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# Factors Affecting Fetal Death Among Women With Cesarean Section(s) in the United States

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Abstract

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MSN, Prairie View A&M University, 2007

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Doctoral Study Submitted in Partial Fulfillment

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Doctor of Public Health

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## Abstract

The United States has a higher rate of fetal death compared to other industrialized nations. Although many studies on the factors that contribute to fetal death have been conducted among women in general, little of this phenomenon is known among women who have had a previous Cesarean section (C-section). The purpose of this study was to explore the factors of fetal death among women with a previous C-section(s) and offer suggestions for interventions. The social determinants of health theory was used with other social constructs to provide a theoretical and conceptual framework for the study. As part of the cross-sectional design, secondary data ($N$ = 884) from the Centers for Disease Control and Prevention were analyzed using multiple logistic regression modeling. The data set included data on fetal deaths occurring from 2014 to 2018 among women with a previous C-section in the United States. The results show a statistically significant relationship between maternal cigarette/tobacco use and the odds of fetal death. There was also a statistically significant association between maternal race and fetal death among women with previous C-section(s) in the United States. This study provides insight on the factors that contribute to fetal death in the United States that may inform policy development. By addressing the accessibility and usage of cigarettes and related products among pregnant women, especially those with a previous C-section, policy makers may be able to improve fetal outcomes, particularly among African American women.

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# Dedication

Words cannot be enough for me to give thanks to God, my heavenly father who made it possible for me to achieve this milestone. I never knew that my eyes would ever see the inside four corners of a university school building, let alone be a student in one. But my heavenly father has led me to obtain the highest degree from such a school. Through it all, the Lord provided the needed finances, protected me and my household daily, commanded my steps, and granted me favor before man and before Him. This is for you, O Lord, my God. I am eternally grateful. Thank you for loving me. This is also dedicated to my mother, Dorcas Enyidiya George Nwosuh, who has loved me, prayed for me, and through whom I can see the work of God in my life. Thank you, Mummy. This is also for you. To the pillar and rock of my life, my love and my wife, Dr. Oluchi Brittany Nwosuh, who encouraged, supported, challenged, and strengthened me through the years. This journey would have been harder without you, my darling. Together, we have achieved this. Thank you for loving me and always rendering a shoulder for me to cry on and laugh on. Indeed, you are my pillar and my rock. I am grateful. Thank you. To my children, David Nnamdi IheanyiChukwu, Charles Obinnaya IheanyiChukwu, and Abigail Chizaram IheanyiChukwu (Ada Papaya), who bring me joy and laughter and remind me of God's love each day! I wish you all the very best this life has to offer and pray that you realize the fulfillment of your sweetest hopes and dreams. I hope that you have been as proud of me as I am of you. I love each one of you, my children, dearly.

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Section 1: Foundation of the Study and Literature Review

## Introduction

Fetal death is the spontaneous loss or death of a fetus during pregnancy from 20 or more weeks of gestation and lasting until the first week of life (Pruitt et al., 2020). Researchers have identified several factors as causes of fetal death. According to Tamrakar and Tripathi (2020), some of the factors that can influence fetal death include cord abnormalities, multiple congenital abnormalities, obstructed labor, and fetal distress. Maternal behaviors before and during pregnancy, genetics, health status, obesity, and nutrition are other factors (Tamrakar & Tripathi, 2020). In the United States, there is a higher prevalence of fetal deaths when compared to other industrialized nations (Kamal & Blumenkranz, 2017). In their evaluation of fetal mortality in the U.S. state of Wyoming, Harrist et al. (2017) noted that the number of fetal deaths exceeds that of infant deaths each year. This phenomenon has not been well studied among women with previous C- sections, whether elective or spontaneous in an emergency. How does intrauterine fetal death relate to C-section? The use of C- section as a delivery method worsens a woman's future perinatal outcome (Kaboré et al., 2019; Kalisa et al., 2017). In their research on intrauterine fetal death and its causes, Tamrakar and Tripathi reported that out of 4,219 deliveries in 2010 and 2011 involving C-sections, 90 (2.13%) were fetal deaths; also out of 5,873 deliveries in 2016 and 2017, involving C-sections, 105 (1.79%) were fetal deaths. This findings led to the conviction of exploring this phenomenon.

Women with a previous C- section may be different from other women who have not had a previous C- section(s). Some of the factors that tend to influence fetal death

have not been specifically studied with an exclusive focus on women with previous C-section(s). Globally, there are differences in incidences of fetal death, depending on the country. Pirhonen and Erkkola (2021) reported that there were 2.6 million fetal deaths, or 18.4 per 1,000 births, around the world in 2015, with the majority occurring in developing countries. At the same time, the United States has seen an increase in C-sections in recent years. They account for about 30% of all deliveries, with 0.6% ending in fetal deaths (Pirhonen & Erkkola, 2021). In their study of 45,988 women with a previous history of C- sections, Pirhonen and Erkkola (2021) found that 209 (0.45%) encountered fetal death. Therefore, having a previous C- section may be a risk factor for fetal death.

Because women with previous C- section(s) are at higher risk of having fetal death (Kaboré et al., 2019), there is a need to study this population and the factors that influence the odds of fetal death among them. In this section, I will present the background of this study, the problem statement, the purpose of this study, the research questions (RQs) and hypotheses, the literature search strategy, and the theoretical and conceptual framework. I will also review literature related to the study topic. Definitions of key terms; the assumptions, scope and delimitations, limitations, and significance of the study; and a summary of the section are also included.

## Background

There is a high incidence of fetal death in the United States and globally. About 23,000 fetal deaths were reported in the United States in 2017 (Pruitt et al., 2017); about 2.6 million were reported globally in 2017 (Poudel et al., 2020). In their study, Poudel et

al. (2020) found that some fetal deaths were preventable, but because of many factors that include poor infrastructure, poor prenatal care, poor delivery methods, poor immediate delivery care, and ineffective providers of healthcare, this prevention has not always been possible in some health care centers in the United States. Etiological factors such as a maternal history of previous C- section, maternal race, educational level, income, cigarette smoking, place of delivery, maternal age, and multiple parities have been implicated in fetal death (Monasta et al., 2020). In the United States, statistics do not account for fetal deaths before 20 weeks gestation because of the International Classification of Diseases (ICD-10), which does not recommend reporting fetal deaths outside of the cutoff point of 22 weeks gestation (Vieira et al., 2016). Although much knowledge has been acquired on the prevalence of fetal deaths through researches, data collection, and studies, little effort has been invested in reducing the statistics of this phenomenon by healthcare providers and public health officials (Poudel et al., 2020).

Specifically, according to my review of the literature, researchers have not examined the factors influencing fetal death with an exclusive focus on women with previous C- section(s). This population of women may be systematically different from other women who have not had C- section(s). This potential difference reinforces the need to study this population of women and the factors that influence the odds of fetal death among them. Understanding the rationale and causes of most fetal deaths among women with previous C- sections can inform the development of specific public health policies for decreasing the prevalence of fetal deaths among the population of women with a previous C- section.

## Problem Statement

Fetal deaths in the United States are a public health concern. The rate of fetal death at 6/1000 live births has been unchanged from 2006 data extending to 2017 in the United States (Harrist et al., 2017). In their study, Vieira et al. (2016) reported that fetal deaths accounted for more than one half of infant deaths around the world as of 2016. . According to Harrist et al. (2017), advocates seeking to improve perinatal outcomes over the years have concentrated on improving infant deaths but not on fetal deaths. Fetal death is related to a spontaneous loss or death of a fetus during pregnancy, measured at greater than or equal to 20 weeks of gestation (Pruitt et al., 2020). In the United States, about 23,000 fetal deaths were reported in 2017 (Pruitt et al., 2020). These infant death statistics are high when compared to other developed nations. For instance, in their study looking at the trends of fetal and perinatal mortality in Korea and their comparison with those in Japan and the United States, Song et al. (2017) reported that 23,602 fetal deaths were reported between 2009 and 2014 in Korea, while Japan reported 44,513 fetal deaths. During the same period between 2009 and 2014, the United States reported a total of 144,248 fetal deaths.

Fetal deaths can not only bring about emotional difficulties but can also lead to a decline in the overall population of a country through higher deaths. According to Saccardo and Calvo (2020), fetal death produces prolonged grief among some women leading to future mother-child detachment or overprotection with live births. In their study of variations in multiple births rates and their impact on perinatal outcome, Heino

et al. (2016) reported that a woman with multiparty has a higher rate of fetal death delivery.

Several risk factors, including maternal cigarette smoking, underlying disease conditions such as diabetes, weight gain as noted with increased body mass index (BMI) and inactivity, increased stress level, advanced age, and many other factors are known to influence the likelihood of fetal death among women in general. According to Morales-Suárez-Varela et al. (2016) cigarette smoking during pregnancy has the potential of causing fetal death. Morales-Suárez-Varela et al. also reported that variables such as maternal weight gain and increase in BMI can be complicated by physical inactivity before and during pregnancy and can contribute to fetal death. In their study on the influence of maternal stress on the odds of fetal death, Ayuurebobi et al. (2019) alluded that there is a high prevalence of fetal death among pregnant mothers with high-stress levels, which contributes to fetal deaths. Qureshi et al. (2019) found that the development of diabetes mellitus and gestational diabetes, if left untreated, can lead to fetal demise or death. In their study on the implication of age to the odds of fetal death, Attali and Yogev (2021) found that the late age of childbearing increases the risk of ectopy pregnancy and spontaneous abortion in early pregnancy. Therefore, it will be necessary to assess the implication of some of these variables in fetal death especially among mothers with previous C-section(s).

Although the effects of maternal smoking habits, race, educational level, and other factors on the likelihood of fetal death have been previously examined in several settings, their effects on fetal death have not been studied in detail among women with

previous C- section(s). Therefore, I explored these factors or variables and their associations with fetal deaths in women with previous C- section(s) in the United States. I sought to offer recommendations for reducing the likelihood of fetal death among this population of women. All women with previous C- section(s), either elective or emergency, were eligible for inclusion in this study.

## Purpose of the Study

The purpose of this study was to investigate factors affecting the odds of fetal deaths among women with previous C- section(s) in the United States, such as maternal race, educational level, and impact of delivery characteristics such as delivery centers. Understanding of how these factors influence the odds of fetal death among women with previous C- section(s), whether elective or in an emergency, may inform potential ways of improving the public health system in the United States. This may help to achieve a reduction in fetal deaths among the population of women with a previous C- section.

## Research Questions and Hypotheses

The two RQs for this study look similar but not equivalent. They pose different questions, and the regression coefficient for each of the independent variables needed to be tested individually to determine their potential statistical significance in the model. The RQs and hypotheses were as follows:

RQ1: What is the association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care?

$H_0$1: There is no association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care.

$H_1$1: There is an association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care.

RQ2: What is the association between maternal race and fetal death among the women with previous C- section(s) in the United States after controlling for maternal age, cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care?

$H_0$2: There is no association between maternal race and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care.

$H_1$2: There is an association between maternal race and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care.

## Theoretical Framework

Several theories have addressed inequalities of health. For instance, the theory of planned behavior tend to predict a person's behavior before the behavior takes place (Meesmann et al., 2019). The theory that informed this study was the social determinants of health, which helps to identify structural and intermediary aspects of inequalities of health. Researchers have used this theory to explore and identify factors contributing to disparities reported using this this theory to address the five elements of health disparities. This theory has been used to address inequities of health stemming from economic stability, access to quality education, health and health care, the environment, and social and community implications (Brown, 2021). Hamal et al. (2020) have also successfully used this theory to address health inequity affecting maternal health in India. Therefore, this theory was appropriate for investigating associations between fetal death, which was the dependent variable, and previous C- section, maternal race, educational level, income, cigarette smoking, place of delivery, maternal age, and multiple parities, which were the independent variables. I used the social determinants of health to develop the RQs and shape the overall inquiry and data collection and analysis. This theory helped to explain how the variables might lead to outcomes. The social determinants of health is based on the understanding that maternal health inequities that range from socioeconomic and political contexts to individual constructs such as access to health care, material situations, behavioral, psychosocial circumstances, biological contributions, and community health systems contribute to fetal outcome (Hamal et al., 2020).

A premise of the social determinants of health is that fetal health is dependent on maternal health. An appropriate positive intervention for maternal management could decrease the rate of fetal deaths. These include interventions on a situational basis such as reducing binge or overeating; behavioral modifications including smoking cessation before, during, and after pregnancy; appropriate antenatal care; and effective immediate delivery care Hamal et al., 2020).According to Amjad et al. (2019), the relationship between maternal health and birth outcome is associated with the economic and social constructs that act on the mother. The complex interconnection of certain elements in society also play a role. Poverty including socioeconomic inequalities, level of education, employment status, and community networks help to differentiate and shape hierarchies in the society, leading towards health disparities and birth outcomes (Amjad et al., 2019) which has been observed by other researchers such as Meesmann et al., (2019) and Hamal et al. (2020).

## Nature of the Study

This research was a cross-sectional analytic study, wherein the dependent and the independent variables were measured and recorded at the same point in time. I used statistical methods to test hypotheses and answer the RQs. The dependent variable for this study focused on fetal death. Fetal death became a binary categorical variable that was measured at the nominal level of measurement. The independent variables of interest included maternal smoking habits before and during pregnancy, maternal race, facility where the birth took place, and maternal educational level. Maternal smoking habit was a binary categorical variable measured at the nominal level. Maternal race and facility

where the birth took place were categorical variables measured at the nominal level. Maternal education level was a categorical variable measured at the ordinal level of measurement.

In the first part of this study, I examined the distribution of fetal death across the United States. I found that fetal death varied based on demographics among the women who have had C- section. I subsequently examined the relationships between fetal death among women with previous C- section(s) and the independent variables of interest by applying inferential statistical techniques targeted at examining the possibility of (and strength of) statistically significant association between the variables.

To explore and describe the data set, I used both numerical and graphical descriptive statistical techniques. The numerical descriptive statistics used for the continuous variables included meaning (which is a measure of central tendency), standard deviation (which is a measure of dispersion), and skewness. Furthermore, the numerical variables are described using graphical descriptive statistics such as histograms. I used frequency distribution tables as the main numerical descriptive statistics approach used for the categorical variables while the categorical variables were described using bar charts.

The main inferential statistics tests included multiple logistic regression modeling. This made it possible to control the effects of potential confounders and other variables, such as marital status and age, while assessing the effects of the independent variables in the two RQs. In their study of the prevalence of human immunodeficiency syndrome (HIV) in Mozambique, John Nutor et al. (2020) report on the effect of using multiple

logistic regression model to isolate confounders and independent variables while assessing the effectiveness of independent variables in their study. The multiple logistic regression modeling made it possible to identify for this study, to isolate, and quantify the effects of each of the independent variables on the odds of fetal death. To assess the statistical significance of the model coefficient for each of the independent variables, I used the Wald test.

## Literature Search Strategy

To search for literature, I used academic databases, the Google Scholar search engine, and other researchers. The academic databases included CINAHL, Medline combined searches, Cochrane Database of Systematic Reviews, Academic Search Complete, ACM Digital Library, Annie E. Casey Foundation, Annual Reviews, APA PsychInfo, Child Stats, CINAHL Plus with Full Text, Cochrane Methodology Register, Database of Abstracts of Reviews of Effects (DARE), National Center for Health Statistics, and EBSCO host databases. The years searched were between 2016 and 2021. Search terms used included *fetal death; fetal mortality; infant death; infant mortality; women with C- section(s) and fetal death; still birth; obesity, BMI and pregnancy; pregnancy and diabetes; maternal age and pregnancy; stress and pregnancy outcome; behavioral modifications and pregnancy outcome; fetal and perinatal mortality' concept and fetal death; effect of C- section on birth outcome; race and fetal outcome; maternal race and birth outcome; maternal race and fetal death; race and women with C- section; method of delivery and fetal death among different races; cigarette smoking and odds of fetal death; cigarette smoking and women with C- section; second hand cigarette*

*smoking, women with C- section, odds of fetal death; cigarette smoking while pregnant; cigarette smoking, odds of fetal death; fetal death, cigarette smoking, women; education level and fetal death; education level, fetal death, women with C- section; fetal death outcomes among women; understanding fetal death and level of education among women;* and *impact of education on fetal outcome.* I did not restrict the literature search on the theoretical framework because previous theories can be used in current studies regardless of the time frame.

A patient can elect to have a C-section as a means of infant delivery, or as suggested by the patient's doctor; in some cases, it can be performed on an emergency basis to save the life of a mother and that of the unborn infant (Singh et al., 2020). Indicators for C- section include maternal preferences and an improvement in social determinants of health including an improvement in the transportation system. There are also an explosive growth in the number of private for-profit birth centers with the capability of handling emergency obstetrics care (Singh et al., 2020). I conducted an extensive review of previous studies related to the RQs used in this study, but I could find no information pertinent to the study topic. Although there are studies related to the general information prevalence of fetal death ((Poudel et al., 2020), none was specifically directed to women with previous C- sections. For instance, I found no previous studies on maternal cigarette smoking and the odds of fetal death among women with previous C-section, or maternal race and the odds of fetal death among women with previous C-section, or even maternal education level and the odds of fetal death. Also, there were no

previous conference proceedings on attributes of cigarette smoking, race, education, and the odds of fetal death among women with previous C- sections in my search results.

To address this gap in the literature, I explored previous studies with generalized findings closely related to the study questions. For instance, because there were no previous studies related to cigarette smoking and the odds of fetal death among women with previous C- section, I explored previous studies on cigarette smoking among pregnant women. I found cigarette smoking to be a contributory factor in fetal death among women in general. I generalized the findings to include women with previous C-sections. The same approach was used for previous research studies related to this study's RQ on maternal race and maternal level of education and the odds of fetal death. I explored six different data bases and fourteen different literatures to arrive at this conclusion.

## Theoretical Framework

Theories on social inequities and determinants of health offer predictions and insights into maternal health outcomes. I drew from these theories to align the RQs and conceptual framework of this study. Social determinants such as maternal mortality ratio, place of infant birth such as a medical institution, maternal care services including obstetrics uptake, and postnatal care have been known to contribute to maternal and infant outcomes at birth (Hamal et al., 2018). According to Barfield (2021), the social determinants of health can affect a newborn and their mother throughout their lifespan. These social factors include lower economic status, lower educational status, poverty level, unemployment, opportunities, race and ethnicity, disability, area of geographical

residence, and gender contributes to inequities of health among maternal health (Barfield, 2021). According to Barfield, race, ethnicity, and social disadvantages are so inextricably linked that Black mothers with high income together with their infants experience health outcomes that are the same or worse than those of White mothers of low income in the United States. Exploring these factors and their impact on maternal health can suggest potential interventions. Barfield observed that solving some of the health issues presented as a result of health disparities can help researchers and healthcare providers to improve maternal health outcomes. Addressing economic opportunities, environmental implications such as air pollution, and making available community resources may be a positive step towards improving maternal health.

## Conceptual Framework

Researchers have used different concepts to address maternal health and health outcomes. A conceptual framework is a model that informs studies and practice. For instance, the concept of education can be a determinant for a mother to accept or decline prenatal care (Meesmann et al., 2019). The concept that informed this study was maternal health. This concept encompasses attributes of health that can lead to a positive maternal and infant health outcome especially as it relates to women with previous C- section and fetal death (Meesmann et al., 2019). For the study's framework, I identified several factors that produce inequities in maternal health. For instance, socioeconomic stratification relating to educational level, socioeconomic status, and employment are known to produce inequities (Meesmann et al., 2019). According to Meesmann et al. (2019), a person's culture, ethnicity, and religion also tend to play important role in

maternal health outcomes. Other factors stem from a maternal and family context (Barfield, 2021). For instance, age at parity, basal metabolic index, nutrition status, infections such as hepatitis and malaria, history of hypertension, diabetes, previous complicated pregnancies, family planning obstetric care, unhealthy practices, and illicit induced practices all play a part in maternal health outcomes (Barfield, 2021). Therefore, the availability of resources such as prenatal and postnatal care, delivery in a skilled environment including the availability of emergency obstetric care, accessibility of distance to the birthing center, time to travel, transportation availability, meeting a financial obligation, and availability of medications and supplies all play a role in optimal maternal health outcomes (Barfield, 2021). Therefore, there is the need to screen for socioeconomic factors and other contributors that could impact maternal health care especially birth outcomes.

## Literature Review Related to Key Variables and/or Concepts

### Trends of Fetal Death

Fetal deaths in the United States have been a public health concern. Studies have shown that fetal deaths account for more than one-half of infant deaths around the world (Vieira et al., 2016), and improving perinatal outcomes over the years have concentrated on improving infant deaths but not on fetal deaths (Harrist et al., 2017). Literature findings have also shown that women with previous C- Section(s) are at an increased risk of having fetal death during pregnancy or during their first week of delivery (Attali & Yogev, 2021). Studies have also shown that the trend of fetal death over the years in the United States is not declining. Dongarwar et al. (2020) evaluated the trend in fetal deaths

in the United States “for term, all preterm, moderate-to-late preterm, very preterm, and extreme preterm phenotypes” (p.146). Their finding shows that despite the rate of fetal death decreasing between 1982 and 2017, there was an increase in extreme fetal death by 7.6% through the same time. Using statistical data from the National Survey of Family Growth on self-reported pregnancy loss in the state of California, which included data from 1995, 2002, 2006–2010, 2011–2015, Rossen et al. (2018) reported that there was an increase in self-reported pregnancy loss of 13.5% in early pregnancy loss between 1990 and 2011 among United States women.

The purpose of this study has been to investigate factors affecting the odds of fetal deaths among women with previous C- Section(s) in the United States and through study findings, offer suggestions that could see a reduction in fetal deaths among women with previous C- sections. Literature review of this subject includes search criteria, databases utilized, and key search terms. The theoretical foundation describes the framework used to understand the associations between the research questions and the problem statement. This review of literature also outlined study design, study population, limitations, and findings.

## Studies Related to the Constructs of Interest

### *Cigarette Smoking and Odds of Fetal Death*

Several studies have explored the phenomenon of fetal death syndrome within different constructs (Attali & Yogev, 2021; Ayuurebobi et al., 2019; Azagba et al., 2020; Bjellmo et al., 2019). However, no study known has investigated the association between maternal cigarette smoking with the odds of fetal death among women with previous C-

sections. Studies had however shown that smoking among pregnant women is declining, but, it is still high among certain races, and those with the least education. How do maternal choices and behavior related to cigarette smoking before and during pregnancy affect the odds of fetal death among women with previous C- sections?

Several studies have found a correlation between cigarette smoking during pregnancy and adverse pregnancy outcomes. Although most of the previous studies concentrated on pregnancy and cigarette smoking, it is however of public health concern that many women, despite anti-smoking campaigns, continue with smoking while pregnant (Hodgetts & Crabb, 2018). According to McDonnell and Regan (2019) cigarettes contain more than 4000 compounds including carbon monoxide, carcinogens, nicotine, and heavy metals that can restrict nutrients and oxygen availability to a fetus, thereby changing or modifying organs development such as the lungs and the brain. The result of hypoxia and hypercarbia can lead to fetal demise and death (Bednarczuk et al., 2020). Smoking among pregnant mothers is up to 8.1 percent in Europe and up to 250 million worldwide (Bednarczuk et al., 2020).

An existing guideline on women smoking recommends for a woman to stop smoking while pregnant (Liu et al., 2020). According to Hodgetts and Crabb (2018), this anti-smoking campaign has been for pregnant women to abstain from smoking due to its adverse health contribution including fetal death. Hickson et al. (2019) say that smoking while pregnant is highly related to adverse pregnancy result in high morbidity and mortality. In their retrospective cohort study of women that smoked during pregnancy, Wainstock et al. (2021) noted an increase in fetal death among this population of women

in their first trimester by 3.61% (95% CI 1.32–9.85) using a multivariable module. In their study of trends in smoking, while pregnant between 2010 and 2017 in the United States, Azagba et al. (2020) reports that although smoking while pregnant is decreasing in the United States, it was however high among those with high school diplomas and American Indian/Alaskan Natives descent. Kvale et al. (2020) corroborated this finding as they reported a declining trend in smoking among pregnant women in the state of Wisconsin from 2011 to 2016. Their report also noted a higher rate and prevalence among those with less education.

***Race, Ethnicity and the Odds of Fetal Death***

Studies related to the impact of race on the odds of fetal death among women with previous C- sections were also explored. The race is defined as women with backgrounds identified as Asian, Hawaiian, or Other Pacific Islander native, Indigenous Americans and Alaskan natives, Black or African American, and White (Johnson & Louis, 2020). No specific and recent studies were found related to the racial or ethnic implication in the odds of fetal death among women with previous C- section were found. However, there exists racial disparity in fetal death in general (Pruitt et al., 2020). The Center for Disease Control and Prevention (CDC) reported that the prevalence of fetal death rates between 2015 to 2017 among black women or non-Hispanic black women were more than twice the rate among Hispanic women and non-Hispanic white women (Pruitt et al., 2020).

Adverse outcomes in pregnancies are also noted to be higher in women of non-Hispanic black populations when compared to other races. In their cohort study of pregnancy outcomes among races using data from the United States vital statistics from

2014 to 2017, Parchem et al. (2020) noted that out of 9,205,873 women that participated in the study 55.5% were identified as non-Hispanic White, 13.7% were identified as non-Hispanic Blacks, non-Hispanic Asians 6.5%, and Hispanic women 24.3%. The study used a Multivariable Poisson regression model to assess the relationship between maternal race and composite adverse neonatal outcomes including mortality of infant, and the outcome of the mother. The result suggested that in comparison to the women that were White, the Black women had a higher risk of composite adverse neonatal outcomes and infant deaths. Therefore, it is suggested that race and ethnicity are contributing factors in the odds of fetal death. Currently, no studies are pointing to the downward trend of this disparity in the United States.

### *Maternal Education and the Odds of Fetal Death*

Maternal educational status does have an impact on birth outcomes (Cantarutti et al., 2017). According to Cantarutti et al. (2017), pregnancy outcomes can be affected by maternal educational level regarding uptake of prenatal and antenatal care. Maternal lack of education can also be attributed to their inability to access quality gynecologic and obstetric care while pregnant. Lack of maternal formal education has been tagged as one of the predictors of fetal death (Mboya et al., 2020). According to Mboya et al. (2020) mothers with primary education only tend to have an increased risk of fetal death. This phenomenon is attributed to a lack of formal education related to childcare before getting pregnant, prenatal care, antenatal, and postnatal care (Mboya et al., 2020). The rationale for formal education while pregnant is for a potential mother to understand the need to carry out needed functions when pregnant. For instance, a woman planning for pregnancy

is expected to take folic acid to prevent neuro tube defects and to have regular checkups while pregnant including laboratory and ultrasound check-ups (Toivonen et al., 2018). However, if these important steps are not taken due to a lack of education, the risk of fetal death increases (Toivonen et al., 2018).

**Previous Research Studies and Approaches**

Different researchers used different approaches in examining the implication of variables used in this study to better understand the phenomenon of fetal death affecting many women. There was no study found that looked at this implication specifically affecting women with previous C- section, pointing towards the need for study of this group. This makes the current study to be important for filling the gap in the literature because this sub-group of women (i.e., the women with previous C- section) are an important subgroup of the population and may have different gestational experience and pregnancy outcomes, making the studying of fetal death in this subgroup of women to be important.

However, many researchers did find contributory variables used in this study as affecting fetal death among women in general. In their research approach on cigarette smoking and pregnancy outcome, Hodgetts and Crabb (2018) criticized a popular television host for being critical of pregnant mothers who smoked a cigarette while doing the same thing when this television host was pregnant. Although Hodgetts and Crabb (2018) highlighted the importance of abstaining from cigarette smoking when pregnant, their study did not involve statistical implications to produce their results. It is a non-statistical study that then questions the reliability of the study. McDonnell and Reagan

(2019) also conducted a study on cigarette smoking during pregnancy and provided data to support their claim. The study concentrated on the different chemical makeup of cigarettes that made them harmful to the body, especially its effect on the fetus during pregnancy. The study provided alternatives to smoking during pregnancy using the trans-theoretical model of intentional behavior change. This research suggests nicotine replacement therapy during pregnancy and the use of electronic cigarettes as methods to alleviate or eradicate cigarette smoking during pregnancy. However, the drawback to their study is that the use of their suggested alternative therapies has not proven to be effective as an alternative to cigarettes.

The use of nicotine replacement therapy is a gradual process in which a pregnant mother can eventually stop smoking, but the time frame is uncertain and not guaranteed (McDonnel & Reagan, 2019). According to these authors, electronic cigarettes do have elements of carcinogens in them. Furthermore, Hess et al., (2017) and Stephens (2018) have reported that there is an increase in heavy metals and carcinogens in electronic cigarettes. Therefore, this rendered alternative may be as good as no alternative at all. There is no methodological statistical measurement presented.

Bednarczuk et al. (2020) studied the effect of cigarette smoking on fetal death. These researchers presented statistical evidence of harm caused by cigarette smoke during pregnancy. They also presented their study outcome's contribution to public health. These include their literature review of cigarette smoking among pregnant women showing hypoxic and hypercarbia results on the fetus. Although their study contributed greatly to further understanding the rationale for abstaining from cigar rete smoking

while pregnant, however, there was no methodological study involving participants. Other researchers also explored the impact of race on the odds of fetal death in women.

According to Pruitt et al. (2020), CDC conducted a study of racial and ethnic implications in fetal deaths among pregnant women between 2015 and 2017. The research included graphs and maps depicting the causes of fetal death and the racial impact among pregnant women in the United States. The research outcome is an exhaustive study; however, the study did not produce suggestions on how to eliminate or decrease the mentioned causes of fetal death among the stated population. Using the United States vital statistics information between 2014 and 2017, Parchem et al. (2020) conducted a population-based cohort study that looked at race and birth outcomes. These researchers utilized a multivariable Poisson regression model with robust error variance to analyze birth and fetal demise findings among pregnant women. The findings included the different categories of women separated by race and how they are being impacted by birth outcomes, the study failed to include the causes of fetal demise among these races and suggested how their findings can be of benefit to public health. Other researchers also explored the impact of education level on the odds of fetal death.

In evaluating a mother's education level and its impact on fetal death, Cantarutti et al. (2017) used the country's previous data to conduct a cohort study. Although this study was not specific to fetal demise, it did, however, provide insights into some rationale for negative birth outcomes based on the level of maternal education. However, the researchers acknowledged their limitations including not gathering information on the women's country of origin that resulted in confounding and potentially impacted the

resulting outcome. Hegelund et al. (2019) also conducted studies on the impact of education level and birth outcome using a linear regression model to analyze the study population (*N*=786,054). These researchers made an important contribution to public health as they successfully linked stillbirth, induced abortion, and spontaneous abortion to maternal education levels. They also successfully linked a higher risk of negative birth outcomes to mothers with low educational attainment. The noted limitation to their study is that they did not have a recommendation on how to improve women's education attainment since it could have helped to improve birth outcomes.

In their study of the impact of education on birth outcomes, Mboya et al. (2020) analyzed their cohort study findings using generalized estimating equations to get the marginal effects of covariates related to the birth outcomes and utilizing the log link mean model that has a robust standard error. Although their finding concluded that mothers with a low education level have a higher risk of the birth outcome, it did not address the mean age of the participants, privacy concerns, and did not address how their findings contributed to public health.

**Rationale for the Selection of the Study Variables**

The study aims to investigate the probable reasons for the fetal death phenomenon among the affected population by exploring concepts such as maternal cigarette smoking while pregnant, race, and maternal level of education. In using the concept of cigarette smoking, McDonnell et al. (2019) reiterated the impact of cigarette smoking among pregnant women with birth outcomes. Using the cigarette variable, we have been reminded of the impact of carbon monoxide, carcinogens, nicotine, and heavy metals we

are reminded that those elements can restrict nutrients and oxygen availability to a fetus, thereby changing or modifying organs development such as the lungs and the brain of a fetus leading to mortality of a fetus. Wainstock et al. (2021) also used statistical evidence to explain cigarette smoking variables and how it impacts the negative birth outcome.

Using racial variables, Pruitt et al. (2020) explored the impact of race on birth outcomes. According to Pruitt et al. (2020), the CDC's analysis of the fetal death rate between 2015 and 2017 showed racial implications in fetal deaths rate can be negatively impacted by racial discrepancies. Complications during pregnancy such as preeclampsia can impact a particular racial group which further impacts the prevalence of fetal death rate among the identified population. A statistical explanation of the impact of racial implication in fetal death rate was also presented by Parchem et al. (2020) who noted non-Hispanic Blacks were mostly affected by fetal death rate than any other population.

The impact of education on fetal death is another variable that was explored by the researchers. Cantarutti et al. (2017) saw lack of higher education as a contributing factor to an increased chance of having fetal demise. According to Cantarutti et al. (2017), lower levels of education such as attaining only high school education have a limitation on the knowledge of prenatal and antenatal care which in turn can negatively affect the birth outcome. This is also corroborated by Mboya et al. (2020) that maternal primary education only is a precursor to having an increased risk of fetal death.

## Previous Studies Related to the Key Variables in this Study

### *Fetal Death (Dependent Variable)*

Several studies have explored the concept of fetal death and arrived at the same conclusion. According to Beune et al. (2021), fetal death arises from fetal growth restriction during pregnancy and is referred to as the inability of a fetus in utero to get to its intrinsic growth potential. This growth restriction is a result of insufficiency of the placenta (Beune et al., 2021). Many rationales and explanations have been rendered to the cause of this fetal demise including some pathological explanations such as placental insufficiency, infections, maternal behavior during pregnancy, environment, diet, and genetic constitution. Several studies have linked fetal growth restriction as to the primary risk factor for most adverse fetal outcomes. According to Beune et al. (2021), fetal growth restriction is responsible for about a seven times higher risk of developing intrauterine fetal death. Pruitt et al. (2020) have also rendered this phenomenon as the spontaneous loss or death of a fetus during pregnancy, measured at greater than or equal to 20 weeks of gestation and lasting until the first week of life. Most studies adhere to this conceptual definition and explanation.

What is known about this phenomenon is that it can happen at any given time or moment with little or no cause. Statistics do not account for fetal deaths before 20 weeks gestation in the United States as a result of the International Classification of Diseases (ICD-10) which does not recommend reporting fetal deaths outside of the cutoff point of 22 weeks gestation (Vieira et al., 2016). There is no known controversy related to the definition of fetal death. Although several factors are related to this phenomenon, some

factors remain unknown and researchers are still investing the unknowns including spontaneous loss of a fetus without an identifiable cause (Vieira et al., 2016).

***Cigarette Use (Independent Variable)***

Several studies have shown that cigarette use among pregnant women is associated with many disease conditions including fetal death. (Jussila et al., 2020; Morales-Suárez-Varela et al. (2018; Lavezzi et al., 2017). Therefore it becomes hypothetical that cigarette smoking could have a relationship among this population of interest. Several researchers have examined the effect of cigarettes on human health over many years. Studies have found that cigarettes have the potential to induce genetic changes in people that lead to cigarette use-related illnesses. McDonnell and Regan (2019) have reported that cigarettes contain more than 4000 compounds including carcinogens, nicotine, and heavy metals that can restrict nutrients and oxygen availability in the body thereby changing or modifying organs development such as the lungs and the brain. According to Kohailan et al. (2016) cigarette smoking is responsible for 30% of cancer-related deaths in developed nations, linked to lung cancer. Kohailan et al. (2016) further report that cigarettes can influence cancer of the lower urinary tract and lead to death by modifying and affecting disease of cardiovascular and respiratory systems. Cigarette has a multipotent mixture of carcinogens that are responsible for many diseases including cancer of the renal pelvis, aerodigestive tract, and the pancreas (Kohailan et al., 2016). In their study of the effect of cigarettes on women, Wetherill et al. (2021) report that smoking is more detrimental to women because of the influence of hormones,

particularly estradiol and progesterone, that enhances the desire to smoke and decreased the desire to quit.

***Race (Independent Variable)***

Race has been defined as a relationship between people of the same skin color who may or may not have the same ideology (Lewis et al., 2019). According to Lewis et al. (2019), although there are racial categories or groups such as Whites, African Americans, Latinos or Non-White Hispanics, Asians, and Native Americans, boundaries exist and are usually formed and separated between these races. In this study, race is defined as women with backgrounds identified as Asian, Hawaiian, or Other Pacific Islander native, American Indian or Alaskan Native, Black or African American, and White (Johnson & Louis, 2020). The concept of race has been controversial not only in the United States but also around the world. The controversy stems from one racial group oppressing other groups evidenced for example by disparities in access to healthcare or birth outcomes (Lewis et al., 2019).

Racial disparity has been associated with fetal death. According to Côté-Arsenault et al. (2020), about 20% to 50% of pregnancies that end up in fetal death in the United States are found to be among African American women. Pruitt et al. (2020) report on the Center for Disease Control and Prevention (CDC) 2015 to 2017 analysis of fetal death reports in the United States, which found African American women to have fetal deaths more than twice when compared to the rates among non-Hispanic Whites and Hispanic women. The report also points to maternal complications during pregnancy which is

found to be more prevalent among African Americans and Hispanic women (Pruitt et al., 2020).

### *Education (Independent Variable)*

Education is another social determinant of health that affects maternal health outcomes. According to Barfield (2021), the higher a woman's education is, the better chances for the woman to understand the rationale for prenatal care uptake, and the better chances for the woman to be able to adhere to instructions such as dietary restrictions, exercises, and medication use while pregnant. Education is the act of acquiring knowledge that the person may not know previously, involving one's awareness of circumstances and helping to reshape one's understanding of events and circumstances (Jack & Hamshire, 2019). Education can help to redirect one's attitude, intentions, and interventions. This concept is important since education can lead to an informed decision on health care and self-management of health, especially related to self-management of health while pregnant. There are no known controversies about informal education. Studies are still ongoing to improve education.

## Studies Related to the Research Questions

The research questions are especially important in studies as they help to guide and shape the design aspect of the study (Capili, 2020). These research questions helped to address the rationale for this study and why this study is beneficial to public health. To better understand the relationship between fetal death and women with previous C-sections, this study explored the contribution of maternal cigarette smoking, race, and education variables in this phenomenon. The reader should note that all the women with

previous C- Section(s), either elective or emergency C- Section(s), are eligible for inclusion in this study.

RQ1 was, what is the association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care? There are no previous studies that have precisely addressed this study question; however, many studies have addressed the relationship between cigarette smoking and fetal death. In their study on smoking cessation during pregnancy, Diamanti et al. (2019) report evidence that supports the harmful effects of cigarette smoking on a fetus. According to Diamanti et al. (2019) cigarette smoking while pregnant can lead to fetal death and miscarriages.

In their study of the impact of cigarette smoke in brain anatomy of pregnant women, Lavezzi et al. (2017) found out that cigarette smoke can alter the cerebellar cortex region of the brain that controls important body functions, leading to low immuno-expression, particularly the alpha nicotinic acetylcholine receptor (α7-nAChR) which is implicated in neuronal differentiation and also its vulnerability in nicotine toxicity. According to Lavezzi et al. (2017), this neuronal nicotine toxicity is found in unexplained fetal deaths of 66% of the population of the study ($N = 66$). This study also explores the question of maternal race and the odds of fetal death among women with previous C-sections.

RQ2 was, what is the association between maternal race and fetal death among the women with previous C- section(s) in the United States after controlling for maternal

age, cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care? An exhaustive search on the implication of race and the odds of fetal death among women with previous C- section identified existing gaps, although many studies have investigated racial disparity in fetal death in general. In their analysis of fetal death rates between 2015 and 2017 in the United States, CDC has reported that there is an increase in fetal death rates among black women or non-Hispanic black women which were more than twice the rate among Hispanic women and non-Hispanic white women (Pruitt et al., 2020).

Johnson and Louis (2020) have also reported on the effect of Pre-eclampsia according to race. In their study of the implication of preeclampsia and racial outcome, Johnson and Louis (2020) report that there is a there is 3%-5% prevalence of preeclampsia among black women or Non-Hispanic Black women, American Indians, or Alaskan natives, and non-Hispanic blacks in the United States. This racial discrepancy is also noted in overall pregnancy outcomes in the United States. According to Parchem et al. (2020), African American women in comparison to White women had a higher risk of composite adverse neonatal outcomes and infant deaths. The question of education level and the odds of fetal death among women with previous C- sections was also explored.

## Definitions

*Education level*: The highest education status attained or degrees earned by the mother, such as a doctorate, master's degree, bachelor's degree, associate degree, some college credit but no degree, high school graduate or general equivalency diploma (GED) completed, no diploma, 9th-12th grade education, or 8th grade education or less.

*Fetal death*: The death of the unborn child not resulting from an induced termination of pregnancy; it occurs before the complete expulsion or extraction from its mother. The CDC (2018), however, does not specify a particular week of gestation. A more detailed definition is provided in the Operationalization subsection in Section 3.

*Maternal age*: The age of the mother at the time of fetal death. It was measured in years in the 2014 data set.

*Maternal cigarette smoking*: The smoking habit of the mother, as defined by the use of any smoking or other use of tobacco products at any point during gestation.

*Maternal race*: The race of the mother; this was a categorical variable with the following categories: White, Black or African American, Asian, Native Hawaiian or Other Pacific Islander, and Alaska Native or American Indian. Since a benchmark had to be used for race comparison, the White race was used as a reference category or baseline.

*Previous Cesarean section*: A woman's having had one or more C- sections from previous conceptions.

## Assumptions

I assumed that the reported fetal deaths in the data set were consistent with the CDC's (2018) definition of fetal death. This assumption is important for the consistency of the fetal death data across all the states of the United States and for the combined data of all the states to have construct validity and be usable. Furthermore, it is assumed that data were collected as described in the document that accompanied the data set. This assumption was important because this study was based on a secondary data set available

from the CDC and I relied on the data dictionary and other documents accompanying the data to understand how the data were collected.

## Scope and Delimitations

This study was limited to the fetal deaths that took place in the United States and its territories alone and in which the mothers has had one or more Caesarian sections before the current conception/current fetal death. The United States and its territories include the 50 states, District of Columbia, American Samoa, Guam, Northern Marianas, Puerto Rico, and the Virgin Islands, and was limited to fetal deaths that occurred between the year 2014 and the year 2018.

The study results may be generalizable to the United States population of women who have previously had C- section(s). On the other hand, the results of this should be interpreted cautiously in the context of the women in other countries because they are not included in the study and the women in other countries may have characteristics that make them systematically different from the women in the United States included in the study. However, the results obtainable from this study provided valuable insights into the factors that influenced the odds of fetal death in women with Caesarian section(s) in other developed countries in addition to its rigorous generalizability to the women in the United States.

## Limitations

Limitations to this study include a non-concise and consistent representation of data that addresses fetal death. There are limited vital statistics describing the rationale for the detailed pathophysiology of the events leading to fetal death which could have

helped to shed light on the probable cascade of events that caused the fetal death and possible interventions. There is also no standardization on data collection of fetal deaths. Muglu et al. (2019) report that most health care centers have different names for the same or similar incidences of fetal death, making it difficult to ascertain the true nature of fetal death for an appropriate plan of intervention.

## Significance

Fetal death is a public health concern and is considered to be an important measure of a country's national health care (Song et al., 2017). Fetal death concerns have brought about little or no interest to public health workers; however, it is important to fully understand the fetal death phenomena to appropriately provide health care to a woman when pregnant and during the peripartum period (Vieira et al., 2016). Several studies have reported on the impact of fetal deaths on mothers in many countries around the world. Some of these factors can be controlled with some modifiable variables. For instance, in many developed countries, the availability and abundance of food leads to obesity and consequently, increased BMI. In their findings of the United Nations (U.N) report on the mean age of childbearing, Attali and Yogev (2021) report that the mean age of childbearing globally decreased from 29.1 years between 1950 and 1955 to 27.5 years from 1990 to the present. However, childbearing age in developed countries rose from 26.5 years to 29.4 years between 2010 and 2015. With the advancement in maternal age complicated with high BMI, Attali and Yogev (2021) found an increase in the risk of fetal death.

Women with previous C- Section(s) are potentially at a higher risk of having fetal death (Attali & Yogev, 2021) but little is known about the factors that influence the odds of fetal death among this high-risk sub-population of women. Therefore, this study explored this gap and phenomenon of fetal death among this population and provided valuable insights into how to address the problem.

## Summary and Conclusions

The prevalence of fetal deaths in the United States is higher than those of other industrialized nations (Kamal & Blumenkranz, 2017). The rate of fetal death has been unchanged since 2006 data until 2017 which is at 6/1000 live births in the United States (Harrist et al., 2017). These make fetal deaths in the United States a public health problem. Although the effects of maternal smoking habits, race, educational level, and other factors on the likelihood of fetal death have been previously examined in several settings, however, these effects on fetal death have not been studied to any reasonable detail among women with previous C- Section(s). Therefore, this study explored these variables and their associations with fetal deaths in women with previous C- Section(s) in the United States. Kindly note that all the women with previous C- Section(s), either elective or emergency C- Section(s), are eligible for inclusion in this study.

In this section, I have presented the Purpose of the Study, the Research Question(s) and Hypotheses, the Theoretical Framework and the conceptual framework, the nature of the study, the literature search strategy, the definitions of important concepts and variables, the important assumptions, the scope and the potential generalizability of the study, and the potential limitations of the study. In section2, I presented the research

design and the rationale for it, the methodology, the target population, the data set that was used in the study, the statistical techniques and the statistical software package that was used, and the potential threats to validity.

Section 2: Research Design and Data Collection

## Introduction

The rate of fetal death in the United States, which is at 6 per 1,000 live births, was mostly unchanged from 2006 to 2017 (Harrist et al., 2017), and the prevalence of fetal deaths in the United States is higher than those of other industrialized nations (Kamal et al., 2017), making fetal deaths in the United States a public health problem. Although the effects of maternal smoking habits, race, educational level, and other factors on the likelihood of fetal death have been previously examined in several settings (Kamal et al., 2017), their effects on fetal death have not been extensively studied among women with previous C- section(s). In this study, I explored these factors and their associations with fetal deaths in women with previous C- section(s) in the United States. In this section, I describe the research design and rationale; the methodology, including the target population, the data set that was used in the study, and the statistical techniques and the statistical software package that was used; and the potential threats to validity.

## Research Design and Rationale

I conducted a cross-sectional analytic study, wherein the dependent and the independent variables were measured and recorded at the same point in time. I used statistical methods to test hypotheses and answer the RQs, making the research an analytic study. In a comparable study, Bresin (2019) successfully used a meta-analytical approach to test hypothesis and answer the RQs presented. The dependent variable for this study was focused on fetal death. Fetal death was a binary categorical variable measured at the nominal level of measurement. The independent variables of interest

included maternal habits (mainly smoking habits) before and during pregnancy, maternal race, and maternal educational level. Maternal smoking habit was a binary categorical variable measured at the nominal level. Maternal race and facility where the birth took place were categorical variables measured at the nominal level. Maternal education level was a categorical variable measured at the ordinal level of measurement.

The cross-sectional analytic design that was used in the study made it possible to examine the association between fetal death among women with previous C- section(s) and the independent variables of interest by applying inferential statistical techniques targeted at examining the possibility of (and strength of) statistically significant relationships between the variables. I could have answered the study's RQs by using a prospective study in which I followed the study participants over time and recorded the presence or absence of fetal death. Although such an approach is very rigorous, it was not feasible for this doctoral research as would have required a lot of capital and several years of research study (Bresin, 2019). As such, it was beyond the scope of this doctoral study. The cross-sectional analytic design selected for this work saved time and capital and provided equally rigorous results to answer the RQs such as the study of Bresin (2019).

## Methodology

### Population

The population for this study were women in the United States who had previously had C- section(s) and subsequently had fetal death. All women with previous C- section(s), either elective or emergency, were eligible for inclusion in this study.

These women were from all 50 states and the District of Columbia as well as the U.S. territories (including American Samoa, Guam, Northern Marianas, Puerto Rico, and the Virgin Islands). The size of this population was known after data cleaning was completed.

**Sampling Procedures Used by Original Creators of the Data Set**

I obtained the data set for this study from the CDC. The data set contains the dependent variable (fetal death) and all the needed independent variables (namely previous C- section, number of women with previous C- section(s), maternal smoking habits, maternal race, maternal education level, and maternal delivery characteristics such as delivery centers) from 2014 to 2018. In addition, the data set includes many variables that could potentially influence the odds of fetal death and whose effects would be controlled for in the study. These variables included maternal risk factors such as the mother's prepregnancy weight, BMI, and tobacco use before and during pregnancy.

The data set contains all known data, as the data are routinely collected for every fetal death that occurs in the United States (CDC, 2018). For this study, I focused on the fetal deaths that occur for women who have previously had one or more C- section(s). This was an important inclusion criterion. Any fetal death for women who have not previously had a C- section(s) was excluded from the study as the study focused only on the women with prior C- section(s). Despite inclusion and exclusion criteria, the available data set was numerically sufficient for this study. Preliminary sample size calculations using G*Power (Faul et al., 2007) showed that a minimum sample size of 884 for RQ1 and 713 for RQ2 would provide adequate samples for answering the RQs with a

statistical power of 80% at an alpha of 0.05. Because the two RQs would be answered from the same sample, the minimum required sample size was 884.

I calculated the minimum required sample size using two tails statistics, setting the Pr(Y=1 | X=1) H1 to 0.15, Prob(Y=1 | X=1) H0 to 0.05, R-squared other X to 0.25 because the covariates were expected to have a moderate association with the outcome. The value of Pr(Y=1 | X=1) H1 was the assumed probability of fetal death (Y = 1) when a mother in the population under study was a smoker (X = 1) for RQ1 or the assumed probability of fetal death (Y = 1) when a mother in the population under study is an African American or Black (X = 1) for RQ2. The value of Pr(Y=1 | X=1) H0 was the assumed probability of fetal death when a mother in the population under study was a nonsmoker (for RQ1) or was not African American or Black (for RQ2). X-Distribution was set to "binomial" with a parameter (X param ∏) of 0.1 for RQ1 that focused on the effect of smoking on fetal death among the population of interest. It was also set to "binomial" with a parameter (X param ∏) of 0.13 for RQ2 that focus on the effect of race on fetal death. In this case, race was treated as one group versus the rest (which is a form of binary encoding of race). The African American or Black race, which constituted about 13% of the U.S. population in 2014 (CDC, 2018), thus 0.13, was used here.

## Instrumentation and Operationalization of Constructs

### *Instrumentation*

I developed no new instruments for this study as I used a secondary data set. The data set was routinely collected by every state and territory of the United States and was collated by the CDC (CDC, 2018).

### *Operationalization*

**Fetal Death**. The definition of fetal death in the data set is as follows:

> Fetal death means death before the complete expulsion or extraction from its mother of a product of human conception, irrespective of the duration of pregnancy and which is not an induced termination of pregnancy. The death is indicated by the fact that after such expulsion or extraction, the fetus does not breathe or show any other evidence of life such as the beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles. Heartbeats are to be distinguished from transient cardiac contractions; respirations are to be distinguished from fleeting respiratory efforts or gasps. (CDC, 2018, p. 4)
>
> *This definition has been adopted by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS) as the nationally recommended standard and is based on the definition published by the World Health Organization in 1950 and revised in 1988.*
>
> *The term "fetal death" is defined on an all-inclusive basis to end confusion arising from the use of such terms as stillbirth, spontaneous abortion, and miscarriage. All U.S. states and registration areas have definitions like the standard definition, except for Puerto Rico and Wisconsin, which have no formal definition. Fetal deaths do not include induced terminations of pregnancy. (p. 4)*

**Education Level**. The education level of each of the mothers reflects the highest degree or education status attained by the mother. The education level is measured at the

ordinal level of measurement with levels including a doctorate, master's degree, bachelor's degree, associate degree, some college credit but no degree, high school graduate or GED completed, no diploma, 9th - 12th grade, and 8th grade or less.

**Race**. Race is a categorical variable measured at the nominal level of measurement with the following categories: White, Black or African American, Asian, Native Hawaiian or Other Pacific Islander, and Alaska Native or American Indian.

## Data Analysis Plan

### *Software/Statistical Computing Platform*

Statistical Package for Social Sciences (SPSS) version 27 was used for the statistical analyses in this study (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp). The stability and robustness of SPSS and its widely-used regression modeling toolkits make SPSS the statistical software of choice.

### *Data Cleaning*

I carried out data cleaning before conducting data analysis. During data cleaning, I processed the raw data and reorganized them into a format that was readable by SPSS, because the data was not originally readily available in an SPSS format. The data was available in a text file and each of the variables was not separated by comma or tab. Rather, the column ranges corresponding to each of the variables were specified in a data dictionary in form of raw text column indexes. For example, a row of the data that was of the form "Female High School40…" is now split into individual variables to obtain "Female" for gender variable, "High School" for educational attainment variable, "40"

for age variable, etc. based on the range of column indexes that represent each of the variables which are obtained from the data dictionary. Furthermore, I looked into ways of imputing missing data wherever possible, otherwise, rows with extensive missing values, too many outliers, or many unreasonable values were regarded as problematic and discarded.

### *Data Transformations*

I carried out variable data transformations and re-coding as needed. For example, using BMI in the regression models, I calculated the BMI from the person's weight and the person's height thereby creating a new variable (BMI) from two other variables (weight and height).

### *Descriptive Statistics*

The nature and the distribution of each of the variables in the data was explored and were described using descriptive statistics. The continuous variables is described using mean and standard deviation, as well as skewness and kurtosis. For the categorical variables, I used proportions, frequency distributions, and mode (Rose & Sullivan, 1993). I also made use of graphical descriptive statistics such as bar/column charts and histograms.

### *Inferential Statistics*

I carried out a statistical test of each of the null hypotheses using inferential statistics techniques. This made it possible to answer each of the research questions. The research questions of interest (and the corresponding null and alternative hypothesis) are listed below.

RQ1: What is the association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care?

$H_0$1: There is no association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care.

$H_1$1: There is an association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care.

RQ2: What is the association between maternal race and fetal death among the women with previous C- section(s) in the United States after controlling for maternal age, cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care?

$H_0$2: There is no association between maternal race and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care.

$H_1$2: There is an association between maternal race and fetal death among women with previous C- section(s) in the United States after controlling for maternal age,

cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care.

### *Multiple Logistic Regression Modeling*

To answer each of the research questions, I carried out a statistical test of the corresponding null hypothesis. For this, I used multiple logistic regression modeling. Multiple logistic regression modeling is appropriate and highly suitable for this test because it is designed for understanding the relationship between any finite number of independent variables (such as race, education level, etc. in this study) and the binary categorical dependent variable, which was fetal death in this study (Ahlbom, 1993; Daniel & Cross, 2010). The effects of other covariates, such as the age of the mother, were controlled by including them in the multiple logistic regression model, because such covariates could on their own have effects on the dependent variable thus the need to control for their effects.

## Threats to Validity

### Threats to External Validity

External validity and generalizability of the study results are highly related (Ahlbom, 1993; Daniel & Cross, 2010; Sullivan, 2011). Given that the United States is different from other nations in terms of demographics, ways of life, as well as medical facilities, and access to healthcare, the results of these studies can only be generalized to the United States' population covered by the study. There may be no straightforward way to generalize the results of this study to other populations outside of the United States because the study is limited to the U.S. population and there are differences in the

systems of government as well as in the healthcare system in the United States and other countries. Such differences between other countries and the United States cannot be rigorously accounted for in this study thereby the threat to the external validity of the results of the study outside of the United States.

**Threats to Internal Validity**

Factors that are difficult to measure and that cannot be easily controlled for may influence the dependent variable and can impact the observable relationship between the independent variable and the dependent variable (Daniel & Cross, 2010), thus threats to internal validity (Ahlbom, 1993; Daniel & Cross, 2010; Sullivan, 2011). Overall, the internal validity was increased as the chances for confounding were reduced. Therefore, in this study, the effects of potential confounders were statistically controlled, thereby reducing the threats to internal validity.

**Threats to Construct Validity**

Construct validity is the extent to which a variable or a test measures that which it sets out or claim to measure (Daniel & Cross, 2010). Generally socioeconomic status is an important variable in public health research. In the current study, the socioeconomic status variable is not available in the secondary data set. Initially, I was considering using the education level of the mother as a proxy for socioeconomic status. However, this may pose threats to construct validity as the education level alone is just a component of (and does not entirely encode) the complete socioeconomic status of an individual. Therefore, I did not account for socioeconomic status in this study because the data set I used does not contain it.

## Ethical Procedures

### *Agreement to Gain Access to the Data*

Secondary data sets that have already been collected and made available by the CDC to anyone who needed them was used for this study. To download the data set, a user needs to create an account and agree to the Terms of Use agreement. I created a user account and agreed to the Terms of Use Agreement and abided by that agreement. I made sure that ensured data set was not provided to other people through me because anyone who needs the data sets is to directly obtain them from the CDC and follow the guidelines of the CDC and agree to the Terms of Use.

### *Compliance With Institutional Review Board Ethical Standards*

I submitted this study's and an application to the Institutional Review Board (IRB) of Walden University before accessing the secondary data set and performing statistical analyses. If the IRB had suggested any revision to the study, the revisions would have been thoroughly carried out. I conducted the study only after obtaining written approval from the IRB, and I made sure that I complied with all of its policies and procedures related to research and ethical standards.

### *Anonymity*

The data sets that was used in this study was already de-identified and anonymous. They do not contain any personal information or any details that could potentially make it possible to identify the individual the data came from.

### *Other Ethical Issues: Research Integrity and Thoroughness*

I maintained the highest level of research integrity. I was not subjective or biased and I assessed information with objectivity and rigorous statistical techniques rather than with subjective opinions. Using diligence, I was able to obtain results that are correct, unbiased, and trustworthy.

## Summary

In this section, I have presented information on the research design and the rationale for it, the methodology, the target population, and the data set that was used in the study. The data analysis approach, the statistical techniques, and the statistical software package used, and the potential threats to validity, as well as applicable ethical considerations, have also been explained in detail.

In the next section, I presented the findings of this study and provided appropriate interpretations of the results. I presented the descriptive statistics first. Thereafter, I presented the results of inferential statistics involving statistical tests targeted at answering the research questions that this study set out to answer.

Section 3: Presentation of the Results and Findings

## Introduction

In this section, I described the data set. This is followed by descriptive statistics including the baseline descriptive and demographic characteristics of the sample. Then, I presented inferential statistics, the findings, and the answers to the RQs in a sequential order. A summary of the answers to the RQs are presented last.

## Accessing the Data Set for Secondary Analysis

I obtained the needed data set from the CDC. The data set contains data for the dependent variable of fetal/child alive or dead at birth and all the needed independent variables (namely previous C- section, number of women with previous C- section(s), maternal smoking habits, maternal race, maternal education level, and maternal delivery characteristics such as delivery centers). The focus was on data for 2018. In addition, the data set describes many variables that could potentially influence the odds of fetal death and whose effects would be controlled for in the study. These variables include maternal risk factors such as the mother's prepregnancy weight, BMI, and tobacco use before and during pregnancy.

The data set contains all known births for 2018 as the CDC routinely collects vital statistics for every birth that occurs in the United States (CDC, 2018). This study was limited to the births that occur for women who have previously had one or more C-section(s). This was an important inclusion criterion. I excluded any birth from women who had not previously had a C- section(s) from the study because I focused only on women with prior C- section(s). Despite inclusion and exclusion criteria, the available

data set is very large and has 594,872 rows, which is much more than sufficient for this study. An earlier sample size calculation using G*Power (Faul et al., 2007) showed that a minimum sample size of 483 would provide an adequate sample for answering the RQs with a statistical power of at least 80%. The available data set is much larger than the minimum required sample size, and the data set is in line with the plan presented in Section 2.

**Descriptive Statistics**

I presented both numerical descriptive statistics (for numerical variables), frequency distribution tables (for categorical variables), and graphical descriptive statistics (for both numerical and categorical variables). Histograms are used for the numerical variables, while bar charts/column charts are used for the categorical variables. The data set contains births that took place in 2018 in the United States and that resulted in fetal death and is limited to births that occurred for women who have previously had one or more C- section(s). The descriptive statistics show that the mean number of previous C- sections by mothers in the data set was 1.42, with a standard deviation of 0.719, with a minimum of 1 and a maximum of 11 (see Table 1 and Figure 1). The mean age of the mothers was 31.08 years, with a standard deviation of 5.308, with a minimum of 14 and a maximum of 50 (see Table 1 and Figure 2). As shown in Table 2 and Figure 3, most (92%) of the mothers did not use tobacco.

The frequency distribution table (Table 3) on whether the fetus is alive or dead shows that a large proportion (99.8%) of the fetuses were alive at birth with a small proportion (0.2%) not alive at birth (see also Figure 4). The distribution of the gender of

the fetus shows that there were a few more males (51.1%) than females (48.9%; see Table 4 and Figure 5), which is consistent with known gender distribution at birth. Frequency distributions of the mother's race, mother's highest education level, mother's BMI, and the month prenatal care began are shown in Table 5 to Table 8, respectively, and in Figure 6 to Figure 9, respectively. The data set is representative of the population of interest. It accounts for all the births that took place in 2018 among women who had previously had one or more C- sections, which is the definition of the population of interest.

**Table 1**

*Descriptive Statistics for the Continuous Variables*

| Variable | *N* | Minimum | Maximum | *M* | *SD* | Skewness |
|---|---|---|---|---|---|---|
| Number of previous Cesareans | 593,791 | 1 | 11 | 1.42 | .719 | 2.021 |
| Mother's age in years | 594,872 | 14 | 50 | 31.08 | 5.308 | .035 |

**Table 2**

*Frequency and Percentage of Tobacco Use*

| Tobacco use | Frequency | Percentage |
|---|---|---|
| No | 547,246 | 92.0 |
| Yes | 44,829 | 7.5 |
| Total | 594,872 | 100.0 |

**Table 3**

*Frequency and Percentage Distribution of Infant Alive*

| Infant alive | Frequency | Percentage |
|---|---|---|
| No | 1,259 | 0.2 |
| Yes | 592,309 | 99.8 |
| Total | 593,568 | 100.0 |

**Table 4**

*Frequency and Percentage Distribution of the Gender of the Child*

| Gender | Frequency | Percentage |
|---|---|---|
| Female | 290,889 | 48.9 |
| Male | 303,983 | 51.1 |
| Total | 594,872 | 100.0 |

**Table 5**

*Frequency and Percentage Distribution of Mother's Race*

| Race | Frequency | Percentage |
|---|---|---|
| White | 428,185 | 72.0 |
| Black | 106,104 | 17.8 |
| American Indian and Alaska Native | 5,784 | 1.0 |
| Asian | 38,499 | 6.5 |
| Native Hawaiians and Other Pacific Islanders | 2,112 | 0.4 |
| More than one race | 14,188 | 2.4 |
| Total | 594,872 | 100.0 |

**Table 6**

*Frequency and Percentage Distribution Mother's Education Level*

| Education level | Frequency | Percentage |
|---|---|---|
| 8th grade or less | 21,312 | 3.6 |
| 9th through 12th grade with no diploma | 58,510 | 10.0 |
| High school graduate or general equivalency diploma (GED) completed | 153,146 | 26.1 |
| Some college credit, but not a degree | 121,127 | 20.6 |
| Associate degree (AA, AS) | 52,012 | 8.9 |
| Bachelor’s degree (BA, AB, BS) | 112,657 | 19.2 |
| Master’s degree (MA, MS, MEng, Med, MSW, MBA) | 53,556 | 9.1 |
| Doctorate (PhD, EdD) or professional degree (MD, DDS, DVM, LLB, JD) | 14,577 | 2.5 |
| Total | 586,897 | 100.0 |

**Table 7**

*Frequency and Percentage Distribution for Mother's Body Mass Index*

| Body mass index | Frequency | Percentage |
|---|---|---|
| Underweight < 18.5 | 10,787 | 1.9 |
| Normal 18.5-24.9 | 188,594 | 32.4 |
| Overweight 25.0-29.9 | 158,877 | 27.3 |
| Obesity I 30.0-34.9 | 109,034 | 18.7 |
| Obesity II 35.0-39.9 | 61,516 | 10.6 |
| Extreme Obesity III ≥ 40.0 | 52,754 | 9.1 |
| Total | 581,562 | 100.0 |

**Table 8**

*Frequency and Percentage Distribution for the Month Prenatal Care Began*

| Month in pregnancy | Frequency | Percentage |
|---|---|---|
| 0 | 9,042 | 1.6 |
| 1 | 35,194 | 6.1 |
| 2 | 230,371 | 39.6 |
| 3 | 183,007 | 31.5 |
| 4 | 52,952 | 9.1 |
| 5 | 26,961 | 4.6 |
| 6 | 16,377 | 2.8 |
| 7 | 13,024 | 2.2 |
| 8 | 10,247 | 1.8 |
| 9 | 3,951 | 0.7 |
| 10 | 36 | 0 |
| Total | 594,872 | 100 |

**Figure 1**

*Number of Previous Cesarean Sections*

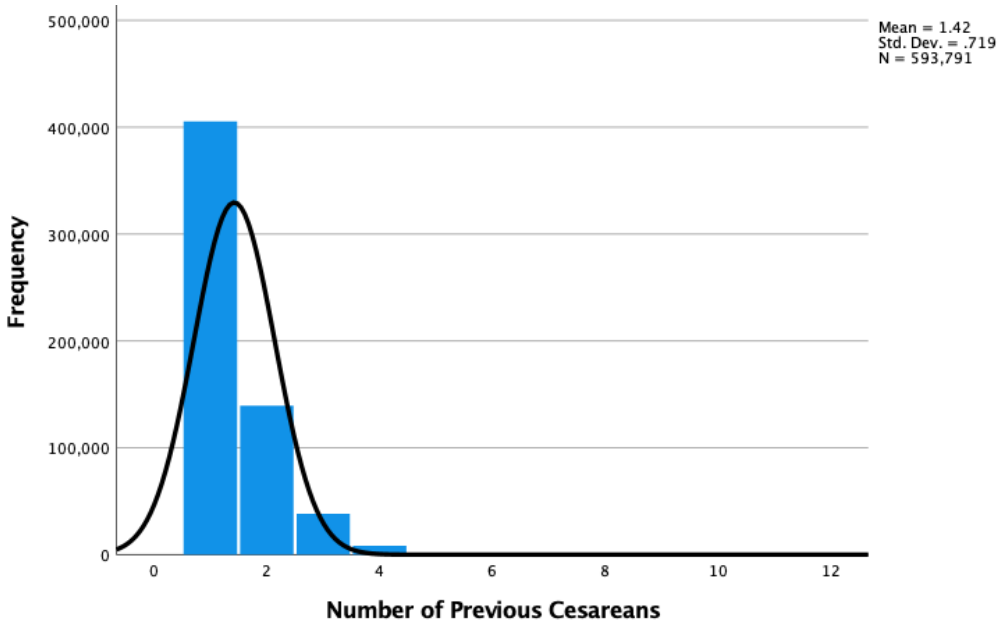



**Figure 2**

*Mother's Age in Years*

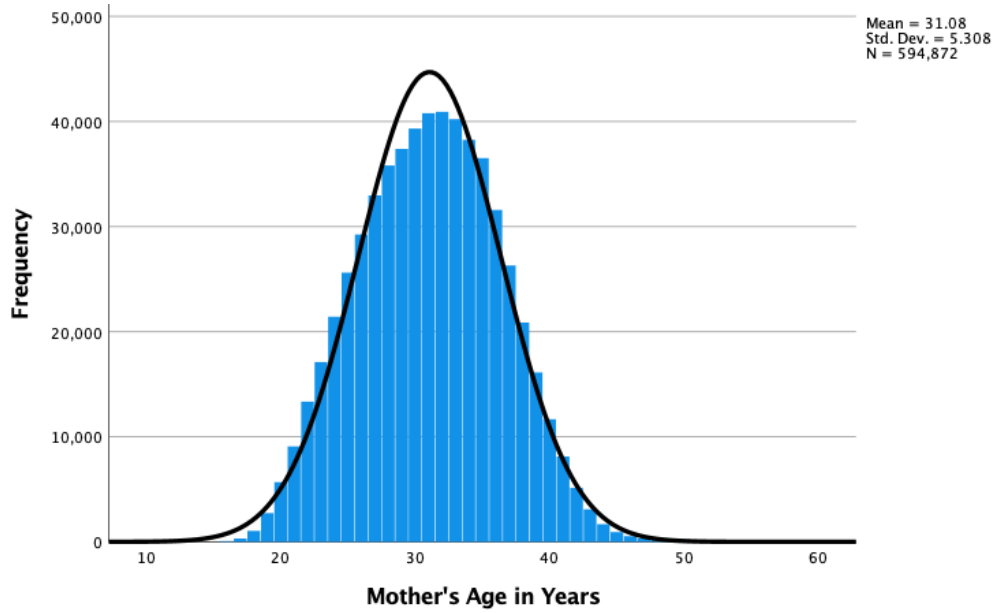


**Figure 3**

*Tobacco Use by Mother*

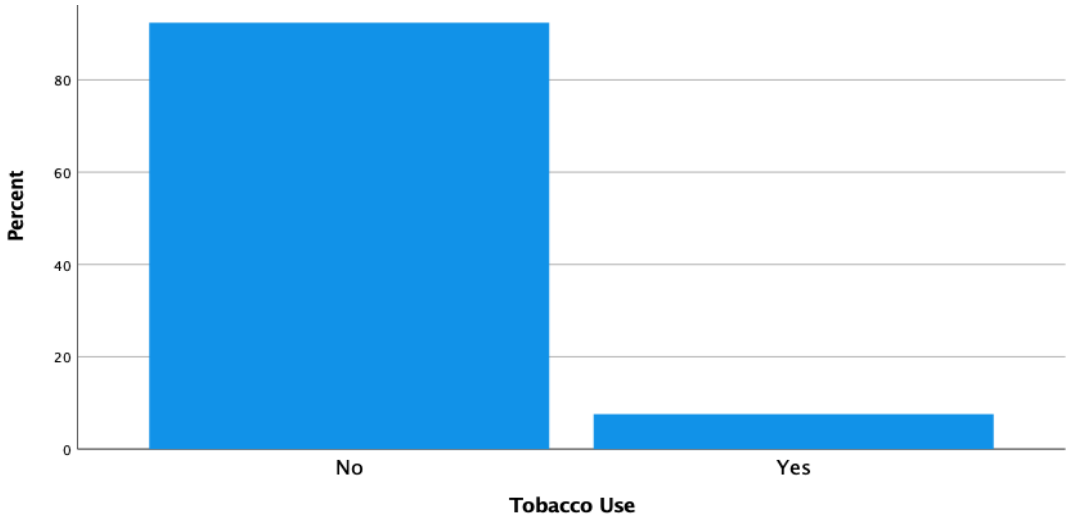



**Figure 4**

*Fetus/Child Alive (Not Dead)*

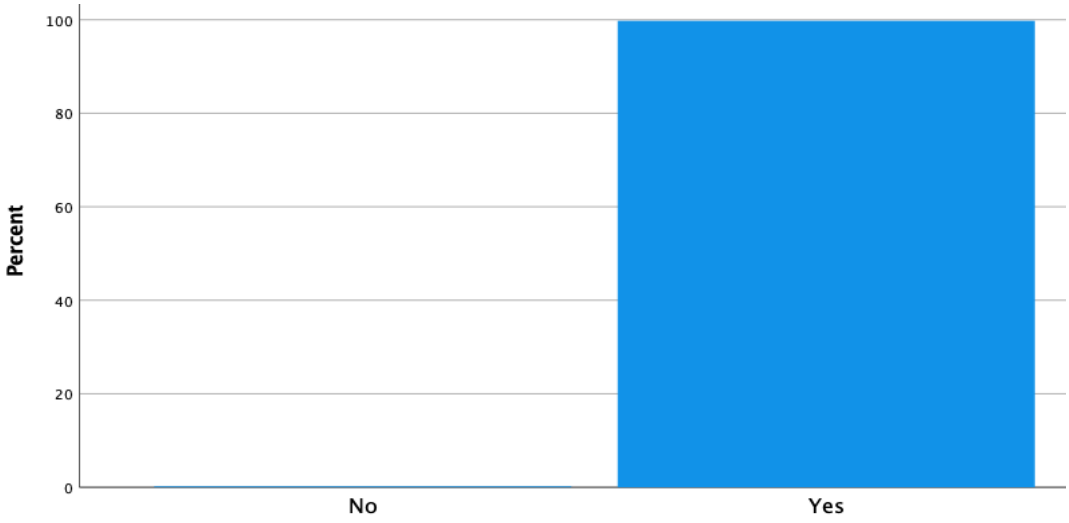


**Figure 5**

*Gender of the Fetus/Child*

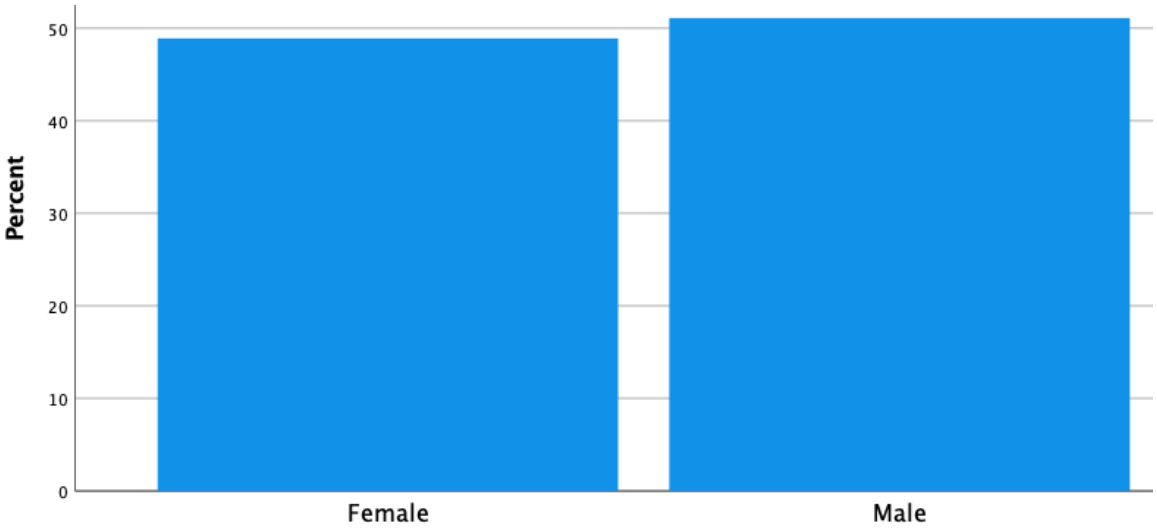



**Figure 6**

*Mother's Race*

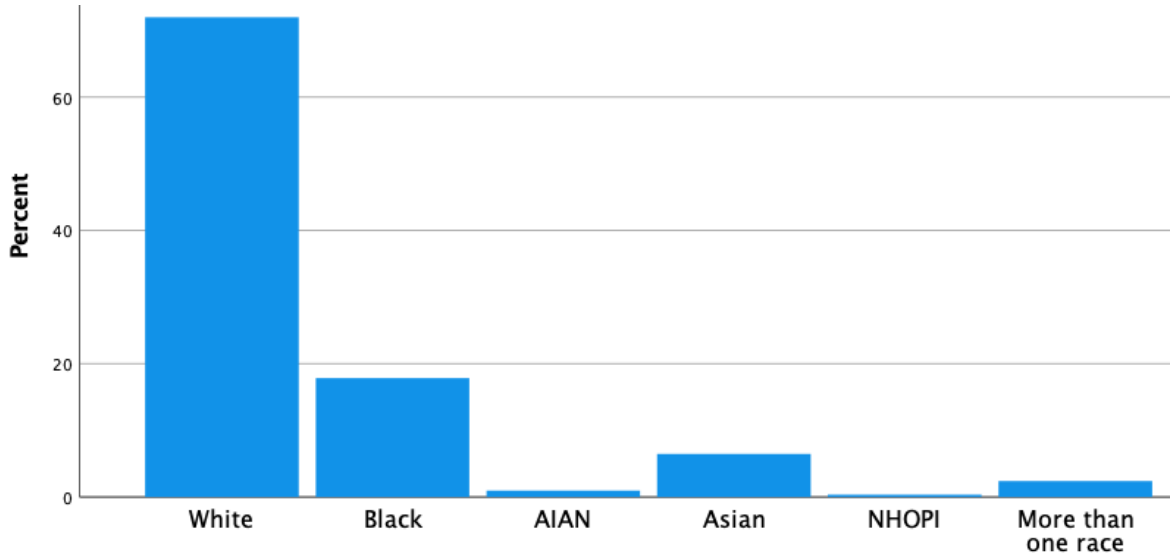


**Figure 7**

*Highest Education Level Completed by the Mother*

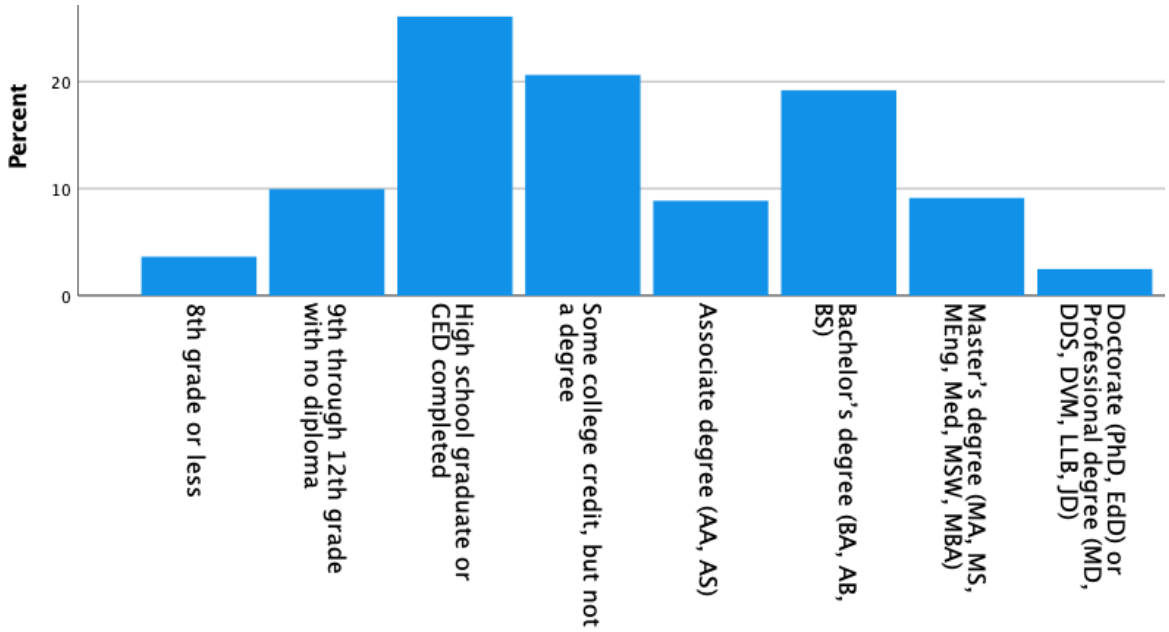



**Figure 8**

*Mother's Body Mass Index*

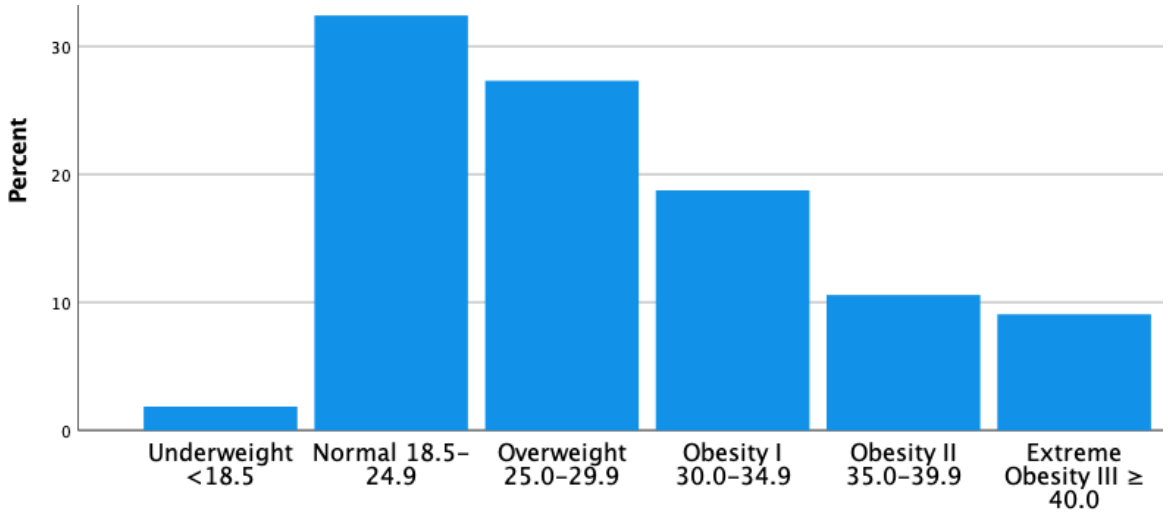
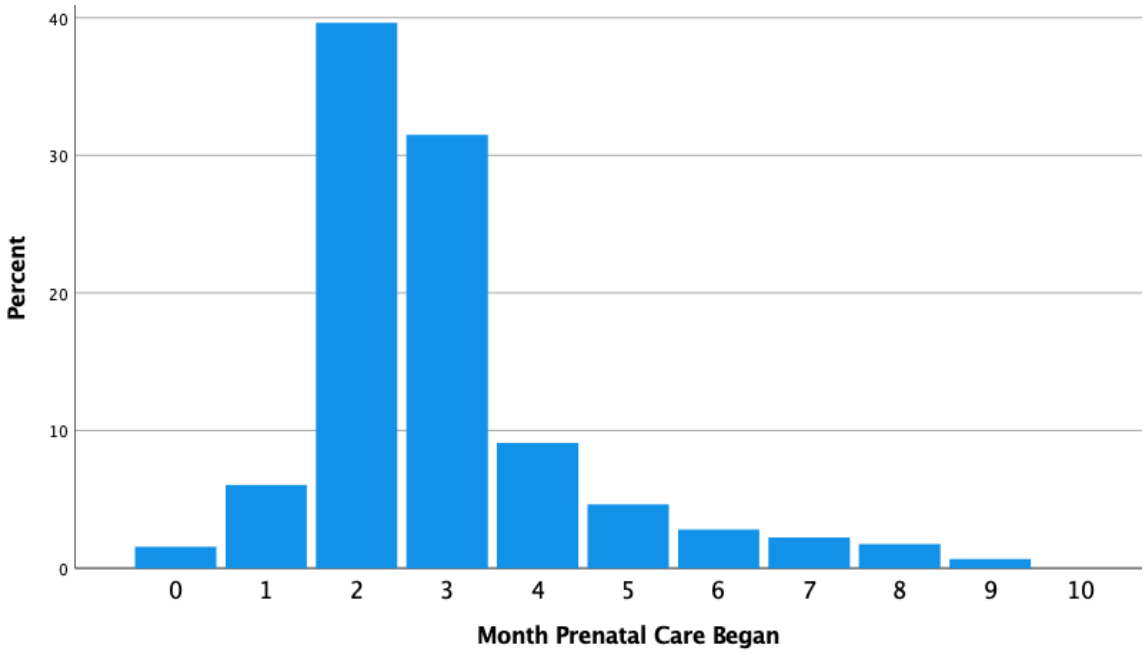


**Figure 9**

*Month Prenatal Care Began*




## Results

From the frequency distribution table on whether the fetus is alive or dead shows that a large proportion (i.e., 99.8%) of the fetuses are alive at birth with a small proportion (i.e., 0.2%) that are not alive at birth. These are shown in Table 3 and Figure 4. The distribution of the gender of the fetus shows that there are a few more males (51.1%) than females (48.9%, Table 4 and Figure 5), which is consistent with known gender distribution at birth. Frequency distributions of the mother's race, mother's highest education level, mother's body mass index, and the month prenatal care began are shown in Table 5 to Table 8 respectively and in Figure 6 to Figure 9 respectively.

**Inferential Statistics and Answers to the Research Questions**

To rigorously and statistically answer each of the study's research questions, inferential statistics methods are used to test the null hypothesis corresponding to each study's research questions. Multiple binary logistic regression analysis is used to achieve this. Multiple binary logistic regression analysis is suitable because it allows the modeling and understanding of the relationship between many independent/predictor variables and one binary categorical dependent variable (Ahlbom, 1993; Daniel & Cross, 2010). Furthermore, multiple binary logistic regression analysis does not make any strong assumption on the distribution of the independent variables. The assumption/requirement that the dependent variable should be a binary categorical variable is met because the dependent variable in this study, namely, whether the fetus is alive or not at birth is a binary categorical variable.

The independent/predictor variables of highest interest in this study are maternal cigarette use and maternal race. The dependent variable is fetal death, i.e., whether a fetus is alive or not at birth. The effects of other factors and potential confounders such as maternal age, maternal highest education level, maternal body mass index, and the start time of the prenatal care were also controlled and this was made possible through the use of multiple binary logistic regression modeling. The results from the analyses are presented in Table 8 and the answers to each of the research questions are summarized below.

***Results for Research Question 1***

RQ1 was, what is the association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care? From the inferential statistics performed through binary logistic regression modeling, it is obtained that there is a statistically significant relationship between maternal cigarette/tobacco use and the odds of fetal death ($p<0.001$, Table 8). Therefore, I rejected the null hypothesis and conclude that there is a statistically significant association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care. In other words, even after controlling for the effects of other variables, maternal cigarette/tobacco use does affect the odds of fetal death to a statistically significant degree.

The coefficient of the maternal cigarette/tobacco use in the binary logistic regression model, i.e., Exp(B) = 1.652 (see Table 8) show that among the mothers with previous C- section(s) the mothers who use cigarette/tobacco have 65.2% higher odds of having pregnancies that result in fetal death compared to similar women who do not smoke (Table 8). This is the case even after controlling for the effects of potential confounders/other variables such as maternal age, maternal race, maternal education level, etc. (Table 8).

***Results for Research Question 2***

RQ2 was, what is the association between maternal race and fetal death among the women with previous C- section(s) in the United States after controlling for maternal age, cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care? The results of the binary logistic regression analysis show that there is a statistically significant relationship (at $p < 0.001$, Table 8) between maternal race and the odds of fetal death. Therefore, I reject the null hypothesis and conclude that there is a statistically significant association between maternal race and fetal death among the women with previous C- section(s) in the United States after controlling for maternal age, cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care.

Although not all the races are statistically different from the White race used as the baseline, the Black race is statistically different from the baseline ($p<0.001$, Table 8). Only the mothers who are Black have statistically significantly higher odds of having pregnancies that result in fetal death compared to the White. Other races are not statistically different from the White race in this regard ($p>0.05$, Table 8). In other words, after controlling for the effects of other variables, the odds of having a pregnancy that leads to fetal death among women with previous C- section(s) is significantly higher only for mothers who are Black and not for any other race.

The coefficient of maternal race in the binary logistic regression model, i.e., Exp(B) = 1.729 (see Table 8) show that among the mothers with previous C- section(s) the mothers who are Black have 72.9% higher odds of having pregnancies that result in

fetal death compared to similar women who are White (Table 8). This is the case even after controlling for the effects of potential confounders/other variables such as maternal cigarette/tobacco use, maternal age, maternal body mass index, maternal education level, etc. (Table 8). Shockingly, the effects of being Black is stronger than the adverse effect of maternal cigarette/tobacco use on the odds of fetal death but it is, indeed, the case (Table 8).

**Effects of Other Variables on the Odds of Fetal Death**

In addition to the answers to the research questions presented in the previous subsection, the effects of the other independent variables on the odds of fetal death were also assessed in the binary logistic regression modeling. From the results, it is observed that the highest level of education completed by the mother also has a statistically significant effect on the odds of fetal death ($p<0.0001$, Table 8). Using the maternal highest education level of $8^{th}$ grade or less as the baseline, mothers who completed high school or GED have about 29% lower odds of fetal death ($Exp(B) = 0.718$, $p < 0.05$), mothers who completed some college credit but not a degree have about 33% lower odds of fetal death ($Exp(B) = 0.668$, $p < 0.05$), mothers who completed an associate degree have about 46% lower odds of fetal death ($Exp(B) = 0.544$, $p < 0.05$), mothers who completed a bachelor's degree have about 54% lower odds of fetal death ($Exp(B) = 0.458$, $p < 0.001$, Table 8), mothers who completed a master's degree have about 68% lower odds of fetal death ($Exp(B) = 0.322$, $p < 0.001$, Table 8), and mothers who completed a doctorate or a professional degree have about 73% lower odds of fetal death ($Exp(B) = 0.274$, $p < 0.001$, Table 8). This suggests that among the women with previous

C- section(s) the odds of fetal death decreases with increasing level of highest completed education (Table 8).

Unlike the maternal highest completed education level which is found to significantly affect the odds of fetal death, maternal body mass index is found to have no statistically significant effect ($p>0.05$, Table 8) on the odds of fetal death among the women with previous C- section(s) studied in this work.

**Table 9**

*Variables in the Logistic Regression Model**

| Variable | B | *SE* | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|
| Tobacco use | .502 | .102 | 24.438 | 1 | .000 | 1.652 |
| Infant gender (female as the reference category) | .138 | .064 | 4.616 | 1 | .032 | 1.148 |
| Number of previous Cesareans | -.032 | .044 | .527 | 1 | .468 | .968 |
| Mother's age in years | .030 | .006 | 22.300 | 1 | .000 | 1.031 |
| Mother's race (White as the reference category) | | | 58.591 | 5 | .000 | |
| Mother's race: Black | .547 | .075 | 53.376 | 1 | .000 | 1.729 |
| Mother's race: American Indian and Alaska Native | -.379 | .411 | .850 | 1 | .357 | .685 |
| Mother's race: Asian | -.025 | .153 | .026 | 1 | .872 | .976 |
| Mother's race: Native Hawaiians and Other Pacific Islander | .560 | .450 | 1.545 | 1 | .214 | 1.750 |
| Mother's race: More than one race | -.159 | .240 | .442 | 1 | .506 | .853 |
| Mother's education ($8^{th}$ grade or less as the reference category) | | | 59.357 | 7 | .000 | |
| Education (9th through 12th grade with no diploma) | -.257 | .172 | 2.236 | 1 | .135 | .773 |
| Education (high school graduate or general equivalency diploma completed) | -.331 | .155 | 4.520 | 1 | .033 | .718 |
| Education (some college credit, but not a degree) | -.404 | .158 | 6.536 | 1 | .011 | .668 |
| Education (associate degree) | -.609 | .181 | 11.327 | 1 | .001 | .544 |
| Education (bachelor's degree) | -.781 | .166 | 22.202 | 1 | .000 | .458 |
| Education (master's degree) | -1.133 | .202 | 31.618 | 1 | .000 | .322 |
| Education (doctoral or professional degree) | -1.294 | .324 | 15.939 | 1 | .000 | .274 |
| Mother's body mass index (BMI; <18.5 as the reference category) | | | 4.419 | 5 | .491 | |
| BMI (Normal 18.5-24.9) | -.219 | .222 | .971 | 1 | .324 | .803 |
| BMI (Overweight 25.0-29.9) | -.251 | .224 | 1.260 | 1 | .262 | .778 |
| BMI (Obesity I 30.0-34.9) | -.103 | .225 | .209 | 1 | .648 | .902 |
| BMI (Obesity II 35.0-39.9) | -.289 | .237 | 1.488 | 1 | .223 | .749 |
| BMI (Extreme Obesity III ≥ 40.0) | -.193 | .237 | .662 | 1 | .416 | .824 |
| Month prenatal care began | -.232 | .026 | 82.424 | 1 | .000 | .793 |
| Constant | -6.147 | .336 | 334.869 | 1 | .000 | .002 |

*Nagelkerke R Square = 0.017.

## Summary

From the inferential statistics, it was established that there is a statistically significant relationship between maternal cigarette/tobacco use and the odds of fetal death ($p<0.001$, Table 8) which led to the rejection of the null hypothesis for the first research question and conclusion that there is a statistically significant association between maternal cigarette use and fetal death among women with previous C- section(s) in the United States even after controlling for maternal age, race, education level, maternal body mass index, and the start time of the prenatal care. Similarly, the null hypothesis for the second research question was also rejected leading to the conclusion that there is a statistically significant association between maternal race and fetal death among the women with previous C- section(s) in the United States after controlling for maternal age, cigarette smoking, education level, maternal body mass index, and the start time of the prenatal care. However, using the White race as the baseline, the odds of having a pregnancy that leads to fetal death among women with previous C- section(s) is significantly higher only for mothers who are Black and not for any other race.

Furthermore, among the women with previous C- section(s), the odds of fetal death decreased with an increasing level of highest completed education (Table 8). On the other hand, maternal body mass index does not have any statistically significant effect ($p>0.05$, Table 8) on the odds of fetal death among the women with previous C-section(s) studied in this work. In Section 4, I presented further interpretations of the findings of this work, the limitations of this work, and the potential applications of the

findings of this work to professional practice. I also presented the social change implications of this work.

Section 4: Application to Professional Practice and Implications for Social Change

## Introduction

Fetal death is the death of a fetus spontaneously during pregnancy assessed at 20 weeks of gestation or thereafter and lasting until the first week of life (Pruitt et al., 2020). The causes of this phenomenon are varied, ranging from maternal behavior before and during pregnancy and genetics to health status, obesity, nutrition, and the start time of prenatal care, among several other factors (Monasta et al., 2020). Factors such as cord abnormalities, multiple congenital abnormalities, obstructed labor, and fetal distress also contribute to fetal death (Tamrakar & Tripathi, 2020). The United States has a higher prevalence of fetal deaths when compared to other industrialized nations (Kamal & Blumenkranz, 2017). Several researchers have investigated this phenomenon with different findings regarding the country's high rate of fetal death (e.g., Pirhonen & Erkkola, 2021; Kamal & Blumenkranz, 2017; Harrist et al., 2017). However, this phenomenon has not been well studied among women with previous C- section(s), whether elective or spontaneous in an emergency, according to my review of the literature.

In their study, Heino et al. (2016) reported a higher rate of fetal death delivery among women with previous C- sections. Morales-Suárez-Varela et al. (2016) reported that cigarette smoking, maternal weight gain, and an increase in BMI during pregnancy were linked to fetal death. Before this study, it was known that women who have had a C- section(s) before may be different from other women who have not had a C- section(s) before. Some of the factors that tend to influence fetal death were not specifically studied

with an exclusive focus on women with previous C- section(s), prompting this study. Qureshi et al. (2019) found that the development of diabetes mellitus and gestational diabetes, if left untreated, can lead to fetal demise or death. Attali and Yogev (2021), on the other hand, found that late age of childbearing increases the risk of ectopy pregnancy and spontaneous abortion in early pregnancy. Considering the lack of research on some of these factors among women with previous C- section(s), there was a need for research on the factors affecting the odds of fetal deaths among this population of women in the United States.

## Interpretation of the Findings

I explored the implication of cigarette smoking in fetal death among mothers with previous C- section and also the effect of fetal death among Black women with previous C- section when compared to their White women counterparts. The results of this study show that cigarette smoking while pregnant had a strong relationship with fetal death among women with previous C- sections after controlling for maternal age, race, education level, maternal BMI, and the start time of the prenatal care. This finding is consistent with those of Heino et al. (2016) and Lavezzi et al. (2017). The findings from the present study also show the more prevalent effect of fetal death among Black women when compared to women of other races, especially the White race.

## Limitations of the Study

I only focused on women in the United States who had had a previous C- section. This focus was adequate for answering the RQs of interest in this study. Since it focused only on women in the United States who had had a previous C- section, it may not be

generalizable to women in other countries. Second, the observed adverse effect of race wherein the odds of fetal death for the Black women is higher compared to the White women. It is not clear from this study whether the effect of race seen could be present in other countries too or if it is just in the United States. The limitation of this work also stems from the data set that was used. The data set contains all known births for 2018. Although this is adequate for answering the RQs of interest in this study, it is unclear whether the observed results are consistent across many years or whether the trend of the relationships between the dependent variables and the independent variables is changing over time across many years or decades in birth inequity among races. Therefore, an updated data set which include women from other countries and with race as an included variable will be needed for a future comparable research.

## Recommendations

One of the single most preventable health illnesses in the United States is cigarette smoking (McDonnell & Regan, 2019). Because this is a new finding among women with previous C-sections noted from this study, there is the need for education and smoking cessation campaigns among all pregnant women in general and among women with previous C- sections in particular. Controls on the accessibility and usage of cigarette and other related tobacco products among pregnant women have helped to reduce the prevalence of cigarette-related fetal deaths, and will be beneficial especially among women with previous C- sections, in the United States. I also recommend for other researchers to investigate the widened discrepancy and the factors affecting the higher rate of fetal deaths incidences, especially among Black women with previous C-

section(s) when compared to their White counterparts. The variables that could be affecting this phenomenon are not exhaustive. I did not consider all variables in this study. Among other variables that can be considered include substance use, thrombophilia, multiple gestations, platelets disorder, congenital anomaly, placental abruption, neural tube defect, hydrocephaly, and comorbid chronic health conditions such as diabetes mellitus and hypertension. Researchers can examine these variables using a cross-sectional analytical study design.

## Implications for Professional Practice and Social Change

Based on the study findings, I recommend that health care professionals explore questionable health conditions among pregnant Black women with previous C-section(s), especially those conditions that are not consistent with normal pregnancy. Expanding on policies that address accessibility and usage of cigarettes and related products could lead to an improved fetal outcome among women with previous C-section. An improvement in policies regarding access to cigarettes among pregnant women in terms of economic disincentives and policy changes could result in a further reduction in fetal deaths among women with previous C- section(s) leading towards positive social change.

## Conclusion

In this study, I investigated factors that influence the odds of fetal death among women with a previous C- section such as maternal race, educational level, delivery characteristics, and access to delivery centers to better understand whether these factors influence the odds of fetal death among this population of women. Inferential statistical

analysis revealed a statistically significant difference in maternal cigarette use and fetal death among women with previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal BMI, and the start time of the prenatal care. There was also statistically significant difference for maternal race and fetal death among women with a previous C- section(s) in the United States after controlling for maternal age, race, education level, maternal BMI, and the start time of the prenatal care. Therefore, I encourage the medical and community health personnel to monitor and screen pregnant women with previous C- section(s) more closely. I also recommend that they pay particular attention to pregnant Black women with previous C- section(s) because this population is more susceptible to having fetal deaths when compared to women of other races, especially the White race. An improved health policy that addresses access and usage of cigarette and other tobacco products is also recommended. Interventions from health care providers including public health officials and lawmakers may bring about a positive downward trend in the prevalence of fetal deaths among women with previous C- section(s) leading to positive social change.

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