adequacy of Prenatal Care, Level of Education, Licit and Illicit Drug Use/Abuse, Diabetes, and Hypertension), in relation to one of two gestational ages during the second half of pregnancy. Hence, for this study, stillbirths were divided into two groups (which arbitrarily divides the last half of pregnancy into approximately two equal parts) 1) Early Stillbirth; defined as a stillbirth occurring between 20 to 28 weeks of fetal life, and 2) Late Stillbirth; defined as a stillbirth occurring after 28 weeks of gestation or fetal life. Death itself was defined as having no signs of life, such as a heartbeat or spontaneous respiration after delivery (Goldenberg, 2004).

Stillbirth Risk Factors and Causes

In the past six to seven decades, there have been a fairly large number of studies concerning the risks and causes of stillbirth; however, for the majority of stillbirths, the etiology is unexplained and definitive answers remain elusive. In the literature, stillbirth research often categorizes and explores fetal death in one of two ways: one is by presumed risk factors and the second is by presumed etiology (Goldenberg, 2004).

Risk factors are described as certain maternal and/or medical characteristics that are associated with stillbirth, but without a known causal pathway leading to death (Goldenberg, 2004). These risk factors can be broadly categorized as: 1) those that are psycho-social in nature, and 2) those that are considered medical in nature. The truth of the matter is however, that the risk factors for stillbirth are not so easily separated, especially as reproduction not infrequently involves medical risk, as well as human beings that live and work in a world that is unpredictable. Given that the risk for stillbirth involves a mixture of factors that are psycho-social and medical, together they are termed ‘bio-psycho-social’, and in combination are of interest in this study. As several terms throughout this research may be unfamiliar to those not in the medical field, a glossary of terms is available (see Appendix A) for reference.

Bio-psycho-social risk factors for stillbirth that have been reported in the literature: Table 1 captures each risk factor along with the key publication(s) that provide comprehensive summaries and/or research findings.

Table 1: Bio-Psycho-Social Risk Factors by Key Publication.

Risk Factor	Author(s)
Teen-age pregnancy	Mclean, 1993
Advanced maternal age	Fretts, 1995
Unmarried	Sims, 2001
History of previous stillbirth	Goldenberg, 2004
Maternal obesity	Froen, 2001; Goldenberg, 2004; Nohr, 2005
Race	Herschel, 1995; Buck, 1995; Vintzileos, 2002; Salihu, 2004; Lieberman, 2004
Low socioeconomic status	Guildea, 2001
Inadequate access to prenatal health care	Petitti, 1987; Alexander, 1998
Low level of education	Little and Weinberg, 1993
Poor maternal nutrition/weight gain during pregnancy	Petitti, 1987
Inadequate housing, poor social support, neighborhood violence	Alexander and Kogen, 1998; Roux, 2001
Stress	Edwards, 1994
Depression	Orr and Miller, 1994
Smoking	Wisborg, 2001
Alcohol and illicit substance abuse	Little and Weinberg, 1993
Maternal/fetal trauma	Goldenberg, 2004

The causes of stillbirth have also been described, and these are considered primarily medical in nature (Goldenberg, 2004). Table 2 summarizes these factors with associated publications. Additional medical entities have also been implicated to cause stillbirth. For brevity, these will be discussed later. Please refer to Appendix A (Glossary) for a definition of these medical terms.

Table 2: Medical Risk Factors by Key Publication

Medical Risk Factor	Author(s)
Congenital anomalies	Goldenberg, 2004
Infection	Goldenberg, 2004
Asphyxia	Goldenberg, 2004
Placental abruption	Goldenberg, 2004
Hypertension	Goldenberg, 2004
Diabetes	Cattingius and Stephansson, 2002
Post-dates delivery	Yudkin, 1987
High and low hemoglobin concentration	Goldenberg, 2004
Umbilical cord accidents	Gomez, 1997; Haddad, 2001; Collins, 2002, Simpson, 2002

THE RESEARCH QUESTION

As stillbirth accounts for nearly 50% of the perinatal mortality in the US and represents a significant adverse pregnancy outcome (Buck and Johnson, 2002; Ventura, 2001), more research concerning stillbirth is needed and may provide clues as to how various bio-psycho-social factors affect mother, fetus, and infant. Some researchers

concerned with maternal-fetal outcomes have proposed that studies involving the bio-psycho-social risk factors with links to stillbirth may represent a form of quality assurance for the measurement of both social welfare policies and medical care in the US (Forbes and King, 1995; Berger, 2001; Simpson, 2002). They believe that research is beneficial in the development of an appreciation for the significance of bio-psycho-social risk factors as they interact with medical processes. It is also believed that this research will be useful to assist in the development of strategies for prevention, legislation, and policy development, which could improve efforts to reduce adverse reproductive outcomes (Forbes and King, 1995; Kotch, 1997).

In the literature, there are many studies concerned with various bio-psycho-social risk factors, and their association with stillbirth occurring after 20 weeks EGA (normal pregnancy = 40 weeks EGA). However, after careful review of the literature, there is little research concerning the relationship between bio-psycho-social risk factors for stillbirth and the estimated fetal age (EGA) when a stillbirth occurs. Some of the studies in the literature that involve the specific timing of stillbirth include research that examines the risks of pre-maturity and fetal outcome (Main, 1987; Fretts, 1992; Gomez, 1997; Alexander, 1998; Covington, 2001). The increased risk in postdates pregnancies (those greater than 40 weeks in length) and stillbirth is also well-documented (Yudkin, 1987; Cotsias, 1999; Smith, 2002). There also appears to be a relationship between maternal infection and stillbirth, which is influenced strongly by gestational age: the earlier the stillbirth, the more likely it is to be related to an infection (Herschel, 1995; Goldenberg, 2004). There is also a study that examines race in relation to stillbirth risk (Guendelman, 1994). This research found that Hispanic women experienced higher rates

of term stillbirths (38 weeks to 40 weeks gestation) as compared to white women; however, the researchers believe that this finding may have been due to poor access to prenatal medical care for Hispanic women. Chang (2003) also found an increased risk for black teenagers experiencing a stillbirth prior to 32 weeks EGA as compared with white teenagers. Women with diabetes (diabetes occurring during pregnancy or GDM) seem to have a greater risk of having a stillborn infant after 28 weeks gestational age (Copper et al, 1994; Goldenberg, 2004). However, women with diabetes prior to pregnancy may have a greater risk of stillbirth prior to 28 weeks EGA (Copper, 1994; Gabbe, 2002). Lastly, research by Nohr (2005), reports that women who are obese before and during their pregnancies, have a risk of stillbirth at 40 weeks gestation that is three times greater as compared with 20 weeks gestation.

After a careful review of the stillbirth literature, there is a paucity of research that examines several (ten) significant bio-psycho-social risk factors: Maternal Age, Race, Marital Status, Education Level, Socioeconomic Status, Adequacy of Prenatal Care, Licit and Illicit Drug Use/Abuse, Obesity, Diabetes, and Hypertension, and their association with the timing of or gestational age when a fetal death occurs. Perhaps, by appreciating the presence of these risk factors either before or very early in pregnancy, modifications in social services and prenatal care may be implemented and thereby prevent an Early and/or a Late Stillbirth.

The problem of focus then, for this research involves the following questions:

- Is the risk of stillbirth greater early in pregnancy (from 20 to 28 weeks estimated gestational age), or is the risk of stillbirth greater later in pregnancy (from 28 weeks to 42 weeks estimated gestational age)?

- Are there identifiable differences in the timing of fetal death dependent upon one bio-psycho-social risk factor or groups of bio-psycho-social risk factors?

Stillbirth is a tragedy affecting parents and families of all races, ethnicities, and income groups. As a significant public health problem, it deserves more research attention. This study will contribute to a greater understanding of the risk factors associated with stillbirth and may inform prevention strategies and policy initiatives aimed at the reduction of stillbirth, especially in disadvantaged and under-served populations.

CHAPTER TWO

REVIEW OF THE LITERATURE

There is a large body of literature that defines many factors concerning poor reproductive outcomes, including stillbirth. For organization and clarity, this review of the stillbirth literature is divided into two categories: 1) maternal and bio-psycho-social risk factors and stillbirth, and 2) medical causes and risk factors and stillbirth. Included are several studies involving both of these categories; both in regard to their respective relationships to stillbirth, as well as in regard to the relationship they have to each other. In addition, this review includes research related to risk factors that have been associated with the EGA of stillbirth. (See the Appendix A for definitions of key terms used throughout this paper.)

The many medical risk factors associated with stillbirth are well described but do not delimit investigation into causal or associated factors placing women at risk. The literature also describes the many bio-psycho-social risk factors that contribute to increased risk for stillbirth. In fact, acknowledgment has been given by the medical profession (Rowley, 1994, pg. 761) that: “It (medicine) can only do so much to contribute...to the effort to reduce the stillbirth rate here in the United States and abroad.” Per Rowley, “...the rate reduction and prevention of poor fetal outcomes, including stillbirth, will not substantially occur until research is conducted that incorporates the social, cultural, and political context of life for women, the environmental stressors and the physiological responses associated with stress, and the protective mechanisms available within women and in the community for responding to stress.” For those involved in medicine and reproductive health to admit to such limitations and to seek

assistance from those within the psycho-social world is important. It is therefore essential not only to include bio-psycho-social factors in the discussion concerning the risks and causes of stillbirth, but it is imperative to study these factors as carefully and as diligently as possible.

As previously described, bio-psycho-social risk factors may be defined as maternal characteristics that are associated with poor fetal outcomes and stillbirth, but are without a known causal pathway leading to death (Goldenberg, 2004). (Refer to Tables 1 and 2). Within this array of risk factors; there are certain ones in the U.S. literature that are found repeatedly to be statistically significant. These include: extremes in maternal age (less than 20 and greater than 35 years), black race, marital status (single), low socioeconomic status, low educational level, inadequate prenatal care, obesity, licit and illicit substance use/abuse, diabetes, hypertension, poor obstetrical history, hypertension, post-dates pregnancy or fetal age greater than 40 weeks gestation, and maternal-fetal trauma. For completeness, these and all of the previously mentioned risk factors will be discussed in the following literature review, reporting on both national and international research.

Bio-Psycho-Social Risk Factors and Stillbirth: A View From Abroad

There is a large amount of scholarly literature on bio-psycho-social risk factors specific to stillbirth that is foreign-based; however, this body of evidence fails to take into account several confounding variables (such as the heterogeneity of our population, different systems of health care delivery, various sources of health care funding, methods of stillbirth data collection, and racism), which may exaggerate or underestimate the true risk as it exists here in the United States.

In the recent foreign-based literature, low socioeconomic status is associated with stillbirth risk in Sweden (Stephansson, 2001), the United Kingdom (Guilda, 2001), and the Czech Republic (Carlson, 1999). In Finland, lack of maternal education was found to be a risk factor (Hemminki, 1992) but not in Denmark, where stillbirth rates were found to be independent of the educational level of mothers. In Sweden, women employed in blue-collared positions were found to have an increased risk of stillbirth when compared to women in white-collared positions (Stephansson, 2001). In recent years, also in Sweden, the relationship between maternal obesity and stillbirth has become apparent (Cnattingius, 1998; Stephansson, 2001). Stephansson (2001) found that Swedish women with a BMI > 29 had a two-fold increase in stillbirth, and this risk remained after adjusting for other risk factors, including smoking. Cnattingius (1998) reported that obese, first-time mothers had more than a four-fold increased risk of stillbirth. And as previously mentioned, in a large Danish cohort study, obese women tripled their risk of stillbirth at 40 weeks gestation as compared to their risk at 20 weeks gestation (Nohr, 2005).

In the United Kingdom, there is extensive documentation of the link between poor prenatal care and stillbirth. A government report of a study of fetal deaths in 1996 and 1997 revealed that poor prenatal care may have contributed to as many as 50% of stillbirths and early infant deaths during those years (Mayor, 2001; Pownell, 1999). Identified areas of negligence included lack of risk assessment for pregnant women and failure of health practitioners to act on reduced fetal movements reported by mothers.

Research indicating strong associations between preventable health behaviors and stillbirths is also found in the foreign-based literature. For example, a recent Danish

population study on cigarette smoking, with adjustment for effect modifiers, indicates that as many as 25% of stillbirths are preventable if pregnant women stop smoking by the 16th week of pregnancy (Wisborg, 2001). In a prospective study on alcohol use in Denmark, Kesmodel (2002) found that stillbirth risk for women who consumed 5 or more drinks in a week was nearly three times increased as compared to women who did not drink, when controlling for smoking, age, obesity, and other obstetric risk factors.

Stillbirth Literature in the United States

Given such differences in our population, (e.g. systems of health care delivery, sources of health care funding, methods of stillbirth data collection, and the social tensions that population diversity can imbue), it is fortunate that there is a growing amount of research on stillbirth which addresses variables relevant to our health care system and society.

Of studies based in the United States, there is a universal finding that past pregnancy outcomes are predictive of future outcomes, and this relationship is true for stillbirth (Goldenberg, 2004). This suggests that when a stillbirth occurs in the case of a first-time mother, careful attention must be given to possible cause, in order to possibly prevent a second such occurrence.

Research in the United States has also consistently shown that teenagers and women greater than age 35 have an increased risk for stillbirth and that this is independent of socioeconomic and other risk factors (Petitti, 1987; McClean, 1989; Buck, 1995; Chang, 2003; Goldenberg, 2004). Fretts (1995) reported a doubling in the risk of stillbirth after the age of 35 (compared with women between ages 20 to 35 years of age), increasing to a relative risk of 2.4 for those aged 40 or older. Increasing parity (the number of

pregnancies a woman has in her lifetime) is related to advanced maternal age (women greater than 35 years of age), but unlike advanced maternal age, Fretts (1995) reports increasing parity has not been consistently shown to be related to stillbirth. Despite this, Fretts (1997) reported that older women had a significantly higher risk for unexplained fetal death. Goldenberg (2004) feels that it is important to note that in the USA and in Canada, advanced maternal age (> age 35), is becoming increasingly more prevalent, pointing to the potential of increasing numbers of stillbirths.

Lower socioeconomic status has been shown to be associated with an increased risk of stillbirth; the reasons for this relationship, however, remain unknown (Little and Weinberg, 1993; Cnattingius and Stephansson, 2002). In a series of studies, Stephansson and Cnattingius (after moving to the U.S. in 2002) examined each of the known characteristics associated with low socioeconomic status, such as smoking, alcohol and drug use, increases in maternal age and body mass index (BMI). None of these factors completely explained the increased risk of stillbirths in their sample. Since the increase in stillbirths in women of low socioeconomic status was more likely to occur in term or near-term fetuses, they hypothesized that subtle differences in medical care may explain the differences in outcome. Delke (1988) also felt that maternal and social factors that result in inadequate care were more important than specific medical causes as contributing factors to avoidable stillbirths.

Race is another risk factor for stillbirth (Silver, 2007). Black women generally have more adverse pregnancy outcomes than do white or Hispanic women, and stillbirth is no exception (Goldenberg, 2004; Silver, 2007). In a study done in 2002, Vintzileos found a greater (by two-fold) risk of stillbirth in African American women as compared to

Caucasian women. In this research Vintzileos and associates examined the issue of racial disparity in relationship to prenatal care. They reported that some, but not all, of the difference in stillbirth rates was associated with reduced prenatal-care utilization by black women. Approaching the issue from a different perspective, Hsieh (1997) evaluated differences in the birth weight-specific stillbirth rate between black and white women. They found that fetal growth and infant birth weights for blacks to be consistently 10 percent below the fetal growth and infant birth weights of whites. They concluded that most of the racial disparity in stillbirth rate was due to differences in fetal growth and birth weight distribution suggesting that only when differences in low birth weight or pre-term birth between blacks and whites are eliminated, would the disparity in stillbirth rates disappear.

Herschel and colleagues (1995) evaluated causes of fetal mortality among black women in Chicago and compared the results with those of Fretts (1992) from a white population in Montreal. There were a number of differences in the causes of fetal mortality between the two study populations. Among the most impressive, there was a nine-fold increase in hypertensive-associated fetal mortality and a two-fold increase in placental abruption (premature detachment of the placenta from the uterus) among blacks in Chicago as compared to whites in Montreal. In the black population, there were also more deaths associated with fetuses being small for gestational age (SGA), umbilical cord accidents (prolapsed cord) and lack of fetal oxygen during labor (asphyxia). In a study of California births from 1984 to 1989, Guendelman (1994) demonstrated equivalent stillbirth rates for white and Hispanic women, but a 2.5-fold increase for black women. In Guendelman's study, Hispanic women had lower rates of pre-term stillbirths

(stillbirths occurring prior to 38 weeks EGA), but higher rates of term stillbirths (stillbirths occurring after 38 weeks EGA) compared to white women; the latter being likely due to poor access to, or poor utilization of obstetrical care.

The inability to pay for health care is also a strong predictor of fetal deaths for all ethnic groups, but more for black women (Chek and Kerr (1999)). Chek and Kerr studied the ability to pay for pre-natal care and stillbirth in white women, Hispanic women and black women living in Texas and reported white and Hispanic mortality rates as being similar, while black rates were two times greater.

Research in the United States points to an inverse relationship between both the quality and quantity of prenatal care utilized and stillbirth (Alexander, 1998; Guendelman, 1994; Kogen, 1998; Modestin, 2001; Maupin, 2004). In contrast to previously mentioned research in the United Kingdom, studies done in the United States suggest that inadequate prenatal care is due to lack of insurance, education and social supports (Huang, 2000; Maupin, 2004). Maupin et al (2004), researched women who deliver with 'no prenatal care' and describe certain characteristics which they possess. Women who receive no prenatal care are more likely to be multi-parous (have delivered more than one child), less educated, uninsured (poor), smokers, and have a prior history of licit and illicit substance abuse. Research in the United States also suggests that lower maternal education is a factor for increased stillbirth risk (Petitti, 1987; Emanuel, 1989; Little and Weinberg, 1993; Sims and Collins, 2001). Cigarette smoking (McCormick et al, 1989; Little and Weinberg, 1993) is not only well-documented as being associated with an increased risk of stillbirth, but Goldenberg (2004) believes that smoking is likely causal for stillbirth. This is due conceptually to there being both a strong dose-response

relationship as well as biological plausibility. Smoking increases fetal carboxy-hemoglobin as well as vascular resistance, both resulting in decreased fetal oxygenation and decreased growth. In addition, the placenta often has significant pathological changes in pregnant smokers. For example, in a study by Mayer and Tonascia, (1977), the elevated risk of fetal death due to smoking was due largely to placental abruption (premature separation of the placenta from the uterus) and placenta previa (a placenta located in the uterus that is abnormally located over the cervix). Raymond (1994) confirmed that while smoking and stillbirth were related, the association was explained by the higher incidence among smokers of fetal growth restriction (infants that do not grow normally in utero) and placental complications (including abruption). Similarly, in a study by Naeye (1980), while there was a 40% increase in fetal death associated with smoking, all of the increase in stillbirth was explained by placental abruption and growth restriction.

Other toxic substances have also been shown to be associated with an increase in stillbirth risk. A meta-analysis of cocaine use showed that users had almost a six-fold increased risk of stillbirth likely due to its association with both growth restriction and placental abruption (Lutiger, 1991). Alcohol use has also been associated with increased risk of fetal death (Faden, 1997); marijuana use however, has not been shown to be associated with an increase in stillbirths (Fergusson et al, 2002).

Poor nutritional status has been associated with an increased risk of stillbirth (Ogunyemi, 1998) and low hemoglobin concentrations are used in pregnancy as a marker for poor nutritional status. Poor nutritional status in terms of iron-deficiency anemia is routinely screened for, and often diagnosed in pregnancy, specifically involving a

hemoglobin concentration less than 10 gm/dl (Gabbe, 2002).

Actually, the relationship between maternal hemoglobin concentrations and pregnancy outcome is an area that has been studied for several decades. Goldenberg et al (1991 and 1993) show a U-shaped relationship in which both low and high hemoglobin values are related to an increased risk of stillbirth.

Maternal injury is considered by some researchers to be causal for stillbirth. Weiss (2001) determined that for every 100,000 live births, there are about four fetal deaths due to maternal injury. Automobile accidents are the leading cause of these deaths, followed by firearm injuries and falls. These types of fetal death are three times more common in young women under the age of 20. It has been noted that in the event of a motor vehicle accident, pregnant women not wearing seat belts were three times more likely to have a stillbirth than women who were wearing seat belts (Hyde, 2003). One relatively unexplored area is the degree to which stillbirths are associated with violence, especially domestic violence (Goldenberg, 2004).

There are several other bio-psycho-social factors that have been explored and found to be associated with an increased risk of poor fetal outcome and stillbirth. Being single has been found to be consistently associated with an increased risk of stillbirth (Emanuel, 1989; Petitti, 1987; Sims and Collins, 2001). Related to being unwed, poor fetal outcomes are associated with an inadequate social support system for the mother, including those that involve a significant other, family, and neighborhood support (Turner et al, 1990; Roux, 2001; Buka et al, 2003). Unstable and inadequate housing as well as homelessness have been shown to increase risk for poor fetal outcomes and stillbirth (Alexander and Kogan, 1998). Stillbirth risk has been found to be greater in

women who experience significant anxiety and depression during the course of their reproductive years and pregnancies (McCormick, 1989; Orr and Miller, 1994). Lastly, two additional factors that have recently been associated with an increase in stillbirth risk are racism and stress (Lu and Halfon, 2003). Several studies have focused on these concepts, with seemingly positive associations to stillbirth; however, due to the subjective nature of racism and stress and their relation to stillbirth, it has been challenging to quantify this relationship (Nuckolls, 1971; Ferguson and Myers, 1990; David and Collins, 1991; McClean, 1993; Edwards et al, 1994; Livingston, 2003; Salihu et al 2004).

In the literature there are several bio-psycho-social risk factors for stillbirth that have been consistently found to be significant in relationship to stillbirth risk. These include Maternal Age, Race, Marital Status, Education Level, Socioeconomic Status, Licit and Illicit Drug Use/Abuse, and Adequacy of Prenatal Care, which is why these risk factors are 7 of the 10 primary variables of interest in this research, specifically in their relation to the EGA when a stillbirth occurs. There are also many risk factors and causes of stillbirth that are considered medical in nature. The following section continues with an exploration and review of this literature.

Medical Factors: Stillbirth Causes and Risks

Disease

It has been recognized, for quite some time, that certain maternal diseases are either the cause or greatly increase the risk of intrauterine fetal death. In the 1950's, the rate of stillbirth in the United States was 14 per 1000 live births. The toxemias of pregnancy (preeclampsia, eclampsia, and superimposed preeclampsia involving chronic

hypertension) accounted for 21% of stillbirths, while 12% were attributable to diabetes mellitus and 4% to erythroblastosis fetalis (Tricomi and Kohl, 1957). Beginning in the 1950's, and continuing through 1985, the stillbirth rate fell from 14.0 to 7.8 per 1000 live births (Fretts et al, 1992). This decline is attributable to the introduction of effective interventions in pregnancy to prevent negative outcomes traditionally associated with these diseases. However, to keep proper perspective concerning fetal outcomes, it should be appreciated that from 1985 to 1998, while infant mortality declined by 32%, from 10.6 to 7.2 per 1000 live births, the rate of stillbirth declined by a more modest 14 %, from 7.8 to 6.7 per 1000 live births (MacKay et al, 2001). This more modest decline in stillbirth rate may be due in part to 3 factors which are all associated with a higher risk of stillbirth:

- 1) The obesity epidemic that has recently developed in the U.S. It is now estimated that 47 % women between 20 and 39 years of age are either over-weight or obese (Clark, 2006);
- 2) Women with chronic diseases (e.g. insulin dependent diabetes or primary infertility (women who have never conceived) who previously did not get pregnant or could not get pregnant, do so now with the help of assisted reproduction techniques (Goldenber, 2004; Silver, 2007);
- 3) In recent years, due to diminishing stigma of having a pregnancy and baby without the 'benefit of marriage', more single women (a significant number of these greater than 35 years of age), many with chronic medical conditions (e.g. hypertension) and other bio-psycho-social risk factors (e.g. low socioeconomic status) elect to continue their pregnancies (Goldenberg, 2004).

Since the mid 1980's, several medical diseases have been recognized and researched carefully as contributing to the rate of stillbirth. Simpson (2002), in his review of the literature, found that about 10% of fetal deaths at 20 weeks or more were related to

maternal medical illnesses such as hypertension, diabetes, lupus, chronic renal disease, thyroid disorders, and cholestasis of pregnancy. In addition, in the past two decades obesity has increasingly been found to be associated with stillbirth (Cnattingious, 1998; Froen, 2001; Nohr, 2005).

Over the past five or six decades, with the exception of obesity, the decrease in fetal deaths associated with certain medical conditions has been remarkable (Goldenberg, 2004). For example, 100 years ago nearly half of fetuses of diabetic mothers died, and currently, the stillbirth rate for diabetic mothers is 10 to 35 per 1000 live births. The reported fetal mortality rates vary depending on the type of diabetes, severity, type of medical care program, etc., but most studies now suggest that with intensive medical management, stillbirth rates approaching those seen in the general population can be achieved (Goldenberg, 2004). For example, using National Vital Statistics System (NVSS) data for 1995 -1997, Mondestin (2002) found a stillbirth rate for non-diabetic women of 7.2 per 1000 live births, while among diabetics it was 8 per 1000 births.

There is however, an important issue related to fetal death and diabetes which needs to be examined further, and that is the extent to which unexplained stillbirths are related to glucose intolerance or pre-diabetes. Lau and Li (1994) found 18% of patients with unexplained stillbirths had abnormal prenatal glucose testing, but were at levels that did not meet the criteria for gestational diabetes or diabetes solely during pregnancy. Goldenberg (2004) recommended that it may be prudent in future to examine the relationship between obesity, borderline glucose intolerance, gestational diabetes, and stillbirth, especially as our pregnant (and not pregnant) female populations become increasingly obese.

For years, various types of hypertensive disorders have been associated with stillbirths (Morrison, 1985; Mabie, 1986; Petteti, 1987). In the past, these disorders accounted for 20 -40% of all stillbirths, but recent studies suggest that this number is now 4 to 9% (Goldenberg, 2004). Most researchers agree that the increased risk of stillbirth associated with hypertension is found mostly in women with preeclampsia and eclampsia, and that among women diagnosed with solely chronic hypertension, the risk of stillbirth is not increased, provided the chronic hypertension is well-controlled. Pathology leading to stillbirth in women with preeclampsia involves primarily a reduction in blood flow and oxygen to the fetus and includes placental infarction, uteroplacental insufficiency without infarction, fetal-maternal hemorrhage, and placental abruption (Goldenberg, 2004).

Similar to studies in Sweden and Denmark, research in the United States has supported the relationship maternal obesity and stillbirth (Buck, 2002). More specifically, Froen (2001) and Cnattingious (1998) have reported obesity, with a pre-pregnant body mass index (BMI) greater than 29, as being very strongly associated with an increased risk of stillbirth. The exact mechanism for this association is unknown, and although it is not explained completely by the increases in diabetes and hypertension associated with obesity (Goldenberg, 2004), there may an association between pre-diabetes or mild glucose intolerance, obesity and stillbirth (Wood et al, 2000). On the other hand, for underweight women (pre-pregnancy BMI < 20) Ogunyemi (1998) reported an increased risk for stillbirth and an increased risk for a fetus being small for their gestational age (SGA). Optimizing maternal weight gain during pregnancy for these underweight women seems to reduce these risks. Although for obese women there appears to be no association between the amount of weight gained in pregnancy and the risk of stillbirth,

given the increase in recent years in the number of obese women of child-bearing years in the US, obesity as a risk factor for stillbirth, needs additional research (Goldenberg, 2004).

Small for gestational age/intrauterine growth restriction (SGA/IUGR), which is inadequate fetal growth during a pregnancy, has been associated with stillbirth in nearly all studies examining this relationship (Goldenberg, 2004). SGA and IUGR are also associated with women who experience pre-eclampsia and hypertension during their pregnancies (Heschel, 1995). Delke (1988) found that in 34% of stillbirths, there was a failure to diagnose IUGR, despite sufficient clinical evidence to suspect it. Another example, Seeds and Peng (1998) evaluated fetal mortality versus percentile of birth weight in Virginia from 1991 to 1993. They found that fetal mortality increased as the percentile birth weight for gestational age decreased below the 15th percentile. For these reasons, Gadow et al (1991) came to the conclusion that a significant proportion of unexplained stillbirths are associated with undiagnosed IUGR. They propose that better clinical detection of fetuses that are SGA, in conjunction with the appropriate initiation of antenatal (before birth) surveillance, will provide the greatest potential to reduce stillbirth. Furthermore, they provide evidence that SGA that is defined by the use of a customized birth weight standard involving maternal size, number of previous pregnancies, ethnicity and infant sex, is a better predictor of stillbirth than is SGA defined by population-based standards. Divon (1998) also describes the importance of the interaction between IUGR and postdate pregnancies (pregnancies lasting longer than 40 weeks in length) contributing to increases in the incidence of stillbirth.

Postdate pregnancies have consistently been associated with an increased risk of fetal

death (Goldenberg, 2004). Goldenberg proposes that there is a calculated risk of stillbirth that exists for each gestational age or number of weeks of intrauterine fetal life. He believes that the most appropriate denominator for the number of fetal deaths in a given week of gestational age is the number of fetuses undelivered when that week began. Considered from this vantage point, pregnancies in the 41st and 42nd weeks have been reported to have anywhere from a two to a ten-fold increased risk of stillbirth compared to pregnancies in the 39th and 40th week. Yudkin (1987) and Smith (2001) concur with these findings. Fortunately, the increasing number of inductions of labor in the 41st and 42nd weeks of pregnancy appears to have reduced the stillbirths previously occurring at these and more advanced gestational ages (Sue-A-Quan, 1999; Cotzias, 1999).

To better appreciate the risk of stillbirth for various medical conditions as compared to the rate of stillbirth for all pregnancies, Simpson (2002) summarized the data as follows: stillbirth risk for all pregnancies = 7 per 1000 live births; for obesity = 15 -20 per 1000 for diabetes = 15-150 per 1000; for hypertension = 15- 300 per 1000; lupus = 40-150 per 1000; chronic renal disease = 15-300 per 1000; thyroid disorders = 15-156 per 1000; and cholestasis of pregnancy = 12-30 per 1000 live births.

Stillbirth: Classified By Physiological Mechanism of Death

In addition to risk factors and causes of fetal death as a method to medically classify and explain stillbirths, another approach is by the physiological mechanism of death. It includes several factors and concepts that are important as they relate to biological and physiological processes that result in stillbirth.

Benden (2001) described three common mechanisms which lead to fetal death: hydrops (severe anemia), asphyxia (lack of oxygen), and shock (changes/significant

reduction in intra-vascular pressure), with each having in common disruptions of essential gas exchange (such as oxygen) between mother and fetus. For each of these mechanisms, Bendon emphasizes that a large number of etiologies may be involved. For example, hydrops, which is usually classified as immune and non-immune, may be caused by anemia secondary to Rh disease, structural heart and cardiac rhythm disease, disorders of other maternal organs, fetal-maternal hemorrhage (significant blood exchange between mother and fetus), and parovirus, as well as other fetal infections. An asphyxial death (from lack of oxygen) may result from a chronic retroplacental hematoma (a collection of blood behind the placenta), acute abruption (premature separation of the placenta from the uterus), umbilical cord accidents and placental thrombosis (blood clot), which are sometimes associated with a maternal or fetal thrombophilia (blood disorders). Fetal shock (change in intra-vascular pressure) occurred secondary to several causes, including fetal blood loss into a fetal cavity (such as the abdomen), the placenta and uterus or into maternal blood. Shock may also follow fetal infection with any of a number of organisms including herpes, toxoplasma, and listeria.

Benden, (2001) emphasizes that when considering medical risk/cause associations with stillbirth, one should be mindful of the fact that the actual chain of risk/causation may often be difficult to follow. Such would be the case in a fetal death secondary to acute asphyxia (lack of oxygen), following a prolapsed umbilical cord (a cord that delivers prior to the fetus), due to polyhydramnios (an excessive volume of amniotic fluid within the uterus), a result of Down syndrome (a congenital anomaly), which might have occurred in a 40-year old woman (considered to be of an advanced maternal age).

Although it seems apparent that there are often multiple medical factors which

contribute to stillbirth, this fact may prove to be an asset in terms of prevention. For example, placental abruption is an important and, at times, preventable cause of stillbirth (Goldenberg, 2004). Occurring in about 1% of all pregnancies, placental abruption accounts for between 10 to 20 % of all fetal deaths, due to severe blood loss and shock (Ananth, 1999), and its incidence may be increasing (Saftlos, 1991). Smoking and hypertension are both strong risk factors for abruption; but abruption is also seen more commonly in fetuses that are small for their gestational age. This suggests that problems with placentation (normal development of the placenta) and asphyxia are common to each of these conditions (Goldenberg, 2004). Other obstetrical complications of pregnancy that have been associated with abruption include multiple gestation (twins, triplets, etc.), coagulopathy (abnormal blood clotting), pre-term labor (labor before 38 weeks fetal gestation), premature rupture of membranes (PROM), and chorioamnionitis (infection of the amniotic fluid) (Saftlas, 1991). Between 20 and 30 years ago, it was noted (Knab, 1978) that the reason for such high mortality associated with abruption was delay in delivery once the diagnosis of abruption had been made. Recent improvements in term stillbirth rates, especially those that occur in labor, suggest that more rapid performance of Cesarean section, once abruption has been diagnosed, has resulted in a lower incidence of abruption-related stillbirth (Goldenberg, 2004). Other intra-partum factors associated with stillbirth, which have benefited from Cesarean section, include fetal distress and cord prolapse (Alessandi, 1992).

Genetic Disorders

Congenital anomalies constitute an important cause of fetal death (Goldenberg, 2004). Factors that also are associated with congenital anomalies (and to stillbirth) are advanced

maternal age (women over the age of 34 at term), alcohol consumption during pregnancy, and assisted reproduction for infertility (Goldenberg, 2004). A study by Faye-Peterson (1999), found 35% of stillbirths that underwent autopsy were found to have genetic anomalies.

In a review of the reproductive literature, Wapner and Lewis (2002) found that 25% of stillbirths have an identifiable intrinsic cause. Of these, 40% have multiple congenital malformations and an additional 40% have a single fetal malformation. The remainder has either minor chromosomal disruptions or changes. Also in this review, 6 to 12% of all stillbirths were caused by or associated with, a major chromosomal abnormality such as, Trisomy 21 (23%), trisomy 18 (21%), and trisomy 13 (8%). Another 23% of stillborn karyotypic (chromosomal) abnormalities involve 45X, and other chromosomal changes. Several autosomal recessive, metabolic disorders (disorders that a fetus inherits from both parents) are known to result in stillbirth (Wapner and Lewis, 2002). These include fetal hemoglobinopathies (blood disorders), glycogen storage diseases, aminoacidurias, and peroxidase deficiencies.

Infection

In developed countries, 10-25% of all stillbirths appear to be caused by a maternal/fetal infection. In developing countries, which often have far higher stillbirth rates, the relative contribution of infection is known to be greater (Goldenberg, 2004). As previously mentioned, there appears to be a relationship between maternal infection and stillbirth, which is influenced strongly by gestational age (Goldenberg, 2004). The earlier the stillbirth, the more likely it is related to an infection. For example, 19% of fetal deaths, at less than 28 weeks in one study, were associated with infection, and only

2% of term stillbirths were infection-related (Herschel, 1995).

The relationship between maternal infection and stillbirth is not clear (Goldenberg, 2004). First, it is often difficult to know exactly why a specific fetus died as autopsy findings may be suggestive of infections as well as other etiologies. Second, finding histological (cellular) evidence of infection or specific organisms in the placenta or on the fetus does not prove causation. Neither does the presence of organisms in internal fetal tissues, although this finding increases suspicion of an infectious cause. Third, infection may cause a stillbirth that initially may not appear to be related to infection. For example, stillbirths associated with rubella-induced congenital anomalies, or with the non-immune hydrops (severe anemia) caused by parovirus is not seen originally as infection-related. Lastly, organisms that now are quite clearly associated with stillbirth, such as parvovirus and ureaplasma urealyticum, are difficult to identify, as well as the fact that they are often not sought in studies of infectious causes of stillbirth (Goldenberg, 2004).

Conceptually, infection may result in fetal death through several pathways (Goldenberg, 2004). Maternal infection may lead to a systemic illness where the mother is severely ill which may involve high maternal fever or respiratory distress, and no offending organism is transferred to the fetus (i.e. influenza or polio). The placenta may be directly infected without spread of the organism to the fetus. This may result in reduced blood flow to the fetus and subsequent stillbirth (i.e. maternal malaria infection). The fetus may be directly infected through the placenta or membranes, with the infectious organisms damaging a vital organ such as the lung, liver, heart or brain (i.e. fetal pneumonia associated with E.coli or group B strep chorioamnionitis) (Goldenberg, 2004).

As mentioned earlier, if an infection occurs very early in gestation, the fetus may develop a congenital anomaly with a fetal death occurring later, secondary to the anomaly, as is the case with an infection due to rubella. An infection in the uterus or elsewhere in the mother's body (such as a urinary tract infection) may precipitate pre-term labor, and thereby contribute to a stillbirth (Goldenberg, 2004). Periodontal infections are also associated with pre-term labor; however the exact mechanism as yet is unclear (Offenbacher et al., 2001). Other infections considered to cause stillbirth include syphilis, coxsackie virus, *Toxoplasma gondii*, *Listeria monocytogenes* and the organisms which cause leptospirosis, Q fever and Lyme disease (Goldenberg, 2004).

In developed countries, screening for many infectious organisms and subsequent rapid treatment has resulted in a significant reduction in this etiological component of stillbirth. However, in certain developing countries, the stillbirth rate remains quite high due to infection with modest hope as to achieving a substantial reduction in both (Goldenberg, 2004).

Umbilical Cord Accidents

Umbilical cord accidents are another important cause of fetal death (Goldenberg, 2004). It is estimated that approximately 15% of all stillbirths may be caused by umbilical cord accidents and this factor may account for 1-2 fetal deaths per 1000 births (Collins, 2002). Cord accidents can be divided into several types including: prolapsed cord (umbilical cord delivered prior to the fetus), velamentous insertion (abnormal cord attachment to the placenta), and rupture; in addition, others include true knot, various types of loops, and cord entanglement (Goldenberg, 2004). Decreased fetal blood flow and lack of oxygen may occur with each condition, resulting in fetal death (Goldenberg,

2004).

Fetal-Maternal Hemorrhage

An additional factor which is likely to be causal for stillbirth is fetal-maternal hemorrhage (a significant amount of blood flow from infant to mother). It has been estimated that, by using Kleihauer-Betke testing, between 3% and 14% of stillbirths are associated with fetal-maternal hemorrhage (Owen, 1989; Laub and Schauburger, 1982).

Multiple Pregnancies

Concerning multiple pregnancies and stillbirth, it is important to note that multiple pregnancies constitute about 3% of all births, but about 10% of all stillbirths (Goldenberg, 2004). This significant difference contributed to the decision for this research to include only stillbirths involving singleton pregnancies.

Stillbirth Risk Factors: A Complex Issue

A review of the literature points to a large number of factors associated with the risk of fetal death. Some of these factors have been associated firmly with fetal death on the basis of epidemiological and other evidence, and include: 1) Maternal factors such as age, pregnancy history, Rh status, disease (hypertension, diabetes), nutritional status (pre-pregnancy weight and height, hemoglobin levels), and genetic load (chromosomal abnormalities); 2) fetal factors: plurality, chromosomal anomalies, birth weight, gestational age, and growth; 3) SES factors: race, education, income, marital status; 4) social factors: cigarette smoking, alcohol consumption, infections, exposure to trauma and environmental toxins; and 5) medical care factors: prenatal care (quantity, quality) and intra-partum care (appropriate use of technology). Delineating these risk factors is helpful to the research process through the selection of variables seemingly appropriate to

include for data collection and statistical analysis. It should be kept in mind however, that complex relationships exist between all these bio-psycho-social and medical risk factors, and that it is thereby important not to assume that these factors affect the risk of fetal death independently or via a single pathway. (Petitti, 1987; Rich-Edwards, 2001; Tiedje, 2003; Goldenberg, 2004).

RESEARCH THEORETICAL FRAME OF REFERENCE

Bio-Psycho-Social Risk and Stillbirth:

The Life Course Model as a Theoretical Frame of Reference

The previous literature review spans approximately six to seven decades. Within the past several years, the essence of this research has woven itself into an Ecological (Person-in-Environment) conceptual framework, which is both descriptive and proscriptive in nature (Brofenbrenner, 1979; McCormick, 1989; Emanuel, 1989; Geronimus, 1992; McLean and Hatfield-Timajchy, 1993; Roux, 2001; Tiedje, 2003; Kotelchuck, 2003, Lu M. & Halfon N., 2003). Termed “The Life Course Model”, this theoretical framework attempts to explain why some groups of women experience poorer fetal outcomes (pre-maturity, stillbirth and neonatal demise) compared with other groups of women who give birth to healthy infants born at term (Lu and Halton, 2003; Tiedje, 2003; Kotelchuck, 2003).

The Life Course Model stems from the Ecological Model of Human Development by a social scientist, Dr. Urie Brofenbrenner (Moen, Elder, and Luscher, 1995). Per Brofenbrenner (1979), the Ecological Model proposes that human behavior and development be examined as a joint function of the characteristics of the person and the

environment. The former includes both biological attributes, such as the individual's genetic heritage and personality. The environment involves the physical, social, and cultural features of the immediate settings in which human beings live (e.g. family, school, and neighborhood), as well as broader contexts such as the society and times into which an individual is born.

According to Elder (Moen, Elder, & Luscher, 1995), there are three propositions which make up the Ecological and Life Course Models. The first is that an individual develops and functions as a well integrated part of the environment. The second is that the individual develops and functions in a continuously ongoing, reciprocal process of interaction with his/her environment. The third proposition integrates mental, biological, behavioral, and environmental factors and has two complementary parts: one part is for current individual functioning; the other is for the individual functioning within a developmental process. As such, the third proposition states that at each specific moment, individual functioning is determined in a process of continuous reciprocal interaction between mental and biological factors and behavior on the individual side, and situational factors on the environmental side. As this is occurring, the individual develops in a process of continuous reciprocal interaction among psychological, biological, and environmental factors.

Apropos to this research is the following example of proposition three (Moen, Elder, & Luscher, 1995). Assume that a woman encounters a situation that she interprets as threatening or stressful. The cognitive act of interpreting the situation stimulates, through the hypothalamus, the excretion of adrenaline from the adrenal glands, which in turn triggers other physiological processes. The cognitive-physiological interplay is

accompanied by emotional states of fear, anxiety, or general arousal. In the next stage of the process, these emotions affect the woman's behavior and handling of the environment. They also influence her interpretation of the sequence of changes in the situational conditions and thereby her physiological reactions in future situations.

Thus, the perceptual-cognitive system and the biological system of an individual are involved in a continuous loop of reciprocal interaction (Moen, Elder, & Luscher, 1995). The way this process functions is contingent, among other things, on the environment, as it is perceived and given meaning by the individual. The outcomes of such situation-individual encounters will set the stage for subsequent reactions and actions to psychologically similar situations, as interpreted by the individual in her perceptual-cognitive system. In the developmental process, this interaction process affects both the mental system and the physiological system. Frequent encounters with stressful situations may affect the immune and other organ systems and lead to a variety of physical diseases and conditions (Moen, Elder, & Luscher, 1995). The relationship between stress and physical conditions will be discussed later in this chapter in terms of 'allostatic load' and women's reproductive health.

The Life Course Model as an outgrowth of the Ecological Model continues to focus on the social forces that shape a woman's life-course and her developmental consequences (Lu and Halfon, 2003). Per Lu and Halfon, emphasis continues to be placed upon the characteristics of women (including their physical strengths and weaknesses) and the environments that evolve and change over time and across generations. Of particular interest to Lu and Halfon (2003) however, are the examination of individual characteristics and environmental factors that foster healthy development

for women at all stages during their life course.

The Life Course Model describes womanhood and female reproductive health as being a complex, holistic, 'life-course' process that is longitudinal and inter-generational (Lu and Halfon, 2003). This model also proposes that significant changes be made in the way in which our society views and cares for women. Specifically, care should be significantly broader and deeper, and begin earlier, even before a female infant is born. In essence, the quality of every woman's life needs to be deeply valued and protected on all levels, not just health. For example, provisions for universal health care can be established and guaranteed for life, so that access to life-long healthcare can be achieved; in addition, a universal standard of economic and social security can be established and maintained in order to minimize as much as possible debilitating stress and uncertainty. Most importantly, these standards of care and security would be maintained throughout every woman's life, as well as continue uninterrupted generation to generation (McCormack, 1989; Emanuel, 1989; Lu and Halton, 2003; Tiedje, 2003; Kotelchuck, 2003). It is believed that by ensuring every potential mother's life-long well-being, we are also ensuring the well-being of any potential pregnancies. It is through this process, we are safe-guarding the members of the next generation (Roosevelt, 1911 in Kotch, 1997, page 11).

As a frame of reference for this study, The Life Course Model (Lu and Halfon, 2003) was selected because it evolved from research that involved several bio-psycho-social risk factors (e.g. low socioeconomic status, racism, physical and mental stressors, and social and community support) associated with poor fetal outcomes, including stillbirth (McCormack, 1989; Emmanuel, 1989; Geronimus, 1992; Roux, 2001; Lu and Halton,

2003; Tiedje, 2003; Kotelchuck, 2003). In developing this model, Lu and Halton (2003) have been recognized for their contribution to Maternal-Child Health. Per Kotelchuck (2003) it is believed that the Life Course Model is beneficial and especially timely as it may prove to be an innovative method to develop a useful interpretation of the enduring disparities that exist in birth outcomes here in the United States: one involving race (black versus non-black) and another involving economics (poor versus non-poor). Both of these factors are important in this study; hence have been incorporated into two of the independent variables involved in this research.

Specifically, it has been reported for more than five decades in the U.S. literature that black women and women from low socioeconomic status consistently experience poorer fetal outcomes than white women and women from higher socioeconomic levels (Emmanuel, 1989; James, 1991; Alexander, 1998). In particular, black women and women who are economically disadvantaged experience stillbirth 2 to 3 times more frequently than women who are white and those who are financially middle- to- high in socioeconomic status (Petitti, 1987; Geronimus, 1992; Goldenberg, 2004). Per the Ecological and Life Course Models (Moen, Elder, & Luscher, 1995; Lu and Halton, 2003; Tiedje, 2003), these disparities appear to be a result of a woman's entire life course experience, not solely due to events during the time of her child-bearing years and the relatively brief period(s) of experiencing pregnancy. In particular, these disparities may be due to the amount of adversity and stress different women experience throughout their life times.

The Life Course Model: Allostatic Load

Consistent with The Ecological Model as previously described (Bronfenbrenner, 1979;

Moen, Elder, & Luscher, 1995), The Life Course Model suggests that the exposure to stress women experience from living with a significant number of acute and chronic adverse events (poverty, lack of education, inadequate economic opportunities, racism, toxic substance use, malnutrition, abuse, trauma, poor social support), and its life time accumulation, can negatively effect pregnancy and various other health outcomes (Rich-Edwards et al, 2001; Lu and Halfon, 2003; Tiedje, 2003). Physiologic reactions to chronic and stressful conditions are described as an ‘allostatic load’ that results from the breakdown in the adaptive processes on both biological and physiological levels when conditions are chronic and unremitting (McEwen, 1998; Geronimus, 1996). ‘Allostasis’ refers to the physiological capabilities of the human body to achieve stability through change, utilizing various organ systems such as the autonomic nervous system, the endocrine system (i.e. the hypothalamic-pituitary-adrenal (HPA axis), and the cardiovascular, metabolic, and immune systems. These organ systems are called upon to protect the body as it responds to internal and external stress (Rich-Edwards et al, 2001). The price of this accommodation to stress is described as an ‘allostatic load’, which is the amount of wear-and-tear from chronic over-activity of the allostatic system (Rich-Edwards et al, 2001). In light of the Life Course Model, it is believed that a woman’s chronic exposure to poverty, racism, malnutrition, toxins, trauma/abuse, whether concurrent, feared, or remembered, increases her ‘allostatic load’. This exposure imprints itself upon her central nervous system, including her brain, which subsequently alters and compromises her physiological and reproductive capabilities (Rich-Edwards et al, 2001; Tiedje, 2003).

The concept that chronic, life-long stress, ‘allostatic load’, and poor pregnancy

outcome being related and perhaps causal, is a fundamental component of The Life Course Model. (Rich-Edwards, 2001; Tiedje, 2003; Kotelchuck, 2003; Lu and Halfon, 2003). Black women, single women, and women from low socioeconomic status tend to experience, throughout their entire lives, a larger number of acute and chronic adverse events that are more significant and of longer duration than other groups of women (Petitti, 1987; Emanuel, 1989; McCormick, 1989; Turner, 1990; James, 1992; Roux, 2001; Rich-Edwards, 2001; Tiedje, 2003). Many of these chronic adverse events are also considered to be bio-psycho-social risk factors associated with stillbirth, which may help to explain why women who are black, poor, uneducated, single, and/or uninsured experience stillbirth at a rate 2 or more times greater than women who are more affluent and white. Given this, both the Ecological and Life Course Models offer an appropriate and innovative way to conceptualize the effects of bio-psycho-social risk factors on stillbirth (Kotelchuck, 2003; Tiedje, 2003; Lu and Halfon, 2003), and are thereby useful as a frame of reference for this research.

CHAPTER THREE

METHODS OF STUDY

Study Design

In the literature, there have been several approaches to examining risk factors and stillbirth including those which are retrospective, prospective, and qualitative in design. Given that the primary interest of this study is in the relationship between bio-psycho-social risk factors and the EGA when a stillbirth occurs, plus the availability of a significant amount of appropriate data, the decision for the current study was to conduct a secondary analysis of existing data archives composed of obstetrical medical records from two large, tertiary-care hospitals located within the same (New York) metropolitan area, in the northeast region of the United States.

The use of obstetrical medical records is both appropriate as well as beneficial in gathering detailed medical and psycho-social information related to a fetal death. As a research method, the retrospective analysis of a medical record can be considered historical and documentary in nature (Grinnell, 1997). The review of such documents reveals an important part of the history and content surrounding a specific setting and event, in this instance, a stillbirth. It relates the accounts of those individuals directly involved, eye witnesses, and reports of medical findings (such as an autopsy and medical testing). Review of the medical record is also an unobtrusive method that provides a rich portrayal of the history of the past event as well as the values and beliefs of the participants in the setting (Marshall and Rossman, 1999). There are limitations to this research method however, as the data are limited to only that which is available in the medical record; data not recorded are data lost.

The two large northeastern university (publicly funded) medical centers were chosen as the settings for the retrospective medical record/chart review for several reasons. First they are receptive to research activities. Second, the number of singleton stillbirths per year is relatively large, together averaging about 45 to 50 per year. Third, the hospitals' Medical Records Departments and Obstetrical Departments are capable of producing comprehensive lists of stillbirths that have occurred within any selected period of time, and they each have a system to facilitate review of medical charts. Fourth, in combination, the two hospitals' demographic data is reflective of the general obstetrical population in the (New York) metropolitan area where the hospitals are located.

The time period chosen for the medical record review was January 1, 2000 through December 31, 2005. This time period was selected in order to not only obtain a large enough sample size, but also to eliminate or reduce any potential bias that may occur from recent changes in technology which may increase fetal survival.

The sample size was calculated using a ratio of 10 cases per one variable of interest (Norman and Streiner, 1997). Since ten (previously discussed) bio-psycho-social risk factors were consistently found to contribute to increased stillbirth risk, they were utilized in this research, and this required at least 100 cases for this study. In order to complement the review of the literature however, data on these risk factors, as well as on others were obtained during the chart review process.

Data were collected and recorded (by hand) directly from the medical record using a standardized data collection tool. Lastly, prior to conducting any research, this study was sanctioned by each of the hospital's Institutional Review Boards.

Data Collection Tool

The data obtained for this retrospective analysis were gathered utilizing a research tool called “The Stillbirth Medical Record Data Abstraction Form” (Appendix B). This data abstraction form was originally adapted from a questionnaire used to collect national infant mortality data for the National Fetal-Infant Mortality Review Program (1996). The Stillbirth Medical Record Data Abstraction Form was designed to collect information (data) relevant to fetal demise from the hospital’s maternal medical record and cover such areas as: demographic data, prenatal care, maternal admission to the hospital’s Labor and Delivery unit, mothers’ subsequent treatment, fetal death certificate, post-partum pathological placental report, and fetal autopsy records.

The adapted form had been successfully tested in 2004 in a pilot study of a review of medical records conducted at one of the hospitals used for this research. The pilot study involved 48 stillbirths that occurred at the hospital between 2001 and 2003. The stillbirth cases involved in the pilot study were incorporated into this research since no significant changes were made in the data abstraction form.

Sample

This study used a purposive sample of stillbirth cases at the two university hospitals participating in this study, during a set period of time. Initially all of the stillbirths were of interest, which defines the group of subjects obtained as a ‘population’, not a ‘probability sample’ (Pyrzczak, 2001).

The study subjects were obtained from a list of all births that occurred in each of the hospitals during the study period. Stillbirth cases were selected from the list as they occurred in reverse chronological order, beginning in December, 2005, selecting

sequentially backward through each year to January, 2000. As an average of 45 to 50 stillbirths occurred each year between the two hospitals, an appropriate sample size of 231 stillbirths (117 from the first hospital and 114 from the second hospital) was obtained. Subjects for the study included only those cases which involved a singleton stillbirth (multiple gestations such as twins and triplets were excluded), and with charts that had sufficient recorded data and information (greater than 95 percent of the desired data) about the stillbirth (maternal demographic data, prenatal care, maternal care in labor and delivery and immediately after delivery, fetal death certificate, post-partum pathological placental report, and fetal autopsy records). Women who did not receive any prenatal care (and hence a prenatal care record was not available) were the exception to this inclusion criteria. As previously mentioned in the literature review, women who do not receive prenatal care have several of the bio-psycho-social risk factors that are believed to be significant in relation to stillbirth (Maupin, 2004); (e.g. women who receive no prenatal care are more likely to be less educated, uninsured, represent low socioeconomic status, smokers, and have a history of substance abuse). Therefore the decision was made to include these women in this study. This decision was also based on the fact that a significant amount of the data that was normally included in the prenatal care record was obtained during the course of admission and treatment in the hospital, and was therefore available in the medical record.

Two exclusion criteria influenced the case selection process. First, the sample size was limited to singleton stillbirths. This controlled for the known increased risk associated with multiple gestations, which was reportedly two to four times greater than the risk in singleton pregnancies (Kahn, 2003). In addition, per Goldenberg (2004),

pregnancies involving multiple gestations represented 3% of all pregnancies, but represented 10% of all stillbirths here in the United States; hence they are over-represented in the national stillbirth population. Another exclusion criterion involved intentional termination of pregnancy, between 20 and 25 weeks gestation, due to significant congenital anomalies diagnosed during the course of prenatal care. The focus of this research remained bio-psycho-social risk factors and stillbirths that occurred as random, unplanned events.

Method

After an appropriate subject was selected, the obstetrical medical record was obtained from the university medical record department. Each subject was assigned a Study ID number which was recorded on The Stillbirth Data Abstraction Form. In order to preserve the confidentiality of the medical record, no identifying information (i.e. name, medical record number, and dates, including month, day, and year) was recorded on the form, and no code list linking the Study ID number with the medical record number was created. Data were abstracted and recorded by hand onto The Stillbirth Data Abstraction Form, and entered into the computer using the Statistical Package for Social Sciences (SPSS). During the process of data entry and preliminary analysis, the variables were cleaned, edited, and re-coded as required for descriptive and multi-variate analysis.

Definition of Variables

The Dependent Variable

The dependent variable for this research is the estimated gestational age (EGA) of the stillborn infant at the time of delivery defined as an infant that is born after 20 weeks of estimated gestational age, weigh greater than 350 grams, and has no signs of life

including a heartbeat and spontaneous respiration at the time of delivery. The data for the infant's EGA were obtained from the attending physician's note recorded at the time of delivery, and when possible (depending upon availability), verified by an autopsy report.

The level of measurement for the dependent variable is nominal and dichotomous: 0 = Early Stillbirth, or 1 = Late Stillbirth. An Early Stillbirth is defined as a stillbirth that occurred between the beginning of 20 weeks EGA and 27 completed weeks EGA. A Late Stillbirth is defined as a stillbirth that occurred from the beginning of 28 weeks EGA until delivery. In this study, as no infant was delivered after 42 weeks EGA; the EGA for a Late Stillbirth is between 28 and 42 weeks.

The Independent Variables

There are ten bio-psycho-social risk factors for stillbirths that represent the independent variables for this research. After careful review of the stillbirth literature, these variables are identified as consistently associated with an increased risk of stillbirth: Maternal Age, Race, Socioeconomic Status, Marital Status, Obesity, Adequacy of Prenatal Care, Licit and Illicit Drug Use/Abuse, Diabetes, Hypertension, and Level of Education. Defined as follows, each variable was dummy-coded after data collection into one of two categories. Categories coded as 1 are identified in the literature a category as having a higher risk of all stillbirths at any EGA; and categories coded as 0 represent a category with a risk of stillbirths that is considered not to be increased at any EGA.

Maternal Age. Data collected for maternal age at the time of registration for medical care were recorded on the ordinal level: 1) women less than 20 years of age, 2) women from 20 through 34 years of age, and 3) women greater than 34 years of age at the time of registration for medical care. However, from the review of the literature, teenagers and

women over the age of 34 have an increased risk of experiencing a stillbirth. Therefore, for statistical analysis, the data were recoded into a dichotomous variable, assigning 1 to women who were less than 20 years of age or greater than 34 years of age at the time of registration for medical care, which represents extremes in maternal age, and 0 to women from the age of 20 through 34 years of age at the time of registration for medical care, which represents women of normal child-bearing age.

Race. Race, a nominal level of measurement, was determined by what a woman self-reported as her race at the time of registration for medical care. The data for race were collected in one of four categories: 1) Black, 2) White, 3) Hispanic, and 4) Other. For statistical analysis, these data were dichotomized into one of two categories which were dummy-coded 1 for black race and 0 for non-black.

Socioeconomic Status (SES). Low socioeconomic status was defined as any woman who financially qualified for and received New York State Medicaid as the payer source at the time of registration for medical care. Data were collected at the nominal level (e.g., ‘yes’ or ‘no’) for this dichotomous variable, and recoded into one of two payer sources: 1 = Medicaid and 0 = non-Medicaid as the payer source.

Marital Status. Women self-reported marital status at the time of registration for medical care. Marital status was measured at the nominal level (e.g., single, married, divorced) and then for statistical analysis, recoded into one of two categories: 1 = single and 0 = not single/married.

Obesity. Body Mass Index was calculated by multiplying a woman’s pre-pregnancy weight in pounds by 705 and dividing this number by the square of her height in inches (Robert-McComb, 2001). Obesity was defined as a pre-pregnancy BMI that was equal to

or greater than 29 (Clark, 2006). The calculated BMI data were recorded using four ordinal intervals: 1) women with a BMI less than 20; 2) women with a BMI from 20 to 26; 3) women with a BMI from 26 to 29; and 4) women with a BMI equal to or greater than 29. For statistical analysis, the data were recoded dichotomously into either 0 as women with a pre-pregnant BMI less than 29, or 1 for women with a pre-pregnant BMI equal to or greater than 29.

Adequacy of Prenatal Care (PNC). The definition for this independent variable was derived from the literature (Alexander and Kotelchuck, 2001; Gabbe, 2002). Inadequate prenatal care was defined in one of the following ways: 1) When a woman did not receive any prenatal care, or 2) had less than two prenatal visits with a provider up to 28 weeks gestation, or 3) had less than three prenatal visits with a provider in a pregnancy lasting greater than 27 completed weeks gestation. The level of measurement for PNC is nominal, and for both data collection and statistical analysis the data were recoded as 1 for inadequate prenatal care or 0 for adequate prenatal care.

Level of Education. Education Level was defined as the number of years of schooling completed. The data for this independent variable were collected at the ordinal level using three intervals: 1) women who had not completed high school or its equivalent; 2) women who completed high school and received a high school diploma or its equivalent; 3) women who attended college. Low level of education was defined as a woman who had not completed high school or its equivalent. For statistical analysis, the data were recoded dichotomously into 1 as a low level of education or 0 as a high level of education.

Licit and Illicit Drug Use/Abuse. This risk factor was defined as present when use was

recorded in the medical record, either reported by the mother herself and/or by the practitioner who provided her medical care. The level of measurement was nominal with 1 for 'yes' or 0 for 'no'.

Diabetes. A woman was considered to have diabetes per the recorded diagnoses in the medical record made by a medical practitioner. The diagnoses of diabetes included diabetes that was diagnosed prior to and/or during the pregnancy. Diabetes was dichotomous and coded as 1 for 'yes' or 0 for 'no'.

Hypertension. A woman was considered to have hypertension per the recorded diagnosis in the medical record that was made by a medical practitioner. The diagnoses of hypertension included hypertension that was diagnosed prior to and/or during the pregnancy, and coded as 1 for 'yes' or 0 for 'no'.

Data Analysis

The data were analyzed using both descriptive statistics and logistic regression. Descriptive analysis consisted of frequencies, and percentages. Logistic regression was used to describe the relationship between the dependent variable (Estimated Gestational Age when a stillbirth occurred, either an Early Stillbirth or a Late Stillbirth) and the independent variables (Maternal Age, Race, Socioeconomic Status (SES), Marital Status, Level of Education, Obesity, Adequacy of Prenatal Care, Licit and Illicit Drug Use/Abuse, Diabetes and Hypertension). However, as this study involved a 'population', statistical significance is not relevant and the results are not inferential in nature; as such, they are not to be generalized to the greater obstetrical population.

As is frequently the case in a study involving logistic regression analysis, more than one, actually two logistic regression models were developed for statistical analysis during

the course of this research. Using the customary hierarchical approach to model building (Agresti and Finlay, 1997) initially, the first model (Model One) involved 9 of the 10 independent variables as bio-psycho-social risk factors for a woman experiencing either an Early or Late Stillbirth. The independent variable, Adequacy of Prenatal Care was not included in Model One as it was the only bio-psycho-social risk factor that (during a pregnancy) represented a medical intervention or a method of medical care delivery. This made Adequacy of Pre-natal Care different from the other nine variables which involved either demographic (e.g. Maternal Age, Race, Marital Status), psycho-social (e.g. SES, Level of Education, Drug Use/Abuse), and/or medical conditions (e.g. Obesity, Diabetes, Hypertension). In addition, it has been shown in the literature (Modestin, 2001) that when women received some form of prenatal care, even if it was only one prenatal visit, maternal morbidity was reduced and pregnancy outcomes improved (e.g. less complications such as pre-eclampsia, fewer stillbirths and less pre-term labor and delivery). It was therefore logical to include Adequacy of Pre-natal Care in the second logistic regression model (Model Two), with the nine independent variables involved in Model One. It also seemed an appropriate step in the building of a second logistic regression model, as it might discern any modification in any association between the original nine independent variables and the EGA when stillbirth occurred.

The Research Question

There are many bio-psycho-social risk factors for stillbirth in the literature; however, there are few studies that focus on risk factors in relation to the EGA when a stillbirth occurs. By understanding the impact of certain risk factors on timing of stillbirth, modifications and interventions in social services and medical care may be implemented,

thereby preventing an Early and/or Late Stillbirth. This being the case, the research question for this research asks, “What is the relationship of bio-psycho-social risk factors to the risk of stillbirth early in pregnancy from 20 to 28 weeks EGA, or later in pregnancy from 28 weeks to 42 weeks EGA?”

CHAPTER FOUR

RESULTS

Descriptive Statistics: Frequencies and Percentages

The following Tables (3 to 13) summarize the descriptive statistics for the dependent and the independent variables involved in this research. Tables 3 through 12 summarize the results for the independent variables (Maternal Age, Race, Socioeconomic Status, Marital Status, Obesity, Adequacy of Prenatal Care, Education Level, Licit and Illicit Drug Use/Abuse, Diabetes, and Hypertension.), and Table 13 summarizes the results for the dependent variable (EGA for Stillbirth: Early Stillbirth and Late Stillbirth).

Additional descriptive data involving the study population and fetal outcomes are subsequently provided to explore several factors which the literature reports as relevant to the risks and causes of the stillbirths. The chapter concludes with Tables 14 and 15, which present the results of the logistic regression analysis.

The Population

As previously described, the population for this research was obtained by reviewing the listings (or birth logs) of all the deliveries that occurred in the two study hospitals from January 1, 2000 through December 31, 2005. A total number of 256 singleton stillbirths were recorded in the two participating hospitals. Among these 256 stillbirths, twenty-five (9.8 %) were excluded for incomplete medical records. Among the remaining 231 stillbirths constituting the study population, 117 were from one hospital and 114 were from the second hospital. The stillbirths were categorized as either late (after 27 completed weeks' gestation) or early (before 28 weeks gestation). There was a fairly even distribution between early and late stillbirth, 114 and 117, respectively. Of the

231 women in the sample, 140 women (60 %) were born in the United States, 76 women (33 %) were born outside of the United States, and data for the country of maternal birth for the remaining 15 women (7 %) were missing or unknown. Of the 76 women who were born outside of the United States, 2.3 % (2 women) were white, 17 % (8 women) were black, 76 % (24 women) were Hispanic, and 20 % (10 women) were born in various other countries (India, Pakistan, Bangladesh, and China).

Reproductive Outcomes

Among these stillbirth infants, 122 were male and 108 were female, and one had ambiguous genitalia. The ratio between male and female infants was consistent with typical birth outcomes (Gabbe, 2002).

In virtually all cases, the mother was offered an autopsy. Among these stillborn infants, an autopsy was performed in two-thirds of cases (n = 145). The cause of fetal death assigned by the attending physician was classified into one of six categories: 1) unknown, 2) cord accident, 3) genetic defect, 4) infection, 5) placental compromise, and 6) prematurity. In descending order of frequency, 57 cases (25 %) were caused by placental compromise such as placental abruption or premature separation of the placenta from the uterus. Forty-six (20 %) were caused by a cord accident such as a tight or true knot in the umbilical cord or by the umbilical cord being tightly wrapped around the infant's neck one or more times.

Infection was listed as the cause of death for 42 of the stillbirths, or 18 %. The most common infections noted in the medical record involved chorioamnionitis, Listeria, and various anaerobic bacteria. Thirty (almost 75 %) of these stillbirths due to infection

occurred prior to 28 weeks gestation, which was consistent with the literature that reported infection as associated with early stillbirth rather than late stillbirth (Copper et al, 1994; Goldenberg, 2004).

Thirty-four (15%) of the stillbirths were caused by the infant being born prematurely. Virtually all of the stillbirths caused by pre-maturity occurred between 20 and 26 weeks EGA. These births were precipitated by pre-term labor and/or premature rupture of the membranes (PROM), which was consistent with the literature (Gabbe, 2002). Per Gabbe, almost 75% of pre-term birth occurred ‘spontaneously’ after pre-term labor and/or PROM.

Twenty-seven (12%) of the stillbirths were due to a range of genetic causes. The most common genetic anomalies involved trisomies 13, 18, and 21 and major congenital heart defects. The remaining 25 (10 %) stillbirths listed the cause of death as unknown.

Independent Variables

Maternal Age

The mothers in this study ranged in age from 14 to 44 years of age at the time of registration for prenatal care: two-thirds were between the ages of 20 and 35; one in 8 were less than 20 years of age; and one in 5 were older than 34, which together represent approximately one-third of the sample (Table 3). Those women younger than 20 and older than 34 years of age are considered to be at the extremes of reproductive age (Gabbe, 2002).

Table 3

Maternal Age at Registration for Medical Care

	Frequency	Percent	Valid Percent	Cumulative %
<20 Years	27	11.7	11.7	11.7
20 to 35 Years	153	66.2	66.2	77.9
35 or > Years	51	22.1	22.1	100.0
Total	231	100.0	100.0	

As the majority of women who experience pregnancy and childbirth in the United States are between 20 and 35 years of age (65 - 70 %) and the minority of women giving birth in the US are under 20 (10-12%) or greater than 34 years of age (20 – 25%) (www.CensusBureau.gov), the number of women considered ‘extreme in maternal age’ is not overly represented in the study sample, which would have been expected given the literature (Goldenberg, 2004). As previously discussed in Chapter 2, one might expect higher percentages in the “extreme age” groupings.

Race

Both of the publicly-funded hospitals involved in this research were located in a large metropolitan area (New York City) in the Northeastern region of the United States. One of these two hospitals served surrounding communities that in terms of race are primarily black and Hispanic (52 % and 32 %, respectively) ; the other study hospital

Table 4

Race of Mother

	Frequency	Percent	Valid Percent	Cumulative %
White	85	36.8	36.8	36.8
Black	60	26.0	26.0	62.8
Hispanic	74	32.0	32.0	94.8
Other	12	5.2	5.2	100.0
Total	231	100.0	100.0	

served communities that were primarily white (76 %) with a minority of blacks and Hispanics (8 % and 12 %, respectively) (www.CensusBureau.gov). As previously discussed, one major reason these two hospitals were initially selected for this research was to draw subjects from a population that would likely yield a sample that was representative of the area and region of the US where the study was conducted. The racial composition of the greater (New York) metropolitan area during the time of this research was 44 % white, 26% black, 27 % Hispanic, with the remaining 3% made up of a mixture of Asian and other races (www.CensusBureau.gov). This compares favorably to the data in Table 4 which shows a similar racial distribution.

Socioeconomic Status

Table 5

Socioeconomic Status (Payer Source)

	Frequency	Percent	Valid %	Cumulative %
Third Party Ins.	67	29.0	29.0	29.0
Medicaid	164	71.0	71.0	100.0
Total	231	100.0	100.0	

The proxy in this research for low socioeconomic status (SES) was Medicaid as the payer at the time of registration for medical care. Low SES accounted for 164 women, which represents over 70% of the sample. The remaining 67 women (29 %) provided another form of third-party payer source for medical care, suggesting at least a medium SES or higher.

Marital Status

The number of pregnant women who reported themselves as ‘single’ numbered slightly more than those ‘married’ (Table 6). This is consistent with national statistics for pregnant women in the U.S. (Ventura, 2008). Per Ventura at the Centers for Disease Control and Prevention’s National Center for Health Statistics, the number of single pregnant women in 2004 represented 45% of all women who gave birth in this country.

Table 6

Marital Status

	Frequency	Percent	Valid Percent	Cumulative %
Single	117	50.6	50.6	50.6
Married	114	49.4	49.4	100.0
Total	231	100.0	100.0	

Obesity/Body Mass Index

The statistics for Obesity/Body Mass Index (Table 7) are reflective of the serious over-weight and obesity problems that have developed in the last two decades in the U.S. According to Mokdad et al (1999), since 1990, the prevalence of obesity in women between the reproductive ages 18 to 29 years has increased by 70%.

The number of women who were classified as being over-weight at the beginning of their pregnancy, with a BMI from 26 to 29, was 27 or 12 % of the women in the sample. The number of women who were classified as being obese with a BMI greater than or equal to 29 at the beginning of their pregnancy were 106 or 46 %; together, the women who were over-weight or obese at the beginning of their pregnancies represent 133 women or 58 % of the total sample. These data were consistent with current BMI data for the adult population in the United States (Clark, 2006).

Table 7

Obesity/Body Mass Index (BMI)

	Frequency	Percent	Valid Percent	Cumulative %
BMI < 20	10	4.3	4.3	4.3
BMI 20 to 26	87	37.7	37.7	42.0
BMI 26 to 29	27	11.7	11.7	53.7
BMI > 29	106	45.9	45.9	99.6
Not Sure	1	0.4	0.4	100.0
Total	231	100.0	100.0	

Eighty-seven women (38%) had a BMI between 20 and 26 prior to pregnancy. These women were considered to be within the normal BMI range and as such, not at an increased risk for experiencing a stillbirth. The remaining 10 women (4.3 %) were considered to be underweight, with a pre-pregnancy BMI of less than 20. Although a BMI less than 20 has been, in some research, associated with a slightly increased risk of stillbirth (Ogunyemi, 1998); the increase in risk virtually disappears with appropriate nutrition and weight gain during the course of a pregnancy.

Table 8

Prenatal Care

	Frequency	Percent	Valid Percent	Cumulative %
Adequate	163	70.6	70.6	70.6
Inadequate	65	28.1	28.1	98.7
Not Sure	3	1.3	1.3	100.0
Total	231	100.0	100.0	

Adequacy of Prenatal Care

Inadequate prenatal care is considered to be a risk factor for poor reproductive outcomes, including stillbirth (Alexander, 1998; Vintzileos, 2002; Chang et al, 2003).

The operational definition of Adequacy of Prenatal Care can be found in Chapter 3.

Seventy-one percent of the women in this study received prenatal care that is considered adequate as defined in this study.

The number of women in the sample who had at least one prenatal visit was 212 (92 %). The number of women who did not receive any prenatal care at all was 19 (8 %). Of the women who received prenatal care, 140 women (66 %) began prenatal care during the first 12 weeks (or first trimester) of their pregnancy; 63 (30 %) began pre-natal care during the second 12 weeks (or second trimester) of their pregnancy; and 10 women

(4 %) began prenatal care during the remaining 12 weeks (or third trimester) of their pregnancy. The location of prenatal care varied by private versus publicly funded settings. Twenty percent or 45 women received prenatal care in a private setting; the remaining 80% or 186 women received prenatal care that was financed with public funds. The primary providers of prenatal care also varied. The practitioners involved included Nurse Practitioners, Nurse Midwives, Physicians Assistants, Obstetricians, Specialists in Maternal-Fetal Medicine, and Family Practice Physicians.

Level of Education

Table 9

Level of Education

	Frequency	Percent	Valid Percent	Cumulative %
Grade School	81	35.1	35.1	35.1
High School	89	38.5	38.5	73.6
College	61	26.4	26.4	100.0
Total	231	100.0	100.0	

As captured in Table 9, the majority of the subjects (66%) had an education level defined as ‘high’, having received at least a high school diploma or its equivalent. Slightly over one-third of the sample had not graduated from high school or its equivalent and was therefore defined as having a low educational level.

Licit and Illicit Drug Use

Table 10

Drug Use

	Frequency	Percent	Valid Percent	Cumulative %
Yes	46	20.0	20.0	20.0
No	185	80.0	80.0	80.0
Total	231	100.0	100.0	

Licit and Illicit Drug Use

Forty-six (20%) of the women had a reported use/abuse of a toxic substance during the pregnancy, such as alcohol, tobacco (cigarettes), heroin, cocaine, or marijuana, (see Table 10). Of the women reporting substances used, 40 (17.4 %) smoked cigarettes, 5 (2.2%) drank alcohol, one (0.4%) smoked marijuana, 4 (1.7%) ingested cocaine, and one (0.4%) was addicted to and used IV heroin. Several women (5 or 2.2%) used/abused more than one toxic substance during their pregnancy. One hundred- eighty- five women (80 %) denied any use/abuse of any toxic substance(s).

Diabetes

According to Gabbe (2002), an estimated 2 to 3 % of all pregnancies are complicated by diabetes mellitus (DM) and that 90 % of the cases were women with Gestational

Diabetes Mellitus (GDM), or diabetes that developed or first diagnosed during pregnancy.

Table 11
Diabetes

	Frequency	Percent	Valid Percent	Cumulative %
Yes	43	18.4	18.4	18.4
No	188	81.6	81.6	100.0
Total	231	100.0	100.0	

In sharp contrast, in this cohort of women experiencing a stillbirth, 43 women (18.4 %) were diagnosed with diabetes mellitus. These results are consistent with the literature, which notes that diabetes has long been associated with an increased risk of adverse pregnancy outcomes. Only two women in the sample had insulin-dependent diabetes mellitus (IDDM) that was diagnosed prior to pregnancy. The majority of the women (99 %) diagnosed with diabetes however, had Gestational Diabetes Mellitus (GDM).

Hypertension

Hypertensive disorders of pregnancy are the most common medical complications of pregnancy, with a reported incidence between 5 and 10 % (Gabbe, 2002). As 20% of the women in this study were diagnosed with high blood pressure or hypertension either

Table 12

Hypertension

	Frequency	Percent	Valid Percent	Cumulative %
Yes	46	20.0	20.0	20.0
No	185	80.0	80.0	100.0
Total	231	100.0	100.0	

before and/or during their pregnancy, this percentage of subjects was up to twice as high as the reported incidence in the general obstetrical population; this is consistent with what would be expected given the study involved only women who experienced a stillbirth.

These data included 6 women (2.6 %) who were diagnosed with chronic essential hypertension prior to their pregnancy, and 40 women (17.4 %) who were diagnosed with pregnancy induced hypertension (PIH) or high blood pressure that developed during their pregnancy.

Dependent Variable

For the 231 stillbirths comprising the present study, nearly half occurred before 27 weeks (Early Stillbirth), and half thereafter (Late Stillbirth) (Table 13). Using logistic regression, we sought to ascertain differences in the distribution of the independent variables between these two groups of stillborn pregnancies.

Table 13

Dependent Variable- Estimated Gestational Age

	Frequency	Percent	Valid Percent	Cumulative %
Early Stillbirth	114	49.4	49.4	49.4
Late Stillbirth	117	50.6	50.6	100.0
Total	231	100.0	100.0	

Logistic Regression

The purpose of this research is to discern if there is any variation in the estimated gestational age (EGA) when a stillbirth occurs in relation to several bio-psycho-social risk factors for stillbirth. In addition to descriptive statistics, logistic regression was utilized for the statistical analysis. As discussed earlier, after data collection, the nominal, dependent variable (the EGA when stillbirth occurs) was coded into 0 = Early Stillbirth and 1 = Late Stillbirth. The categories for each of the independent variables: Maternal Age, Race, Marital Status, Obesity, Education Level, Licit and Illicit Drug Use/Abuse, Diabetes, Hypertension, and Adequacy of Prenatal Care were also collapsed where necessary into dichotomous variables and then dummy-coded, with value labels assigned according to the following convention: 1 for categories from the literature associated with an increased risk for stillbirths and 0 for categories from the literature without an

increased risk for stillbirths. (See Chapter 3 for complete operational definitions of all variables).

Table 14

Logistic Regression: Model One

Variable	B	S.E.	Wald	p	Exp (B)
Maternal Age	.342	.305	1.254	.263	1.408
Race	-.796	.340	5.493	.019	.451
SES	.231	.356	.419	.517	1.260
Marital Status	.180	.320	.316	.574	1.197
Obesity	.329	.296	1.233	.267	1.389
Educational Level	-.046	.334	.019	.891	.955
Drug Use/Abuse	.413	.376	1.210	.271	1.512
Diabetes	.820	.399	4.227	.040	2.270
Hypertension	.426	.370	1.326	.249	1.531
Constant	-.356	.407	.765	.382	.701

Model Chi-Square 18.6333 (df=9, N = 231) Model Summary: -2 Log likelihood
291.672

Model One

Table 14 showed the results for the logistic regression analysis for Model One which excluded the independent variable, Adequacy of Prenatal Care (refer to Chapter 3 discussing the rationale for developing a second logistic regression model). The results in Model One showed that for the population in this research, two variables, Race and Diabetes, displayed the most variation in relation to the EGA of stillbirth. The logit coefficient (B) for Race was negative in Model One, and the Odds Ratio for the black women in this study was .451. Together, these indicated that in this population, the odds of the black women experiencing a Late Stillbirth were less than half the odds of non-black women experiencing a Late Stillbirth.

Another way of reporting these results is by using logistic regression to calculate the odds ratio for black women versus non-black women in this population experiencing an Early Stillbirth instead of a Late Stillbirth. This calculation resulted in an Odds Ratio that was 2.217, which indicated that, in this population, the odds for black women experiencing an Early Stillbirth, instead of a Late Stillbirth, compared with non-black women was 2.2 to 1.

The logit coefficient for the independent variable, Diabetes in Model One was positive, which indicated that in this population, women who had a diagnosis of diabetes during their pregnancy were at an increased risk of experiencing a Late Stillbirth as compared with women who did not have diabetes. The Odds Ratio for the independent variable Diabetes was 2.270, which meant that the odds of a woman in this study, diagnosed with diabetes experiencing a Late Stillbirth, instead of an Early Stillbirth, was 2.3 to 1, compared with study subjects without diabetes.

Model Two

Table 15 showed the results for the logistic regression analysis for Model Two which included the independent variable, Adequacy of Prenatal Care in addition to the nine independent variables included in Model One. The results in Model Two indicated that the independent variable, Race showed virtually the same magnitude in variation in relation to the dependent variable, EGA as in Model One. The odds ratios for Race were .451 in Model One and .447 in Model Two (both .45 with rounding). The logit coefficient (B) for Race in Model Two was negative, which again showed that the black women in this population were at an increased risk of experiencing an Early Stillbirth (instead of a Late Stillbirth) compared with women who were not black.

Similarly to Model One, when using these results to calculate the odds ratio for black women experiencing an Early Stillbirth instead of a Late Stillbirth, this calculation resulted in an Odds Ratio of 2.236. This indicated that, when controlling for Adequacy of Prenatal Care, the odds of a black woman experiencing an Early Stillbirth instead of a Late Stillbirth, as compared with a non-black woman, were 2.2 to 1, which is the same Odds Ratio obtained in Model One. This would suggest that in this population, the variable Adequacy of Prenatal Care had virtually no effect on the variable Race in relation to the EGA when stillbirth occurs.

Conversely, when controlling for Adequacy of Prenatal Care in Model Two, the results showed a small reduction in the variation for variable Diabetes in relation to the EGA when stillbirth occurred. In Model One women with Diabetes during pregnancy had an Odds Ratio of 2.3 with rounding, and in Model Two, for these same diabetic subjects, the results showed an Odds Ratio of 2.1. The results for Diabetes in both of

Model Two

Table 15

Logistic Regression Analysis Model Two

Variable	B	S.E.	Wald	p	Exp (B)
Maternal Age	.397	.309	1.656	.198	1.488
Race	-.805	.340	5.600	.018	.447
SES	.182	.366	.249	.618	1.200
Marital Status	.168	.321	.276	.599	1.183
Obesity	.385	.300	1.651	.199	1.470
Pre-natal Care	-.044	.323	.018	.904	.960
Education Level	-.041	.335	.015	.385	1.342
Drug Use/Abuse	.409	.377	1.175	.278	1.506
Diabetes	.753	.404	3.481	.062	2.124
Hypertension	.431	.371	1.350	.245	1.539
Constant	-.329	.408	.651	.420	.719

Model Chi-Square 18.6 (df=10, N = 231)

Model Summary: -2 Log likelihood

288.905

these models indicated that, in this population, the women diagnosed with diabetes during pregnancy were at an increased risk for experiencing a Late Stillbirth instead of an Early Stillbirth compared with women without diabetes.

After comparing the statistical results obtained in the two models, very little variation for the remaining independent variables (Maternal Age, SES, Marital Status, Obesity, Educational Level, Licit and Illicit Drug Use, Hypertension) was evident. This will be discussed more in the next chapter.

CHAPTER FIVE

DISCUSSION AND INTERPRETATION

Logistic Regression

In this research, Race and Diabetes were the two independent variables which showed the greatest variation in relation to the dependent variable, EGA of stillbirth. However, due to the fact that the study sample represented a population rather than a probability sample, there are limitations in terms of reporting statistical significance for these findings. In spite of this, it can be said that the results in the logistic regression models, both One and Two, suggest support for previous research that described black women as being more vulnerable to experiencing poor reproductive outcomes (e.g. Early Stillbirth due to prematurity and Very Low Birth Weight (VLBW) infants or infants born with a birth weight less than 1500 grams) *earlier* in their pregnancies, especially prior to 28 estimated weeks of gestation than women who are not black (Copper, 1994; Collins & David, 1998; Rich-Edwards, 2001; Vintzileos, 2002). The results in both logistic regression models are also consistent with the literature which has suggested that women with diabetes diagnosed during their pregnancy may be more vulnerable to experiencing a stillbirth after 28 weeks estimated gestational age (e.g. Late Stillbirth) than women who do not have diabetes during their pregnancy (Copper, 1994; Gabbe, 2002).

Early Stillbirth Risk and Race

Part of the explanation for the findings in this research concerning Race lies within the context of the ecological ‘person in environment’ perspective and the stress theory involving allostatic load; specifically, this study’s findings may not only involve ‘race’ per se, but in addition, it may involve racism, both conscious and unconscious. There are

two components to support this argument. First, almost 99% of the black women in this study's population were poor enough to be eligible for Medicaid as the payer source for medical care, and as such vulnerable to experiencing the chronic and debilitating stress of living in and with poverty. Second, as previously discussed in Chapter Four (Table 4) the majority of the black subjects in this study (88%) lived in communities surrounding one of the two hospitals that participated in this research. According to the Census Bureau, (www.CensusBureau.gov), black families living on Long Island in New York State, frequently reside in segregated neighborhoods and communities; when compared with other communities on Long Island where predominantly white families live, the black communities tend to have much poorer housing, more unemployment and fewer economic resources.

In the literature, this marginalization and concentrated segregation of black individuals and families, has been translated by several researchers, as representing social and institutional racism (David and Collins, 1991). The consequences of this, in terms of the increased stress (allostatic load) of both poverty and racism in relation to reproductive health, may be reflected in the results of this research, which suggests that in this study's population, the black women involved may be at a greater risk for experiencing Early Stillbirth as compared with the women who are not black. In this population, perhaps due to the chronic stresses of poverty and racism, black women may not have had the physical strength to carry a viable pregnancy closer to term which may have resulted in a healthier outcome.

Diabetes

In addition to the results concerning Race and Early Stillbirth, the results of this study

involving Diabetes showed that in this population, the women diagnosed with diabetes during their pregnancy may have had a higher risk for experiencing a Late Stillbirth, compared with women who are not diagnosed with diabetes during their pregnancy. Similar to Race, the results involving Diabetes in this research are also consistent with those in the literature.

It is important to note that 99% or almost all of the women with diabetes in this research were women diagnosed with Gestational Diabetes during their pregnancy, and in this population, these women seemed to be at an increased risk of experiencing a Late Stillbirth versus an Early Stillbirth. Therefore, the results of this study are consistent with the results reported in the literature cited in Chapter Two. Although the exact mechanisms contributing to the increased risk for women with GDM to experience Late Stillbirth has not been fully described, the cause is believed to be physiological in nature (Gabbe, 2002).

In the study population, only two women had diabetes prior to their pregnancy, being treated with insulin both prior to as well as during their pregnancies. As these two women experienced their stillbirths prior to 28 weeks EGA (Early Stillbirth), this is also consistent with the literature (Copper, 1994), though the small numbers inhibit further analysis.

Diabetes and Prenatal Care

Although the results in this research are consistent with the literature in terms of the variables Race and Diabetes, and the respective gestational ages when stillbirth occurs, the results of Models One and Two are inconclusive with regard to the variables involving Diabetes and Adequacy of Prenatal Care. As previously discussed, using a

hierarchical method of model building for the logistic regression analysis, in Model Two the variable Adequacy of Prenatal Care was added to the nine variables in Model One as it was the only variable that involved a medical intervention. Although this addition resulted in a small reduction in the variation in Model Two between the variable Diabetes and the EGA of stillbirth, this does not imply that when women with diabetes do not receive prenatal care, they are at an increased risk of experiencing a Late Stillbirth. What it does mean is that the variables Diabetes and Adequacy of Prenatal Care can be viewed as being confounding (Grinnell, 1997). In other words, when these two variables are present in the same logistic regression model, although they are not statistically collinear, their effects on the dependent variable or the EGA of stillbirth are indistinguishable from each other. Hence, the results in Models One and Two involving the variables Diabetes and Adequacy of Prenatal Care are inconclusive.

What May Be Suggested About Prenatal Care

As the results in this research showed that the black women in this population may have had an increased risk of Early (instead of Late) Stillbirth compared with non-black women, it would suggest that black women would benefit from receiving medical care during the seemingly important and vulnerable period either before and/or as early in their pregnancies as possible in order to decrease their risk of Early Stillbirth. This is especially true in light of the fact that even when not pregnant, black women are at an increased risk of having diabetes as well as hypertension (Gabbe, 2002).

In addition, the results of this study showed that in its population, the women diagnosed with GDM or diabetes during their pregnancy may have had an increased risk of experiencing a Late Stillbirth instead of an Early Stillbirth, compared with women

without diabetes. Given this, as well as, per Gabbe (2002), at least 2% to 3% of all pregnancies are complicated by diabetes, it seems prudent to support the theory that *all* women would benefit from receiving pre-conceptual care, inter-pregnancy care, as well as very early prenatal care in order to diagnose, treat and control medical conditions such as diabetes either prior to or very early in pregnancy, thereby potentially reducing the risks of an Early and/or Late Stillbirth.

Other Bio-Psychosocial Variables

The following discussion involves this study's statistical findings concerning the remaining bio-psycho-social variables, Maternal Age, SES, Marital Status, Obesity, Educational Level, Licit/Illicit Drug Use, and Hypertension, in relation the EGA of stillbirth. In both of the logistic regression models, these independent variables had odds ratios between approximately 1 to 1.5, which suggests that in this population, there was very little variation in the association between these variables and the dependent variable.

To conclude the discussion involving Prenatal Care, although two-thirds of the women who experienced stillbirth received Prenatal Care that was defined in this study as adequate and timely to have led to a positive birth outcome, unfortunately the birth outcomes were anything but positive, as all of the women included in the study sample experienced a stillbirth. A caveat exists however, regarding this research and the variable Prenatal Care. Compared to what is considered to be the 'standard of care' in normal obstetrical practice concerning professional recommendations for when a woman should begin prenatal care and the number of prenatal care visits a woman receives, the definition of 'adequate' prenatal care for this research may be considered liberal by many providers (Alexander and Kotelchuck, 2001; Gabbe, 2002). As a frame of reference, a

typical pregnancy is calculated by using the first day of a woman's last menstrual period with a pregnancy usually lasting approximately 38 to 40 weeks. These weeks are divided into approximately 12- week intervals (or trimesters) with a variety of tests and prenatal visits planned to occur at specific times during each trimester, the goal being to optimize maternal and fetal outcomes. It is customarily recommended by the obstetrical community that women begin prenatal care as early in their pregnancy as possible, which is usually after she has missed a menstrual period or two (such as over one to two months, or 6 to 8 weeks) and suspects that she may be pregnant (Gabbe, 2002). Following this recommendation, women optimally should begin prenatal care during the first 12 weeks (or first trimester) of their pregnancies in order to optimize their own health as well as the health of their infant. The number of prenatal visits after the initial visit varies depending upon a mother's and the unborn baby's health; however, a typical number of prenatal visits after the first trimester would be approximately 10 to 12 visits. This is obviously many more visits than two or three which is what is defined as 'adequate' in this study (see Chapter 3). Of note is the fact that several women in the study sample, especially those that began prenatal care during the first trimester and subsequently experienced a stillbirth at term or after 38 weeks EGA, had documentation in their medical record that they did receive at least 10 to 12 prenatal care visits. However, one could argue the calculation of Adequacy of Prenatal Care may account for this study's findings.

BMI/Obesity

The women who were either over-weight or obese prior to their pregnancy (per their pre-pregnant Body Mass Index) also represented almost two-thirds of the study sample,

which reflects a growing and troublesome health trend for adults in the United States. Although in a large (national) Danish study, Nohr (2005) reports obese women having at least two to three times the risk of having a stillbirth at term (38 to 40 weeks EGA) as compared to obese women prior to 24 weeks EGA, in comparison, the result in this research involving association between obesity and EGA of stillbirth (Odds Ratio 1.4) is quite small. Perhaps this is due to this study's relatively small sample size.

Licit/Illicit Substance Use

Women using licit/illicit substances during their pregnancy numbered 46, which represented 20% of the study sample. Of these 46 women, 40 or 17 % of the study sample smoked cigarettes during pregnancy which is consistent with the approximately 20 percent of all women who smoke cigarettes in the United States (Fergusson, 2002). It may be considered more common however, for pregnant women to discontinue smoking early in their pregnancies (i.e. before 16 weeks EGA) (Wisborg, 2001). Per Wisborg, early smoking cessation is primarily due to the initiation of early prenatal care (prior to 12 weeks EGA) and patient education regarding the dangers of smoking during pregnancy, which subsequently results in upwards of an 80% reduction in pregnant women who smoke by 16 weeks EGA. The benefits of early smoking cessation in pregnancy are well documented in the reproductive literature and include a significant reduction in several pregnancy risks such as intrauterine growth restriction, uterine abruption and stillbirth (Goldenberg, 2004; Silver, 2007). In addition, as the study sample involved only pregnant women, it might be expected that the percentage of women who smoked during their pregnancy might be less than the 17 % that was found, especially in light of the fact that 66 % of the women who received pre-natal care, began prior to 12

weeks EGA.

Hypertension

Twenty percent of the women in the study sample had hypertension during their pregnancy (either chronic or pregnancy-induced hypertension/PIH). This is up to twice the percentage of hypertensive cases typically found in the typical obstetrical population (5% to 10% (Gabbe, 2002). The percentage of cases in this study is logical, however, as all of the women in this research had a stillbirth, and as previously discussed, hypertension is associated with an increased risk of such an occurrence. The results of this study showed hypertension to have an Odds Ratio of 1.5, which suggests a small relationship to the EGA of stillbirth.

Maternal Age

In terms of the independent variables involving demographic data, the women in the study sample had a maternal age distribution consistent with women of child-bearing age in the United States (Gabbe, 2002). Perhaps this distribution contributed to the study results which showed an Odds Ratio of 1.4 for Maternal Age in both logistic regression models, suggesting that for this population, little association between this independent variable and EGA of stillbirth.

Marital Status

The number of unmarried women in this study represented slightly more than 50% of the study sample and this is consistent with a recent and rising trend in the past two decades for single women giving birth in the United States (Ventura, 2008). As previously discussed in the literature review, being single has long-been associated with an increased risk of stillbirth (Turner et al, 1990; Roux, 2001; Buka et al, 2003). The

explanation for this increased risk of stillbirth may be due to the perception that being unmarried has historically been associated with less social support as well as with an increase in the amount of social and personal stress experienced by single pregnant women. Perhaps this is based upon norms or more traditional religious beliefs that in the past often involved condemnation, social discrimination, and isolation of unwed, pregnant women (Nuckolls et al, 1972; Turner et al, 1990). However, in the past ten to twenty years, this discriminatory trend has been under-going a subtle transformation (Ventura, 2008), seemingly making single motherhood more accepted in our general society and thereby less inherently stressful. This evolutionary trend with its subsequent decrease in stress may account for why the variable Marital Status had an Odds ratio of virtually 1 in this study.

Education Level

The odds ratios for Education Level were very close to 1 in both of the regression models. Although the minority of the research population (35%) had a low level of education as it is defined in this research, without some clarification the statistical results can be misleading. Of note is the fact that almost 12 percent of the sample was under the age of 20 and attending high school when they experienced their stillbirth. This factor was not taken into consideration in the examination of the variable Educational Level as it was defined in this study (see Chapter 3). Educational Level was defined solely as attaining a certain level of education, regardless of age appropriateness of levels of completion. One could argue that educational attainment reflects the perceived value of education and a commitment to the educational process, rather than attainment of knowledge. It may be that commitment to education could be a more relevant measure

because of the enormous amount of prenatal education that characterizes prenatal care processes. Further analysis of this variable should be a focus of future research.

Payer Source/Socioeconomic Status (SES)

The socioeconomic status (with payer source/Medicaid as a proxy for SES) in the study sample was reflective of the larger metropolitan area where this study was conducted, as well as of the women living in the communities surrounding each of the hospitals involved in this research (www.CensusBureau.gov). Although having over two-thirds of the sample defined as having a low SES based on payer source may seem excessive, this percentage was reflective of the two study hospitals' insurance data for women receiving maternity care. For example, in one of the two hospitals (where approximately half of the stillbirths occurred), Medicaid was used as the payer source for 90 % of the women who received medical care. In the other hospital, Medicaid was used as the payer source for approximately half of the pregnant women who received medical care. In addition, the fact that both of the study hospitals are large, publicly-funded medical centers rather than small, private community hospitals may have also increased the number of women with Medicaid versus an alternate payer source.

Payer source may not accurately reflect SES however, as many middle-class people with employment are without health insurance and cannot afford healthcare costs. Even those with insurance may have such high co-payments that access to care is as much of a barrier as for those without insurance. This may have contributed to the results showing SES as an Odds Ratio of 1.2 in relation to the EGA when a stillbirth occurs. However, Medicaid eligibility is often used to indicate low SES (Vintzileos, 2002; Maupin, 2004), and was the strongest proxy given the data available as well as the design of the study.

CHAPTER SIX

Summary

A stillbirth is one of the most common adverse outcomes of pregnancy. In spite of this, there is little research in the reproductive literature that examines common risk factors for stillbirth in terms of when during pregnancy stillbirth occurs. Given this, this study examined ten bio-psycho-social variables that, from the literature, are considered to be risk factors for stillbirth and their relationship to the EGA when a stillbirth occurs. The specific variables of interest included Maternal Age, Race, Socioeconomic Status (SES), Level of Education, Marital Status, Licit and Illicit Drug Use/Abuse, Diabetes, Hypertension and Adequacy of Pre-natal Care. The nominal, dependent variable, the EGA when a stillbirth occurs, was dichotomized into two categories: 1) an Early Stillbirth which was defined as a stillbirth that occurred before 28 weeks EGA, and 2) a Late Stillbirth, defined as a stillbirth that occurred after 28 weeks EGA. Data were collected via a retrospective review of the obstetrical medical records of 231 singleton stillbirths that occurred between January 2000 and December 2005 (a total of 6 years), in two large tertiary care, publicly funded hospitals located on Long Island in New York State. As the sample obtained was not a probability sample, it was treated statistically as a population. Data analysis involved descriptive statistics and logistic regression.

The results of this study indicated that the independent variables involving Race and Diabetes were two risk factors which displayed the greatest variation in relation to the EGA of stillbirth, and these became the focus of this research. Specifically, in this population, black women were found to be at an increased risk (Odds Ratio 2.24) of experiencing an Early Stillbirth compared to women who are not black. This was the

case both in the presence (Regression Model Two) and in the absence (Regression Model One) of the independent variable, Adequacy of Pre-natal Care. The results in both logistic regression models also showed that in this population, women who were diagnosed with diabetes during their pregnancy were at an increased risk (Odds Ratios 2.3 and 2.1, respectively), of experiencing a Late Stillbirth (a stillbirth after 28 weeks EGA) compared with women without diabetes during their pregnancy.

Due to the fact that this research involves a population instead of a probability sample, statistical significance is not relevant and the results for the logistic regression are not inferential in nature. However, the findings for this population are consistent with those previously reported in the reproductive literature concerning race and diabetes.

Specifically, in the literature, black women tend to experience a greater number of poor reproductive outcomes (e.g. preterm labor and delivery and prematurity) *earlier* in their pregnancies compared with women who are not black. Although many possible reasons for this have been examined in the past, the explanation remains unclear; this is also true for the results obtained in this study. However, after thoughtful analysis of the economic and demographic data for this population, part of the explanation for the results in this study involving black women and Early Stillbirth, may not rest solely within the variable 'Race' per se, but may also involve racism. Specifically, racism as a long-standing problem in the U.S. involving black Americans living in a society, whose fabric is interwoven with conscience and unconscious racial discrimination and social and economic segregation. Racism as such, for some black women, may prove to be quite stressful, to the point of negatively affecting their ability to carry every pregnancy to a healthy term birth; hence, as in this population, seemingly to have an increased risk for

Early Stillbirth.

With regard to the variable Diabetes, although the reproductive literature includes research showing pregnant diabetic women at an over-all increased risk for stillbirth, as previously discussed, there is some debate as to when during pregnancy a women with diabetes is at increased risk. From the literature it appears that it depends upon the type and severity of diabetes. Women with diabetes prior to pregnancy are at an increased risk of experiencing a stillbirth prior to 28 weeks' gestation (consistent with the timing of Early Stillbirth in this study) while women diagnosed with diabetes solely during their pregnancy (Gestational Diabetes), are at an increased risk for experiencing a stillbirth after 28 weeks (consistent with the timing of a Late Stillbirth). As 99% of the women in this study diagnosed with diabetes were diagnosed with Gestational Diabetes and the majority (75%) experienced a Late Stillbirth, the results of this study are similar to that reported in the literature.

Although the exact mechanisms for the increased risk for stillbirth in diabetic women have not been fully described, the cause is believed to be physiological in nature. From the literature, it also appears that with the help of pre-conceptual and early prenatal care, gravid women with diabetes tend to experience better reproductive outcomes (Copper, 1994; Gabbe, 2002). Unfortunately, however, due to the nature of the study design, it cannot be said that the results in this research involving Adequacy of Pre-natal Care and Diabetes, are in agreement with the literature. Specifically, the variable Adequacy of Pre-natal Care in this study does not measure the timing of when pre-natal care was initiated in relation to Diabetes and the dependent variable, EGA of stillbirth. Rather, the variable Adequacy of Pre-natal Care is defined solely by the number of prenatal visits the

subjects received during their pregnancy prior to the stillbirth occurrence, which may be a study limitation.

Ultimately, the results of this study suggest support for the theory that black women and their families might benefit by living in a society with social and economic opportunities that are universally inclusive, unbiased, and racially stress-free in order to reduce the risk of Early Stillbirth. The results of this study also suggest support for the theory that, as women in general are physiologically at an increased risk for developing diabetes during pregnancy, every woman would benefit from healthcare involving primary prevention *before* pregnancy, as well as by receiving timely and early prenatal care. These strategies offer women opportunities for possible prevention of diabetes, as well as early diagnoses and treatment of the disease, which may decrease the risk of Late Stillbirth.

Policy Implications and Program Development

The Life Course Model

The life-course model as a theoretical frame of reference has policy implications for not only reducing the risks for both Early and Late Stillbirth, but for reducing the risks for other poor reproductive outcomes as well. As a first step, the life-course model calls for greater investments in women's health. Presently, many women, particularly low-income women and black women lack access to women's health care (Chek and Kerr, 1999; Maupin, 2004). Many components of women's health care are not covered or are inadequately covered by public or private insurance (i.e. pre-conceptual care or primary care for women) (Lieberman, 2003). Access to continuous health care is limited for many low-income women when they are not pregnant and they lose their Medicaid coverage at

60 days post-partum even if they had a poor pregnancy outcome (Lu and Halfon, 2003). This is especially detrimental to black women, as they have a higher incidence of hypertension and diabetes both prior to as well as during pregnancy compared to white and Hispanic women (Vintzileos, 2002; Gabbe, 2002; Chang, 2003). Expanding access to Medicaid and instituting universal health care insurance coverage seems to be a logical step.

Strategies for increasing health insurance coverage include expanding the State Children's Health Insurance Program to provide family coverage, enabling Title X to cover pre-conceptual care, and extending pregnancy-related Medicaid to cover inter-conceptual care for all women, but especially for women with a prior poor pregnancy outcome (Lu and Halfon, 2003). A more unified approach toward universal health care and coverage (e.g. electronic medical records and universal health insurance) for continuous women's health care is also needed. Ultimately, these long-term investments ('womb to tomb') in women's life-course health development may yield greater returns on future birth outcomes, rather than the current practice of short-term 'quick fixes' attempted solely during pregnancy with pre-natal care.

In addition, the life course model calls for greater investments in community health (Lu and Halfon, 2003). As long as poor and black women continue to grow up and reside in neighborhoods and communities that put them at disadvantages beginning early in life which lead to greater allostatic loads, greater numbers of poor pregnancy outcomes and reproductive racial disparities will likely persist, even with the best pregnancy care or women's health care (Geronimus, 1996). Building stronger and healthier communities requires investments in infrastructure, such as safe neighborhoods with affordable and

decent housing, clean and accessible parks and recreation, quality schools, thriving businesses, and community-based health care (Alexander and Kogen, 1998). Such an endeavor requires much in the way of collaboration (Kotelchuck, 2003). Those within the community: families, businesses, religious organizations, schools, health centers and the local government must work together to clarify community needs and to decide where investments ought to be made. For example, to ease access, municipal transportation authorities can map out new routes to facilitate transportation to and from businesses, schools, and health centers; or to improve nutrition, small convenience stores can be given economic incentives to offer a greater selection of fresh fruits and vegetables.

Lastly, the life-course model calls for greater investments in improving social conditions designed to reduce the allostatic load and chronic stress which makes up the fabric of too many women's lives (Alexander and Kogen, 1998; Tiedje, 2003). This requires policy and program development to address important issues that disproportionately impact women, such as programs designed to meet the challenges for women to find work, as well as in combining work with safe and appropriate childcare (Lu and Halfon, 2003). Policies also need to be developed to reduce the chronic stress that many women routinely experience; policies to safeguard employment, work safety, and working conditions; to establish work-site health care services and to ensure paid sick time and expand paid maternity and family leave (such as those established in Scandinavian countries), thereby wielding greater protections for pregnant and parenting women and men here in the United States (Kotelchuck, 2003).

By improving social conditions, public policy can help to improve women's health over the course of their lifetimes. This offers opportunities for all women, but especially

black women to be better protected against the damaging effects of a cumulative allostatic load over their life course including during their child-bearing years. The result may lead to a reduction in stillbirth, both Early and Late.

Strengths and Limitations

In a research study involving a retrospective (historical) data analysis, data that is not recorded are data lost, which is one of the limitations of this research. It is common for obstetrical medical records to be incomplete, as women frequently do not deliver their infants in the hospital when and where they originally planned, especially in pregnancies involving a stillbirth. In addition, the hospital where a woman delivers may not be affiliated with the medical practice or clinic where she received her prenatal care. Both of these circumstances are true concerning the stillbirth deliveries involved in this research. Hence, medical records that may have been requested by the hospital, may not have been forwarded, or if sent, may have been lost in transit. To over-come this limitation, only those medical records containing 95% or more of the data (demographic, pre-natal care, hospital admission to Labor and Delivery, fetal death certificate, post-partum pathological placental report and fetal autopsy) desired for this research were selected for inclusion for this study. Although omitting these incomplete medical records may result in a small amount of bias, due to the historical nature of this research method, this bias is unfortunately unavoidable and hopefully minimal.

The size of the population of subjects (N=231) is relatively small, which is another limitation of this research. While it did achieve a ratio of 10 early stillbirths and 10 late stillbirths for each of the ten independent variables or bio-psycho-social risk factors for stillbirth, a larger sample size may be more representative of the general stillbirth

population in the United States.

Another limitation of this study concerns the method of collecting data involving Marital Status. The data as they were collected do not accurately reflect a woman's actual support system in terms of having a 'significant other' or 'significant support person' or 'persons' during her pregnancy. It would have been an improvement if data were collected concerning a woman's over-all support system (significant other(s), friends, family, home environment, religious affiliation) as this would give a more accurate reflection of her support systems and any association involving stillbirth risk.

A fourth limitation of this study is the use of Medicaid as a proxy for Low Socioeconomic Status (SES) as Medicaid may not accurately reflect in individual or family's actual SES. There are many individuals and families in the United States who, though employed, may not possess health insurance through their employer. They can have an annual income that is in excess of eligibility standards for Medicaid. Although far from affluent, they are forced to use finite economic resources to purchase private health insurance or pay out of pocket for care. The financial demands of healthcare can contribute to lower SES, which would not have been captured within this study.

From the literature, low educational status is considered a risk factor for a woman having a stillbirth (Little and Weinberg, 1993). In this research low educational status is defined as a woman who has not received a high school diploma or its equivalent. This definition may be a limitation for this study due to the fact that 27 women (12 %) included in the sample were under the age of 20 at the time of their stillbirth, and the majority (20 of the 27 women) were still attending high school.

The method of collecting data involving Race is another limitation. The data were

collected from the registration form completed by a woman when she was admitted to the hospital to deliver her stillborn. In terms of Race, the only choices a woman had to choose from in order to complete the form were 'White', 'Black', 'Hispanic', and 'Other'. This method has its limitations as it does not capture certain ethnicities and races such as those women from Asia as well as women with origins involving a mixture of races or ethnicities. For example, a woman who identifies herself as Hispanic may also be 'Black' or 'White'.

As previously discussed, in addition to collecting demographic data involving maternal age, race, educational level, marital and socioeconomic status in this study, data were collected involving maternal country of origin. Of the 231 women in the sample, 60 percent were born in the United States and at least 33 percent were born outside of the United States. The fact that almost one-third of the women in this study's sample were born abroad and immigrated to the US may have some influence on their pregnancy outcomes (James, 1993; Williams, 1994). Per Williams (1994), women who immigrate to the United States and deliver an infant within one to two years, tend to have babies that are heavier, longer and described as healthier at birth than women who immigrate to and have lived in the United States for one or two decades. The explanation for this finding remains uncertain; however, per James (1992), it may be due in part to 'selective migration' (healthier and wealthier women are better able to immigrate), and/or to maintenance of a 'protective culture' in foreign-born women. Regardless, it is difficult to discern if immigration has affected this study's results, as data involving the length of time each woman has been living in the US were not abstracted from the medical record. This represents not only a study limitation, but especially as the population in the United

States is growing in terms of Hispanic immigrants, it is also an area for future research.

Data collected involving diabetes as a risk factor for stillbirth represents another limitation. Unfortunately, during the course of data collection, the severity of the diabetes for each woman diagnosed with diabetes was not recorded with regard to treatment: either with diet alone or with diet and insulin. Data involving patient compliance with prescribed diabetic treatment were also not recorded. Lastly, data were not recorded separately on the data collection tool for those women who had an abnormally high one-hour oral glucose-diabetes screening test during their pregnancy, but went on after additional testing to be diagnosed as not having Gestational Diabetes or diabetes during pregnancy. Some researchers believe that having an initial one-hour oral glucose challenge test that is abnormally high, in and of itself places a woman at an increased risk of experiencing a stillbirth and could impact the timing of the stillbirth and could impact the timing of the stillbirth as well. (Lau and Li, 1994; Stamilio, DM et al.2004). Not collecting these data separately may be considered a limitation of this research.

Study Strengths

One of the strengths of this research involves the demographic make-up of the sample. As compared to 2004 census data (www.CensusBureau.gov), the sample for this study appropriately represents the demographic data (maternal age, race, socioeconomic status, and marital status) for women of child-bearing age who live in the communities that surround and are serviced by the two hospitals involved in this research. In future research, this population may be incorporated into a larger sample of stillbirths, which potentially may contribute to this study's external validity.

In addition, the title, which begins, ‘The Silent Womb’ ... belies and contradicts one of the limitations of this study, subsequently revealing strength. As previously discussed, research involving a retrospective review of medical records or historical data has a weakness as it is limited by the quantity and quality of the data available. Data that are not recorded or lost represent a piece of missing history; a gap in the story of, in this case, the events surrounding a stillbirth. Fortunately however, in this research there is strength in the large quantities of data that are available in each of the 231 obstetrical records included. Each of these medical records speaks volumes and reveals a detailed stillbirth story that is extensive and clear. In simple terms, the medical records included in this research are an asset as they contain a great deal of appropriate and helpful information with regard to examining bio-psycho-social variables for stillbirth; hence, ‘The Silent Womb’ is ultimately anything but silent.

Future Research

Research must continue in an attempt to increase our understanding of the relationships between various bio-psycho-social risk factors and stillbirth, especially the timing of stillbirth to reduce the rates world-wide. Additional research is needed on the clinical-individual level, comparing exposures to risk and protective factors during pregnancy; however, per the life-course model, it also must be expanded to involve approaches that are more longitudinal and integrative in nature.

An area of future research on the individual-clinical level involves the prenatal screening process for diabetes which is almost universally done during pregnancy here in the United States. During the process of data collection for this study, it was observed that some of the women had an abnormally high one-hour oral glucose-diabetes screening

test during their pregnancy. They subsequently had additional testing, and although they could be described as having ‘impaired glucose tolerance’ during their pregnancy, they were ultimately diagnosed as not having diabetes and did not receive treatment. Some researchers believe that having ‘impaired glucose tolerance’ or ‘border-line diabetes’, as demonstrated by an abnormally high one-hour oral glucose challenge test during pregnancy, in and of itself places a woman at an increased of experiencing a stillbirth (Lau and Li, 1994; Stamilio, 2004). Hence, research involving ‘impaired glucose tolerance’ in relation to birth outcomes, including EGA stillbirth occurs, might be considered important in future studies.

Another area of future research on both the individual-clinical level, as well as in larger epidemiological studies concerns the topic of obesity. Obesity is a significant and expanding public health problem here in the United States that is associated with an increased risk for women developing diabetes (Clark, 2006), as well as experiencing Late Stillbirth (Nohr, 2005). Due to this risk profile, obesity represents an important area of research in terms of prevention, diagnoses, and treatment. This is especially true in light of the fact that the majority of women here in the United States are over weight or obese prior to beginning a pregnancy (Cnattingius, 1998; Nohr, 2005).

Research involving ‘racism’ is very challenging, but in light of the results of this and other studies, racism as a bio-psycho-social risk factor for stillbirth represents a very important area of research; both on the clinical-individual as well as on a longitudinal level. The essence of a new direction for future research to explore racism can be summarized simply via a shift of focus solely from ‘race’ to also include ‘racism’.

Race and Past Research Assumptions

It has long been evident, that much of the work involving race and reproductive outcomes has been based upon the assumptions that there are two theoretical possibilities to explain the differences between races and their risks of poor birth outcomes (David and Collins, 1991). The first assumption is that there exists a set of social and/or environmental risk factors that differ in quantity between blacks and non-blacks. The second assumption is that if such risk factors cannot be found, disparities must result from genetic, biological differences between races.

Per David and Collins (1991), the validity of the biological concept of race in relation to reproductive outcomes is questionable on scientific grounds and it also has somewhat of a disturbing history here in the United States. In the U.S. for example, the concept of race and many of its associated racist beliefs were developed in the context of slavery and imperial colonialism (Wegman, 1981). Race has also functioned in this country, not only to classify human variation, but in addition, it has been used to justify and maintain the exploitation of groups defined to be inferior (David and Collins, 1991). Exploitation aside, epidemiological research on racial variations in reproductive outcomes has long been based upon a genetic model, which views race as a reflection of biological homogeneity. Any resulting differences in reproduction are thereby considered largely genetically determined (Wegman, 1988); interestingly enough, this model emerged in the late 18th century, long before any precise theory of heredity existed.

In the last 100 years, a great deal has been learned about the science of genetics. It is now known that there is more genetic variation within races than between them, and that racial categories do not capture biological distinctiveness (Yankauer, 1990). The fact that

we know what race we belong to actually tells us more about our society than about our genetic make-up. In addition, the designation of race as a taxonomic entity has always been problematic, to the extent that it remains undecided as to how many races there actually are (David and Collins, 1991).

Although in the past 30 years, the concept of race has been largely abandoned by most physical and cultural anthropologists (David and Collins, 1991), in our current society the designation of race as a social entity remains an undeniable fact. Consistent with this fact are the patterns of mass diseases in epidemiological studies, which in all age groups, fit better with a social rather than a biologic concept of race (Williams, 1994). For example, in newborn infants, cause-specific mortality is higher for blacks than for whites or Hispanics in 9 of 10 disease categories, including infection, prematurity, respiratory diseases, immune disorders, and accidents (Williams, 1994). The only category for which all ethnic groups are equivalent in terms of mortality rates are congenital anomalies, and this is the only category in which (arguably) genetic differences might be expected to play a role (Williams, 1994).

Therefore, after thoughtful analysis, the results of this study, although involving a small population of women, supports the idea which suggests that in the process of examining various bio-psycho-social risk factors and stillbirth (including their relationship to the EGA when stillbirth occurs), a key independent variable of interest for future studies would be 'racism' in addition to 'race'. 'Racism' as a research variable may prove to be appropriate and valid, as potentially it has a greater capability, compared with 'race', of accurately capturing the true black experience in the United States; and as such may ultimately be more enlightening as to how and why various bio-psycho-social

risk factors contribute to stillbirth and the EGA of stillbirth.

Another area of future study related to racism involves the study of stress and coping mechanisms as employed by various ethnic groups. Even if environmental stressors are equal between mothers in different ethnic groups, the prevalence of various mechanisms of coping with such stress probably differ. Use of various coping styles among women of different ethnic groups can reflect different customs and values which may have positive or negative effects on birth outcomes.

A third area of future research concerning racism and reproductive outcomes involves women who are born abroad and subsequently immigrate to the United States. As discussed previously, at least one-third of the women in this study's sample were born outside of the United States and this may have some influence on their pregnancy ending in stillbirth. This would be especially important with regard to black women, as it would be not only interesting, but also important to examine the EGA when stillbirth occurs for black women born abroad, the length of time they have lived in the United States, and compare these data with the EGA when stillbirth occurs for black women born in the United States.

The Life Course Model and Future Research

In the literature there is a plethora of research comparing exposures to risk and protective factors solely during pregnancy in relation to poor reproductive outcomes including stillbirth; however, as clear answers remain elusive another research approach may be found to be beneficial. As previously discussed, the life-course model is such an approach as it calls for research that goes beyond examining risks only during the relatively few months of pregnancy, to comparing cumulative experiences over the life-

course of women in relation to reproductive outcomes (Lu and Halfon, 2003). As such, the life-course model calls for research that is much more longitudinal and integrative in design.

The life-course model calls for longitudinal study designs such as a prospective cohort study with appropriate controls, a sufficiently large sample size, and adequate duration of follow-up (Lu and Halfon, 2003). Pregnant women recruited into such a study could be followed prospectively, with their children followed from infancy through their reproductive years. If the study were to continue long enough, it could span across three generations and the health and developmental outcomes of each generation could be evaluated with measures collected longitudinally. This could enable researchers to begin to investigate the impact of different early life experiences and cumulative allostatic stress over the life course of each generation, as well as across generations in relation to birth outcomes.

The life-course model also proposes better data integration. Per Lu and Halfon (2003), various databases need to be linked across different stages of pregnancy from pre-conception through pregnancy to post-partum, as well as from one pregnancy to the next. Maternal data needs to be linked to not only pregnancy outcomes data, but to data on long-term health and developmental outcomes, as well as be connected across generations in order to examine inter-generational effects (Lu and Halfon, 2003).

In order to support this kind of longitudinal and integrative research, Lu and Halfon (2003) call for the creation of an infrastructure to support life-course research. They believe that research priorities need to be defined from the life-course perspective and that grants must be made on much longer funding cycles. Most importantly, they propose

that a multidisciplinary research network be developed in order to bridge the existing 'chasm' between bio-medical and social-behavioral research on birth outcomes and disparities.

The goals of this kind of long-term research are to understand and reduce stillbirth and other adverse pregnancy outcomes, as well as to try to implement strategies to eliminate racial disparities in birth outcomes. Although these goals are noble, implementing this kind of research involves a great deal of time, and commitment from funding sources; and the results from this kind of investment may be a long-time in coming.

Meanwhile, in addition to quantitative research, qualitative research may prove to be very beneficial in terms of gathering valuable data that are stored within those individuals whose lives we are trying to improve; data which are key to our understanding women and their life-course. Listening for each individual woman's story is important. It affords us the opportunity to hear a sense of her personal history and better appreciate the context of her life in the present as it impacts on her life course and her reproductive outcomes.

Conclusion

Stillbirth remains one of the most common adverse outcomes of pregnancy, and among the least understood (Goldenberg, 2004). Although in the literature there are many studies that include various bio-psycho-social risk factors for stillbirth, very few studies examine these risk factors in relation the EGA when a stillbirth occurs. By examining certain bio-psycho-social risk factors for stillbirth (Maternal Age, Race, SES, Marital Status, Obesity, Adequacy of Prenatal Care, Education Level, Licit and Illicit Drug Use/Abuse, Diabetes, and Hypertension) in relation to the time during pregnancy

(EGA) when a stillbirth occurs, this research may represent a small contribution to our understanding of stillbirth, as well as may be helpful in terms of prevention.

From the literature and this research, it is evident that the complicated etiological web of stillbirth is still being defined and that the many mechanisms and pathways leading to stillbirth, both Early and Late, remain unknown and unexplained. In order to reduce the number of all stillbirths, additional research is clearly needed, both about the causes of unexplained stillbirths as well as the bio-psycho-social pathways leading from risk factors to stillbirth.

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APPENDIX A

GLOSSARY OF TERMS

*Advanced Maternal Age- A term used to describe a pregnant woman who will be older than 34 years of age at the time of her expected date of delivery.

*Asphyxia- Lack of oxygen.

*Ante-partum- The period of time during a pregnancy before labor.

*Body Mass Index- A mathematical calculation of a person's body mass based upon their height and their weight. To calculate a woman's Body Mass Index (BMI), multiply her weight in pounds by 705 and divide this number by the square of her height in inches. A value less than 20 means that a woman is underweight for her height; a value between 20 and 26 means that a woman is an appropriate weight for her height; a value between 26 and 29 means that a woman is over-weight for her height; and a value greater than equal to 29 means that a woman is obese or very much over-weight for her height.

*Breech presentation- A term used to describe the position of a fetus within a woman's uterus with the buttocks ready to be born first during a vaginal delivery. It is more common for an infant to be born with the head in position to be born first, which is considered to be a safer way for a baby to be born.

*Cholestasis of Pregnancy- A liver disease during pregnancy that involves generalized pruritis (or itchy skin) and mild jaundice (a yellowish color to the skin); it is associated with an increased risk of stillbirth.

*Chorioamnionitis- A term used to describe an infection inside the uterus during a pregnancy.

*Eclampsia- A term used to describe the occurrence of seizures or coma unrelated to

other cerebral conditions with signs and symptoms of pre-eclampsia (See Pre-eclampsia).

*Erythroblastosis fetalis- A disease during a pregnancy involving the destruction of the red blood cells in the fetus which can result in severe anemia and fetal death.

*Fetal death- A term to describe a fetus with no signs of life, such as no heart beat and no spontaneous respiration after delivery.

*Fetal Distress- A term used to describe a potentially seriously compromised physical state of a fetus prior to delivery; usually diagnosed during labor by electronic monitoring of the fetal heart beat.

*Fetal-Maternal Hemorrhage- A term used to describe the transplacental passage of fetal red blood cells to the mother sufficient to cause an immune response in the mother.

* Hypertension- Abnormally elevated blood pressure.

*Intra-partum- A term used to describe the time during a pregnancy when a woman is in labor.

*Intra-Uterine Growth Restriction- (IUGR)- A term used to describe fetal growth during a pregnancy that is less than that expected for gestational age, usually less than the 10th percentile for weight. As many as 40 percent of stillbirths (Gabbe, 2002) are growth restricted. Another term for closely associated with IUGR is 'Small for Gestational Age' or SGA. This term refers to infants with a birth weight that is at the lower extreme of the normal birth weight distribution, also usually less than the 10th percentile for gestational age.

*Neonatal Demise- A term used to describe the death of an infant that occurs between the time of birth through 28 days of life.

*Parity- A term used to describe the outcome of a woman's pregnancy(ies) in terms of

gestational age as well as the number of living children she currently has.

*Placental Abruption- A term used to describe the premature separation of the placenta from the uterine wall during a pregnancy; this, potentially, is an emergency, and if not treated appropriately, may result in fetal death.

*Placental Infarction- A term used to describe a lack of oxygen within a placenta; this can result in inadequate oxygen being transferred from mother to fetus, as well as a stillbirth.

*Placenta Previa- A term used to describe the location of a placenta that is implanted in a woman's uterus during a pregnancy; the placenta is located over the cervix or opening of the uterus. This is a serious obstetrical problem and if undetected, unappreciated, and mis-managed by medical providers, may result in maternal and fetal hemorrhage and death.

*Polyhydramnios- A term used to describe an abnormal (excessive) amount of amniotic fluid within the uterus during a pregnancy; it is a symptom of a potentially serious problem with the fetus.

*Pre-eclampsia- A term used to describe a medical condition that can develop during a pregnancy involving high blood pressure, protein in the mother's urine, and maternal edema; a very serious condition with significant risk of maternal and fetal mortality.

*Pre-mature Rupture of Membranes- (PROM)- A term used to describe the pre-mature rupture or breaking of the amniotic membranes in a pregnancy, before the onset of labor; this can increase the risk of infection.

*Pre-term- A term used to describe the time during a pregnancy between 20 and 37 completed weeks estimated gestational age.

*Prolapsed (umbilical) cord- A term used to describe when the umbilical cord is delivered into the vagina before the body of the infant; this is considered an emergency and is greatly associated with fetal death due to asphyxia.

*Post-dates or post-term- A term used to describe the time during a pregnancy that is after the estimated date of delivery.

*Retro-placental hematoma- A term used to describe a collection of blood between the placenta and the uterine wall. If large enough, this may contribute to less oxygen being transferred from the mother to the fetus in utero.

*Stillbirth- A fetal death that occurs after 20 weeks of fetal life or a birth weight greater than 350 grams.

*Term- A term used to describe the estimated gestational age of a fetus between 38 and 40 weeks; considered to be an optimum time for an infant to be born healthy.

*Utero-placental Insufficiency- A term used to describe compromised functioning and substrate (e.g. Oxygen) exchange between mother (uterus) and fetus via the placenta.

The following references were used in developing the Glossary: ACOG, 2000; Gabbe, 2002.

APPENDIX B

Stillbirth Medical Record Data Abstraction Form

Study Number: _____

Prenatal Record:

1. Did the mother receive prenatal care? Yes_____ No_____
2. Race of Mother: White _____ Black _____ Hispanic _____ Other_____; if other,
Please specify _____.
3. If Hispanic, please specify: Mexican _____ Puerto Rican _____ Cuban_____
Central/South American _____ Other_____.
4. Country of Birth: USA _____ Outside of the USA; please specify_____.
5. What was the mother's marital status at prenatal registration: Single_____
Married _____ Separated _____ Divorced _____ Widowed_____.
6. Mother's age at registration or prenatal care: _____ years.
7. Mother's LMP date:_____
8. EDD by LMP date:_____
9. EDD by sonogram/MD assessment:_____
10. Weeks of gestation at first prenatal visit:_____.
11. Where did mother receive prenatal care? County or City Health Department:_____
Managed Care Organization:_____ Clinic at work or school:_____ Clinic at a
hospital: _____ Hospital ER: _____ Community Health Center: _____ Other:_____
No Prenatal Care:_____.
12. Who was the most frequent provider of care? Obstetrician_____ Family
Physician_____ Maternal-Fetal medicine Specialist_____ Physician's

Assistant____ Nurse Midwife____ Nurse Practitioner____ Other, please specify_____.

13. Was the mother referred to any other providers for assessment? No____
Yes____. If yes, check all that apply: Obstetrician____ Maternal-fetal
Medicine Specialist____ Internist____ Other____; If other specialist,
Please specify_____.

Pregnancy History: Please provide the information below in reverse chronological order,
most recent pregnancy first.

14. Gravida ____ Para____(Term, Premature, Abortions/miscarriages, Living
children).

A. Year_____

Pregnancy outcome: Spontaneous Abortion/Trimester____ Elective Abortion/Trimester
____ Ectopic ____ Stillbirth____, grams Live Birth____; birth weight _____
grams.

Current Status: Living____ Deceased____ Unknown____; If deceased, state cause of
death_____. Maternal complications: Yes ____ No ____; If yes, please
specify:_____.

B. Year_____

Pregnancy outcome: Spontaneous Abortion/Trimester____ Elective
Abortion/Trimester____ Ectopic ____ Stillbirth ____ ,grams. Live- birth____;
birth weight ____ grams Current status: Living ____ Deceased ____ Unknown
____ If deceased, state cause of death: _____.

Maternal complications: Yes ____ No ____; if yes, please specify: _____.

C. Year _____

Pregnancy outcome: Spontaneous Abortion/Trimester _____ Elective

Abortion/Trimester _____ Ectopic _____ Stillbirth _____ grams. Live birth

_____ ; birth weight _____ grams Current status: Living _____ Deceased _____

Unknown _____ If deceased, cause of death: _____.

Maternal complications: Yes _____ No _____ ; if yes, please specify: _____.

If there are additional pregnancies, please use a separate copy of this page and continue.

15. Was the father the same _____ or different _____ for each of the pregnancies?

If different, please specify which pregnancies: _____.

16. What is the payer source at registration for medical care? Check all that apply:

Private insurance _____ Managed Care Organization _____ Medicaid _____

Self Pay _____ CHAMPUS _____ Other _____ ; please specify:

_____.

17. Does the medical history reveal any maternal use of alcohol, tobacco, or other

drugs? Yes _____ No _____ If yes, please state type and amount of use (check all

that apply): Cigarettes- number _____ /day Alcohol- number of drinks _____ /day

Heroin _____ Amphetamines _____ Cannabis _____ Methadone _____ mg/day

Cocaine/crack _____ Hallucinogens _____ Other _____.

17. Check which of the following tests were ordered at the initial visit, the results of

those tests, and whether any treatment was prescribed.

CBC / HCT/HGB _____

ABO Blood Type/Rh factor _____

Antigen/Antibody screen _____

Gonorrhea culture _____

Chlamydia culture _____

GBS culture _____

Serology Test for Syphilis _____

Urine culture _____

Hemoglobin Electrophoresis _____

Rubella titer _____

HepBsAg _____

Urine Toxicology/drug(s) found _____

TB test _____

Other _____

19. Was a prenatal psycho-social assessment performed? Yes _____ No _____

20. Was a social worker available for assessment/follow-up? Yes _____ No _____

21. Did providers identify any of the problems listed below during the initial visit or at any other times during the prenatal course, and if so, was a referral made?

Yes _____ No _____

Child Abuse/neglect _____

Depression _____

Inadequate support systems _____

Housing inadequate/homeless _____

Need for Public Assistance, Medicaid, Food Stamps, WIC, or other financial support _____

Abuse (emotional/psychological/physical) _____

Mother abused as a child _____

Drug/Alcohol abuse (mother/partner) _____

Employment/educational needs (mother/partner) _____

22. Did a Social Worker see the mother? Yes _____ No _____

23. Was a case management plan developed for any of the above problems?

Yes _____ No _____ if yes, please describe:

24. Please list any medications prescribed during pregnancy and the trimester(s)

taken: _____

25. Did the mother have any significant medical problems either before or during this pregnancy? Yes _____ No _____ If yes, please describe:

Cardiovascular Disease _____

Urologic Disease _____

Endocrine/ Metabolic Disease _____

Respiratory Disease _____

Neuro/psychiatric Disease _____

Hematologic Disease _____

Gastrointestinal Disease _____

Trauma/ Physical Injury _____

Immunological Disease _____

NUTRITION

26. Pre-pregnancy weight _____

27. Total weight gain during pregnancy _____

28. Height _____ BMI _____

29. Was a nutritional assessment documented in the chart? Yes _____ No _____

30. During this pregnancy were there any of these nutritional factors present?

Yes _____ No _____ if yes, please specify:

Obesity (BMI > 25 before pregnancy) _____

Excessive weight gain (> 8 lbs/ month) _____

Low pre-pregnancy weight (BMI < 19 before pregnancy) _____

Inadequate weight gain during this pregnancy (< 2 lbs per month after the first
Tri-mester) _____

31. Was a referral to a registered dietitian ordered? Yes _____ No _____

If yes, did the dietitian see the mother? Yes _____ No _____

32. Was the mother referred for any support services during this pregnancy?

Yes _____ No _____

If yes, check all that apply:

Mental Health Services/ Counseling _____

Financial Planning _____

Genetic Evaluation/Counseling _____

WIC _____ Family Planning/BTL Counseling _____

Housing Services _____ Homeless Shelter _____

Methadone Maintenance Program _____

Other Drug Treatment Programs _____

Medicaid _____ Unemployment Office _____

Child Protective Services _____

Social Work Case Management _____

Smoking Cessation Program _____ Visiting Nurse _____

33. Was a prenatal risk assessment done at the initial prenatal visit? Yes _____

No _____

34. Based on the review of the record of the initial visit, please check those factors

which were present:

Moderate Risk Factors:

Age: (<17 or > 35) _____ Race: (non-white) _____ Marital status (unwed during

pregnancy) _____ Anemia (<11gms Hgb) _____ Cigarette smoking _____ Poor

SES Status _____ Suspected Poor Nutrition _____ Substance Abuse _____

Prior C/Section _____ Cardiac Disease (Class 1 or 11 or MVP) _____ Seizure

Disorder _____ Endocrine infertility _____ Any other chronic illness _____

DES exposure _____ Initiation of Prenatal Care > 20 weeks _____

High and Very High Risk Factors:

Insulin-dependent diabetes _____ Drug/alcohol addiction _____

Cardiac disease Class 111 or 1V _____ Multiple Pregnancy _____

Rh Sensitization _____ Prior neurologically damaged infant _____

Uterine abnormality/ incompetent cervix _____ Prior infant born <2500

grams _____ Hypertension _____ Chronic Renal Disease _____

Hx > 2 Spont. Fetal Deaths after 20 weeks EGA _____ Prior Neonatal Death

(from delivery to 28 days) _____ Prior infant requiring admission to the NICU _____ > 4 Moderate Risk Factors _____

35. Prenatal Education: At any time during the prenatal period were any of the following topics documented in writing as having been discussed?

Yes _____ No _____

If Yes, check all that apply:

Rights and responsibilities of the pregnant woman _____ Signs of complications of pregnancy _____ Nutrition education including appropriate dietary intake and appropriate weight gain _____ Physical activity and exercise during pregnancy _____ Avoidance of alcohol, drugs, OTC medication and tobacco _____

Sexuality during pregnancy _____ Occupational hazards _____

Risk of HIV and Risk Reduction Behaviors _____ Relaxation techniques in labor _____ Obstetrical anesthesia and analgesia _____ Preparation for

parenting/ infant development, care, and options for feeding _____

Newborn genetic screening _____ Infant sleeping position _____

36. Was a prenatal risk assessment done at 28 weeks gestation?

Yes _____ No _____ If no, state reason: _____

37. Based on the review of the record up to 28 weeks EGA, check all those factors that were present:

Moderate Risk Factor: Weight gain (either < ½ or > 2 lbs per week) _____

Anemia (< 10 gms/dl Hgb) _____ Smoking cigarettes daily _____

HIV Positive _____ Clinical UTI _____ Other infection(s) _____

Specify _____ 3-Hr GTT Positive _____ Poor or

Non-compliance (advice, appts., meds.) _____ Illicit drug and/or
Alcohol use _____ Working Mother _____ Maternal Stress _____

High Risk Factor: Rh Sensitization (Titer > 1/8) _____ Suspected Hydramnios
_____ Suspected Viral Infection _____ Uterine
Irritability _____ AIDS _____ Other (specify) _____
> 2 Moderate Risk Factors _____ High Risk Status on 1st Screen _____

Very High Risk Factor: Multiple Pregnancy _____ Mid or 3rd trimester vaginal
bleeding _____ PIH/Chronic Hypertension, requiring medication _____
PPROM _____ Cervix effacing > 40% _____ Cervix dilated > 2 cm
_____ Tocolytics required _____ Suspected IUGR _____
➤ 2 High Risk Factors _____ Very High Risk on 1st Screen _____

38. Please check which of the following tests were done, the results of those tests and
whether or not treatment was prescribed:

HIV Testing _____

Sonography _____

NST/BPP _____

Amniocentesis:

Genetic _____

Maturity (L/S ratio) _____

Genetic Counseling _____

Vaginal/GBS Culture _____

Karyotyping _____

Urine C & S _____

3-Hr. GTT _____

TORCH _____

AFP Screening _____

Other _____

39. Number of Prenatal Appointments Kept: _____ visits

40. Check the documented methods used to follow-up in missed appointments:

Letter _____ Telephone Call _____ Public Health Nurse _____

Other _____ None _____

41. Maternal Hospitalization during pregnancy: Yes _____ No _____

Date(s) of admission _____

Admission(s) diagnosis _____

Discharge diagnosis _____

Length of stay (number of days) _____

Notes:

Maternal Intra-partum and Post-partum Record:

42. Acuity of hospital of admission/birth: Primary _____ Secondary _____

Tertiary _____ Unknown _____

43. Did the membranes rupture prior to the onset of labor? Yes _____ No _____

44. Were the membranes artificially ruptured? Yes _____ No _____

45. Number of hours between ROM and delivery: _____ hours

46. Did the mother die during labor or delivery? Yes _____ No _____

47. Duration of labor and delivery : Normal Abnormal Not Known

First Stage (3 to 20 hours) _____ _____ _____

Second Stage (0 to 2 hours) _____ _____ _____

Third Stage (0 to 30 minutes) _____ _____ _____

48. Did the mother have a C/Section? Yes _____ No _____

49. If Yes: Indication(s) _____

50. Electronic Monitoring: Yes _____ No _____

51. Internal Monitoring: Yes _____ No _____

52. External Monitoring: Yes _____ No _____

53. Did the mother develop any significant medical or obstetrical problems during this labor and delivery or in the immediate post-partum period? Yes _____ No _____

If Yes, please check all that apply: HPT _____ CVA _____ PE _____

CHF _____ Hypotension _____ Cardiac arrest _____ UTI _____

54. Fetal Heart Rate description during the last 2 hours before delivery:

Documented Intervention(s):

Normal (110 to 160 bpm) _____

Bradycardia (<110 bpm) _____

Tachycardia (>160 bpm) _____

Loss of variability _____

Late decelerations _____

Variable decelerations _____

55. Did mother develop any significant medical or obstetrical problems during this

pregnancy? Yes _____ No _____ if yes, please specify:

Cardiovascular _____ Urologic _____

Endocrine _____ Metabolic _____

Respiratory _____ Neuro/Psychiatric _____

Hemologic _____ Gastrointestinal _____

Infection _____ Immunologic _____

Trauma/Physical Injury _____

56. Did any of the following obstetrical problems/complications occur, or were present during labor and delivery? Yes _____ No _____; if yes, please specify:

Pregnancy Induced Hypertension _____

Chorioamnionitis _____

Macrosomia _____

Uterine rupture _____

IUGR/SGA _____

Fetal demise _____

Polyhydramnios _____

Oligohydramnios _____

Malpresentation _____

Hemorrhage (> 500 ml) _____

Postmaturity _____

Fetal Distress _____

Amniotic Fluid Embolism _____

Gross Meconium _____

Fourth degree extension/laceration _____

Failure to Progress _____

Shoulder Dystocia _____

Cord Accident _____

Premature Labor _____

Previous C/Section(s)/ Indication(s) _____

Other _____

57. Were there any placental complications? Yes _____ No _____; if yes,

Please specify:

Abruptio _____ Previa _____

Accreta/Percreta _____ Manual Removal _____

Abnormal placenta or cord (specify): _____

58. What was the description of the placenta corpus (if available)

Placental weight: _____

Fetal-placental weight ratio _____ (normal range: 1 to 10)

Color of maternal surface: Pale _____ Pale foci _____ Congested _____

Red _____ Deep Red _____ Other (specify) _____

Color of fetal surface: Opaque _____ Tan _____ Green _____ Other _____

Cultures Taken : Yes _____ No _____ Results: _____

Shape: Ovoid _____ Irregular _____ Accessory Lobes _____ Other _____

Specify _____

Miscellaneous: (Check all that apply): Circummarginate _____ Thrombosis _____

Circumvallate _____ Hemorrhage _____ Laceration _____

59. What is the assessment of the umbilical cord (if available)? Check all that apply:

Excessive length (> 70 cm at term) _____ Short (< 30 cm at term) _____

Hematoma _____ Stricture _____ True knot _____ Amniotic Web _____

Velamentous insertion _____ Single artery _____ Thrombosis _____

Torsion _____ Acute Vasculitis _____ Chronic Vasculitis _____

Other (please specify) _____

Extra-placental membranes (check all that apply): Meconium changes _____ Acute

Membranitis _____ Amniotic Bands _____ Amnion nodosum _____ Chronic

Deciduitis _____ Other (please specify) _____

Maternal Uteroplacental Vasculature (check all that apply): Infarction _____

Inter-villous Thrombosis _____ Subchorionic Thrombosis _____

Retroplacental Hematoma _____ Decidual Vasculopathy _____

Intervillous Fibrin Deposition _____ Other _____

Fetal Placental Vasculature (check all that apply): Chorangioma _____

Chorangiosis _____ Thromboses _____ Stromal Edema _____

Nucleated RBC's _____ Other (specify) _____

Villous Pathology (check all that apply): Accelerated Maturation _____

Delayed Maturation _____ Dysmaturity _____ Acute Villitis _____

Chronic Villitis _____ Other (specify): _____

Notes:

Fetal/Infant Death Certificate:

Year of delivery: _____

Sex: Male _____ Female _____ Unknown _____

Place of delivery: Home _____ Hospital _____ On the way to the

Hospital _____ Other _____

Mother admitted to the hospital: Yes _____ No _____

Estimated Gestational Age of fetus: _____ weeks

Death Caused By:

Immediate Cause: _____

As a consequence of: _____

Autopsy Performed: Yes _____ No _____ Unknown _____

If autopsy done, please state cause of death:

Primary: _____

Other contributory/associated findings/causes

