2016

Gestational Age, Birth Weight, and Incidence of Adult Type 2 Diabetes among Southeast Alaska Natives

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Abstract

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M.P.H., Walden University, 2007

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Dissertation Submitted in Partial Fulfillment

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Doctor of Philosophy

Public Health

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Abstract

American Indian and Alaska Native adults are 2.6 times more likely to have adult onset diabetes resulting from higher weight at birth. Pregnant women, providers, and Indian Health Service administrators may benefit from timely information during pregnancy to intervene and prevent Type 2 diabetes. The purpose of this study was to examine the role of birth weight in the development of Type 2 diabetes among Southeast Alaska (SEA) Natives. Guided by the socioecological model, this study examined the extent to which birth weight and gestational age predict the incidence of Type 2 diabetes. The study used a quantitative research design with retrospective analysis of 540 Native children born in SEA whose data were abstracted from birth journals and electronic medical records at ages 43-53. A *t* test indicated a significant positive correlation between gestational birth weight and incidence of Type 2 diabetes ($t_{(285)} = 13.91$, $p < .001$). Birth weight for gestational age was associated with frequency of Type 2 diabetes, where small for gestational age (SGA) had the lowest risk (1.42%), average for gestational age (AGA) at medium risk (8.76%), and large for gestational age (LGA) had the highest risk at 32.25% ($x^2_{(12)} = 63.29$, $p < .0005$). Findings indicate that adult Type 2 diabetes among the SEA Native population is due to excess intrauterine fetal weight gain. The positive social change implications include preventing Type 2 diabetes in SEA Natives by controlling weight gain during pregnancy; the findings also suggest using diagnostic risk profiles for those who are LGA at birth for the management of diabetes and prevention of obesity and chronic disease.

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Dedication

I dedicate this to my daughter, Kristi Kay, and my son, Arnie Thomas, and their beautiful families. Over time, they have inspired me to dream, believe, and pursue my personal and professional aspirations and goals. Without your love and support, this dissertation would not have been.

Acknowledgements

I sincerely acknowledge with appreciation the contributions of my dissertation committee. I owe a debt of gratitude to Dr. Patrick B. Williams, my faculty mentor and dissertation committee chair, for his helpful comments and insights on study design and previous drafts.

A special thanks to committee member Dr. Mary Lou Gutierrez for serving on my committee and reading the manuscript, providing advice and offering valuable suggestions to fortify the study.

I would like to acknowledge the people that have encouraged me to pursue my academic career. First I would like to acknowledge Ann Rankin and her family. Ann, I will always remember my first trip to college. To my sister Sharon Kay who was able to help me out in so many ways. I thank you and I will always remember what you have done for me. I would like to acknowledge Anthony Mark who has been my guiding light during my academic pursuit of a Doctor of Philosophy in Public Health/Community Health.

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Chapter 1: Introduction to the Study

Introduction

Noninsulin dependent or Type 2 diabetes is becoming a common chronic health condition with trends indicating that minority populations are disproportionately affected by the disease. Diabetes is the seventh leading cause of death by disease in the United States (Centers for Disease Control [CDC], 2011). In addition, diabetes is an important global health problem and is characterized by lifestyle changes such as physical inactivity and increased calorie consumption that have led to obesity and other chronic diseases (Valway, Freeman, Kaufman, Welty, Helgerson & Gohdes, 1993).

Background of the Study

The CDC (2011) estimated that in the year 2011 25.6 million people aged 20 years and older, or 11.3% of the population, had Type 2 diabetes. Diabetes prevalence increases with age and is more prevalent in certain ethnic groups such as African Americans, Hispanic Americans, Native Americans, and Pacific Islanders (CDC, 2011). National estimates of diagnosed diabetes are available from national survey data and the Indian Health Service (IHS) National Patient Information Reporting System (NPIRS) for some but not all minority groups. The NPIRS includes data for approximately 1.9 million American Indians and Alaska Natives in the United States who receive health care from the IHS (National Institutes of Health [NIH], CDC, 2011). The chapter presents the background of the study where factors such as intrauterine exposure to diabetes and infant size are discussed in relation to adult incidence of Type 2 diabetes at earlier ages in minority populations. Other topics in this chapter include a statement of the problem, nature of the study, and the study's significance.

Data from the 2009 IHS-NPIRS revealed that 14.2% of American Indians and Alaska Natives aged 20 years and older who receive care from IHS were diagnosed with diabetes (CDC, 2011). After adjusting for population age differences, 16.1% of the total adult population served by the IHS was diagnosed with diabetes (CDC, 2011). The total prevalence of diabetes includes 25.8 million children and 8.3% of adults in the U.S population (ADA, 2011). Approximately 18.8 million are diagnosed, 7.0 million undiagnosed, and 79 million are pre diabetic (ADA, 2011). Accordingly, in 2010, there were 1.9 million new cases of diabetes diagnosed in persons aged 20 years and older in the United States (ADA, 2011). There is a growing incidence of diabetes in the general population and specifically among American Indians and Alaska Natives.

Boney, Tucker, and Vohr (2005) found that before patients and health care providers address long term care needs they must understand the risk factors of Type 2 diabetes in children such as intrauterine exposure to diabetes and infant size at birth. Further, Boney and associates (2005) evaluated major factors contributing to diabetes in a longitudinal cohort study of children at ages 6, 7, 9, and 11 years who were Large for Gestational Age (LGA) or Average for Gestational Age (AGA) including offspring of mothers with or without gestational diabetes mellitus (GDM). These researchers concluded that there were no differences in baseline characteristics (gender, race, socioeconomic status, and maternal weight gain during pregnancy) for the four groups except for birth weight. There was a trend toward a higher prevalence of maternal obesity before pregnancy in the LGA group (Boney et al., 2005).

The rate of Type 2 diabetes among children born LGA increases incrementally in groups with a high percentage of Native American ancestry (Lee, Howard, and Savage, 1995). For example, the prevalence of diabetes in individuals with 50% Native American ancestry was found to be significantly higher than those with less than 50% (CDC, 2011). Data from the 2009 IHS NPIRS indicate that 14.2% of American Indians and Alaska Natives aged 20 years or older who receive care from IHS had been diagnosed with diabetes (CDC, 2011). Figure 1 illustrates the rate of new cases of Type 1 and Type 2 diabetes among youth aged < 20 years by race and ethnicity 2002-2003.

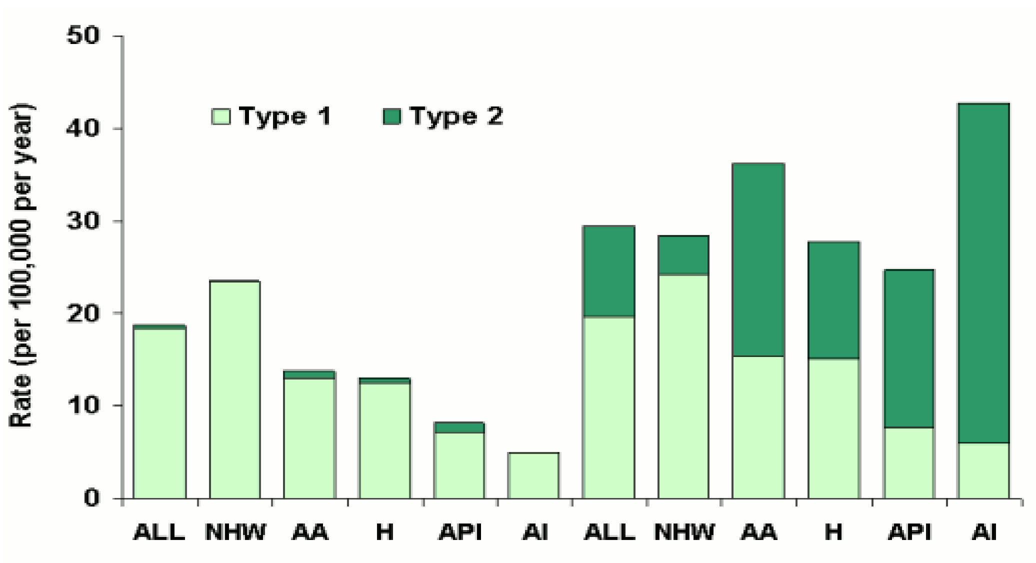

Figure 1. The rate of new cases of Type 1 and Type 2 diabetes among youth aged < 20 years by race and ethnicity 2002-2003. NHW=Non-Hispanic Whites; AA=African Americans; H=Hispanics; API=Asians/Pacific Islanders; AI=American Indians. Centers for Disease Control and Prevention (2007). National Diabetes Fact Sheet. Retrieved from http://www.cdc.gov/diabetes/pubs/estimates07htm

Although the association between fetal birth weight and the risk of developing Type 2 diabetes was examined to some extent (Boulet et al., 2003; Haas, 2007; Walton, 2009), the association of birth weight and Type 2 diabetes has not been systematically addressed. The surveillance of fetal weight and subsequent diabetes is critical in understanding Type 2 diabetes among SEA Natives. A systematic approach may be a unique opportunity to determine whether an association exists between surveillance of fetal weight, maternal diet, and health education. The information may contribute to positive social change by reducing the incidence of Type 2 diabetes among SEA natives. Lifestyle changes in diet, exercise, and weight represent an important target for preventive interventions as they are the most important modifiable causes of disease and premature death worldwide (WHO, 2009). Gestational diabetes in pregnancy is associated with an increased risk of macrosomia (Ferrara, Weiss & Hedderson, 2007); both factors are related to increased risks of Type 2 diabetes (Fall, Stein & Kumaran, 1998). This study, which was to address fetal weight and gestational age in relation to Type 2 diabetes, also assessed the relationship between birth weight and Type 2 diabetes among SEA Natives. It further inquired if birth weight predisposes an individual to develop Type 2 diabetes later in life.

The importance of understanding cognitive processes associated with eating behaviors and health outcomes (Johansson, 2006; Wethington, 2008) are vital health promotion strategies and policies targeting individual behaviors, such as increases in physical activity or changed eating habits. Such programs or health policies often fail due to lack of availability of appropriate support (Glasgow et al., 2008). The alternative approach to improve health behavior based on the socio ecological model would improve health status in low income neighborhoods through positive social interaction, improvement in public transportation, and building recreation areas and facilities to increase physical activity and diet quality (Sallis et al., 2006).

Problem Statement

The research problem addressed by this study involves the disproportionate prevalence and incidence of Type 2 diabetes among SEA Natives and the associated health risks and costs. Diabetes mellitus is one of the main causes of morbidity, disability, and mortality affecting about 25.8 million persons in the United States, including 7.0 million with undiagnosed diabetes (CDC, 2011). In the United States, Native Americans and Alaska Native populations suffer disproportionately from diabetes (CDC, 2015). Diabetes has emerged as an important public health concern among Native American communities in the United States for the past 40 years (CDC, 2011). The Pima Indians in Arizona currently have the highest recorded prevalence of diabetes in the world (CDC, 2011). On average, American Indian and Alaska Native adults are 2.6 times more likely to have diabetes compared to nonHispanic whites of similar ages (CDC, 2011).

The lack of knowledge among SEA Natives regarding the effect of birth weight on health outcomes has led to high risk social significance in the community. If a link can be established, then the use of a prognostic risk profile during pregnancy may be useful in surveillance of fetal weight gain during pregnancy. There are implications for the importance of assessment of nutritional status during pregnancy together with birth weight and gestational age (Hediger et al., 1998). Pregnant mothers who appear to be gaining weight over the recommended weight gain may benefit from nutritional and physical activity management. Early intervention, prevention, and control predicted on a risk profile could reduce the risk of obesity during pregnancy and Type 2 diabetes later in life (Hediger et al., 1998). The literature review had found studies addressing the prevalence of Type 2 diabetes among American Indians and Alaska Natives together as a whole. The review did not find studies that only included SEA Natives. Establishing fetal weight guidelines throughout each trimester may reduce the incidence of Type 2 diabetes among SEA natives.

Maternal weight gain also called gestational weight-gain refers to the amount of weight gained from conception to delivery. The number of calories consumed by the mother and weight gained during pregnancy contributes directly to the number of calories reaching the fetus and fetal weight gain. The Institute of Medicine [IOM] (2009) published recommended weight gain amounts based on pre pregnancy body mass index (BMI) for optimal infant health. Maternal weight gain is based on pre pregnancy weight status and is considered as a major determinant of birth weight as well as infant mortality and morbidity (CDC, 2011). The recommended gestational weight gains for women who are underweight is 28 to 40 pounds, normal weight women 25 to 35 pounds, and overweight women 15 to 25 pounds remains unchanged from 1990 IOM guidelines. However, there is now a specific, and relatively narrow range of weight gain recommended for women who are obese 11-20 pounds (IOM, 2009). A causal role exists in altered maternal fetal glucose metabolism in the genesis of obesity in the offspring

(Gillman, Rifas-Shirman, Berkey, Field & Colditz, 2003). The pattern of weight accumulation is a significant factor in the overall evaluation of weight gain during pregnancy. The maternal component begins in the first trimester and is greatest during the first half of the pregnancy. Fetal growth is most rapid in the second half of pregnancy, with the fetus more than tripling in weight in the last trimester (American Congress of Obstetricians and Gynecologists [ACOG], 1993).

Purpose of the Study

The purpose of this study was to examine the role of gestational age on birth weight and incidence of adult Type 2 diabetes among adult Natives born in SEA. This study provided insight into the association between birth weight and gestational age and subsequent development of Type 2 diabetes. Examination of gestational age by clinical categories established the potential usefulness of a prognostic risk profile during pregnancy that may be useful in surveillance of fetal weight gain during pregnancy.

Infants who are over nourished or under nourished at birth may have a predisposition to diabetes.

Nature of the Study

This study was a quantitative retrospective research design with secondary data analysis. The dependent variable was the presence or absence of Type 2 diabetes in patients receiving care at SEARHC Mt. Edgecumbe Hospital in Sitka, Alaska. The independent variables were birth weight and gestational age categories of each SEA native and were extracted from birth records stored in birth journals. The birth weight was classified into birth weight categories from the Association of Women's Health, Obstetrics and Neonatal Nurses (AWHONN) birth weight category standards. Table 1 shows the 2010 AWHONN birth weight standard categories.

Table 1

AWHONN 2010 Birth Weight Standard Categories

SGA	**AGA**	**LGA**
Small for **G**estational **A**ge	**A**verage for **G**estational **A**ge	**L**arge for **G**estational **A**ge
Low birth weight	Normal birth weight	High birth weight
Less than 2500 grams	2500 – 3999 grams	4000 grams or more
2500 grams is equivalent to Less than 5lbs, 8oz	Range equivalent to 5lb, 8oz--8lb, 12oz	4000 grams equivalent to 8lb, 12oz or over

Source: 2010 Association of Women's Health, Obstetrics and Neonatal Nurses (AWHONN) Categorical Birth Weight Standards

Statistical Analysis

The birth weight of all infants born between 1970 and 1980 was categorized and assigned a number. The number 1 was assigned for small for gestational age (SGA), the number 2 for average for gestational age (AGA), and the number 3 for large for gestational age (LGA). The chi square test was used to verify whether the sample of data were from the population with a particular distribution.

Research Questions and Hypotheses

The following research questions and hypotheses were formulated and tested for this study:

1. Was there a relationship between gestational birth weight and incidence of Type 2 diabetes among adult SEA Natives?

$H_0$1: There were no differences in gestational birth weight between SEA Natives of SEARHC with Type 2 diabetes and those without Type 2 diabetes.

H_a1: There were differences in gestational birth weight between SEA Natives of SEARHC with Type 2 diabetes and those without Type 2 diabetes.

2. Was there an association between gestational age birth weight category and instances of Type 2 diabetes among SEA Natives?

$H_0$2: There were no differences in group placement for gestational age birth weight categories depending on Type 2 diabetes status among SEA Natives of SEARHC.

H_a2: There were differences in group placement for gestational age birth weight categories based on Type 2 diabetes status among SEA Natives of SEARHC.

Theoretical Framework

This study was based on the social ecological model (SEM). SEM was developed out of the work of Bronfenbrenner (1979). According to Bronfenbrenner, the SEM seeks to explain individual knowledge, development and competencies, and the social change over time, which is the cumulative effect of individual choices.

In using the SEM theory, the independent variables, birth weight, and gestational age would influence the dependent variable, Type 2 diabetes, because there was a relationship between the individual and the environment. Pregnant mothers would be responsible for instituting and maintaining the lifestyle changes to reduce the risk of Type

2 diabetes to their unborn child. The environment would also determine the pregnant mother's behavior. The SEM recommends that a combination of individual, interpersonal, organizational, community, and policy efforts will lead to healthy behavior between people and community. Figure 2 demonstrates interaction of gender and cultural competence with clinical treatment, support and community services.

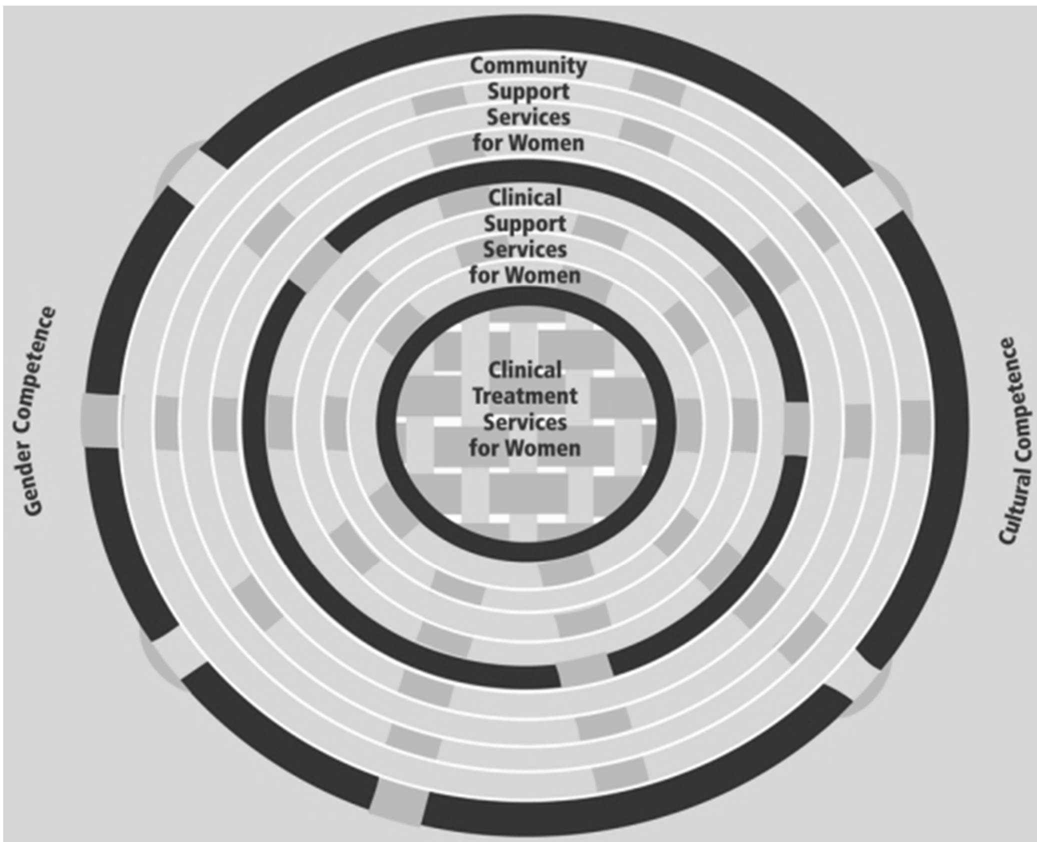

Figure 2. National Center for Biotechnology Information, 2009[NCBI]). Retrieved from http://www.ncbi.nih.gov/books/NBK832591

The social ecological perspective on health promotion is based not only on a singular discipline or theory but rather on a broad, overarching paradigm that bridges several different fields of research. Bronfenbrenner's (1979) SEM theory was founded on the interaction between the people and the environment and their influence on one another and the environment. SEM is a comprehensive public health approach that addresses the individual risk factors and norms, beliefs, socio economic systems that create the conditions for a sedentary lifestyle (Bronfenbrenner, 1979).

Definition of Terms

AGA: average for gestational age birth weight (AWHONN, 2010).

AWHONN: Association of Women's Health, Obstetrics & Neonatal Nurses (AWHONN, 2012).

Birth Weight: Independent Variable. In humans, the first weight of an infant obtained within less than the first 60 minutes after birth (AWHONN, 2010).

Diabetes Mellitus: A illness that effects the body's production of insulin that is used to convert food into energy (CDC, 2009).

Diabetes Type 2: Dependent Variable. A disorder of glucose metabolism in which the body does not produce sufficient insulin and/or does not utilize insulin properly. Genetics and environment have been cited as risk determinants (ADA, 2009).

LGA: large for gestational age birth weight (AWHONN, 2010)

Native American: American Indian and Alaska Natives. A person having origins in any of the original peoples of North and South America (including Central America) and who maintain tribal affiliation or community attachment (U.S. Census Bureau, 2012).

Southeast Alaskan Native: Indigenous Tlingit, Haida, and Tsimshian people of the SEA region (SEARHC, 2010).

SEARHC: Southeast Alaska Regional Health Consortium is a nonprofit tribal health consortium. SEARHC services the health interests of the Tlingit, Haida, Tsimshian, and other Native people living in a remote region of Alaska. Many of the communities served by SEARHC can be reached only by plane or boat, and most of them have populations fewer than 1,000 people. There are 18 Native communities that belong to SEARHC; Yakatat, Klukwan, Skagway, Haines, Juneau, Douglas, Hoonah, Pelican, Tenakee Springs, Angoon, Sitka, Kake, Petersburg, Wrangell, Klawock, Craig, Kasaan and Hydaburg (SEARHC, 2010).

SGA: small for gestational age birth weight (AWHONN, 2010).

Assumptions

The following were the basic assumptions for this study:

1. This study assumed that birth weights used for the research were recorded in the birth journals from 1970-1980.
2. This study assumed that patient charts would have ICD codes 250.0 recorded for Type 2 diabetes.
3. This study assumed that patient charts and labor journals would be available for use in this study.
4. This study assumed that all births recorded in birth journals were those from SEA Natives of the SEARHC.

Limitations of the Study

The following were the limitations of this study. Because the majority of the population was comprised of SEA Natives, the data were limited to a small sample of Alaska Natives and may not be generalized to other Native groups. The SEA population with Type 2 diabetes might not be representative of the entire Alaskan Natives who experience the disease. The extent to which the International Classification Data (ICD) codes identifying Type 2 diabetics was omitted on paper or electronic paper charts is unknown.

Significance of the Study

American Indians and Alaska Natives experience many health problems associated with diabetes and are susceptible to developing diabetes more than any other ethnic group (CDC, 2009). This study provides information about the relationship between birth weight and Type 2 diabetes among Southeast Alaska Natives.

This hypothesis suggests that conditions very early in development, even in-utero, can leave lasting effects on a person's physiology, imprints that may affect susceptibility to diseases with onsets that may occur many decades later (Gluckman, Hanson, Spencer, and Bateson 2004). In fetal life, the tissues and organs of the body go through what is termed critical periods of development (Barker, 2004). During such critical period organs and systems are sensitive to the environment. For most organs and systems, the critical periods of development are in utero (Barker, 2004).

Historically, between the 1960s and 1980s it gradually became common to recommend a gestational weight gain average of 11 kilograms (24lbs) or more, rather than the 8 to 9 kilograms (18-20lbs) or less recommended previously (Barker, 2004). This change was accompanied by a 50% increase in gestational weight gain (National Research Council [NRC], 1990). Between 1971 and 1980 the mean birth weight increased by approximately 60 grams for whites and 30 grams for blacks (National Academy of Science [NAS], 1990). The recommendations for gestational weight gain during pregnancy are based on pre pregnancy Body Mass Index [BMI]. The BMI is based on the standards of the World Health Organization [WHO].

Summary and Transition

Type 2 diabetes is a chronic disease that has an enormous impact on Native Americans and Alaska Natives. While information on the effects of Type 2 diabetes is available, information that is pertinent to understanding birth weight and the effect it has on a predisposition to Type 2 diabetes among SEA Natives is unknown.

In Chapter 2, the literature review covers topics of Type 2 diabetes, the significance of access to prenatal care, diet, and physical activity, and how behavior and lifestyle change can influence individual's beliefs in diet and caloric intake. Chapter 2 also addresses the pathology of Type 2 diabetes and how social determinants might affect the Native population. Included in the reviews are literature related to research content and method and how intrauterine exposure, maternal diabetes, and the percentage of Native American ancestry might increase the prevalence of Type 2 diabetes among this population and other information that is relevant to this study. The evidence and impact of the disease are reviewed. The data that are pertinent in Chapter 2 includes the birth weight of known Type 2 diabetics and explores the possibility of LGA birth weight as a predisposing factor. In Chapter 3, a detailed research methodology is described including the sample population, research design and data collection procedures.

Chapter 2: Literature Review

Introduction

The purpose of this study was to examine the role of gestational age on birth weight and the incidence of adult Type 2 diabetes among Natives born in SEA. The socio ecological method was the theoretical framework utilized for this study. This study also included the SEA lifestyle and the use of data to support improved monitoring of fetal weight gain during pregnancy. Infants who are overnourished at birth may have a predisposition to diabetes. This chapter includes factors that contribute to the prevalence of health disparities in Type 2 diabetes among SEA natives.

Literature Search Strategy

The libraries of Sno/Isle County and Walden University were used to access information for this study. A thorough search was carried out of the databases Medline, Medscape, and the National Library of Medicine. Key words used included *American Indian,* and *Alaska Native health*, *Type 2 diabetes*, *obesity*, *access to health care*, *treatment, and compliance protocol*, and *racial disparities in health* provided a multitude of articles from peer reviewed public health journals. This chapter involved literature reviews that included Type 2 diabetes mellitus, prevalence and progression of Type 2 diabetes, pathophysiology of Type 2 diabetes, social determinants, reviews related to content, reviews relating to the method, and a summary of the literature reviewed.

The role of birth weight, particularly LGA infants, and the implications of a possible predisposition to Type 2 diabetes was addressed. Research involving different theories of etiology, current treatments for diabetes, and new and emerging information regarding the influence of birth weight on the development of Type 2 diabetes will be discussed. Additionally, gestational categories of small, average, and large for gestational ages will be examined to determine if they have an effect on a link to the disorder. The literature reviewed was based upon the theory of intrauterine growth and birth weight as predisposing factors leading to chronic disease. The issues of diabetes as a chronic disease, maternal caloric interaction in the womb, the financial burden to society, and research involving different theories of etiology and emerging information regarding the influence of birth weight on the development of Type 2 diabetes were examined.

Literature was also reviewed for other potential causative factors of Type 2 diabetes. The interaction between maternal calorie intake and fetal weight are components that may influence fetal health (Abu-Saad &Fraser, 2010). The weight gain of the fetus may influence responses within the body predisposing the infant to Type 2 diabetes (Abu-Saad & Fraser,2010). In utilizing a gestational age categorization strategy, it might be possible to evaluate a causal relationship between fetal weight and Type 2 diabetes.

The current chapter examined theoretical and empirical research from the last 2 decades regarding the influence of birth weight, particularly for LGA infants, on the development of Type 2 diabetes. The first section of this chapter discussed the broad and specific constructs of diabetes, prevalence rates, statistical information, and an overview of diabetes as a chronic disease and public health problem. The impact of fetal weight on diabetes and the link to other health disorders were equally explored.

Type 2 Diabetes Mellitus

The term diabetes mellitus describes a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion and insulin action or both (American Diabetes Association [ADA], 2009). Diabetes can be classified into two major classes: Type 1 diabetes and Type 2 diabetes (ADA, 2009). Type 2 diabetes mellitus is mainly characterized by insulin resistance, but impairment in insulin secretion also occurs in Type 2 diabetes (ADA, 2009).

Although Type 2 diabetes usually occurs after age 45, it is being diagnosed in certain ethnic populations at an earlier age (Pippitt & Li, 2016). In Type 2 diabetes, either the body does not produce enough insulin or the cells ignore the insulin (Pippitt & Li, 2016). When glucose builds up in the blood instead of going into the cells, it can cause two problems: (a) cells become starved for energy; and (b) over time, high glucose levels may damage the eyes, kidneys, nerves, or heart (ADA, 2009).

Significance of Access to Prenatal Care

Inadequate prenatal care, including late initiation of care, infrequent prenatal visits, and total lack of care has been associated with poor infant and maternal outcomes (State of Alaska, 2007). The State of Alaska revealed many SEA women do not have immediate access to prenatal care; these women live in villages on remote islands and travel by air or Alaskan ferry system to obtain prenatal care (State of Alaska, 2007). Prenatal care in the State of Alaska includes: screening for gestational diabetes, providing prenatal counseling, and promoting appropriate health behaviors (The State of Alaska, 2005). The State of Alaska (2005) discovered prenatal care in the first trimester among Alaskan women was 80.1% compared to the national average of 84.1%. The proportion of women receiving adequate prenatal care in Alaska was lower than 58.3% compared to the national average of 74.6% (State of Alaska, 2005). The State of Alaska concluded nearly one in three Alaskan women who delivered an infant received less than adequate prenatal care and nearly one in seven received inadequate or no care at all.

The State of Alaska (2007) acknowledged the significance of prenatal care and helping pregnant women stay healthy and deliver healthy babies. Prenatal care provides early detection of potential health problems, advises women about the consequences, and emphasizes the importance of proper nutrition and other measures (State of Alaska, 2007). Prenatal care can also help expectant mothers manage preexisting and pregnancy related conditions like diabetes (State of Alaska, 2007). Such prenatal care is important for all pregnant women, but especially for three groups known to be high risk for problems; these three groups are the young, the unmarried, and those with little education (State of Alaska, 2007).

Weiss, Hofman, Winter, Purstner, and Lichtenegger (1984) specified a lack of prenatal care can increase poor birth outcomes and the risk of chronic diseases such as diabetes, which negatively affects status and quality of life of American Indians and Alaska Natives. Weiss et al. examined the prevalence rates of diabetes, in comparison to the general population, ranges from 1% among adult Alaskan Athabaskan’s to approximately 50% among adult Pima Indians of Arizona. Weiss et al. compared the Paleo Native Americans and their hunter gatherer ancestry to the Athapaskan people.

Weiss et al. concluded that the greater length of time the Athapaskan's had to adapt to their environment may possibly contribute to their ability to adapt to new environments. Among Native Americans and Alaska Natives, only the Eskimo and certain Athapaskan's, such as the Navajo and Apache in the Southwest United States, Alaska, and Canada; have diabetes rates that compare to nonHispanic whites. While Type 2 diabetes is still relatively rare, rates are several fold higher than those reported by European countries (Bell et al., 2009).

Diet and Physical Activity

Sandefur, Rindfuss, and Cohen (1996) examined the changes in Native American diets associated with the increase in diabetes. The high calorie and high fat foods consumed replaced the traditional agricultural driven diet (Sandefur et al., 1996). McGarvey, Bindon, Crews, and Schendel (1989) examined Native American diets during modernization and found traditional Native American diets and physical activity based on local subsistence practices changed to a diet of purchased foods and reduced physical activity. The change to a more modern or western diet and sedentary activities has resulted in a positive energy balance with increased body weight and adiposity (McGarvey et al., 1989). Bindon and Baker (1997) found physical inactivity and lack of exercise appears to be a contributory factor to the onset of diabetes; as modernization has progressed in the United States, daily lives require little physical activity and less muscle movement. The insulin receptors on the peripheral muscle cells of diabetic patients become more sensitive to binding and circulating insulin with increasing activity (Bindon & Baker, 1997).

Social Ecological Model/Weight Gain/Behavior Change

The framework for this study is based on the social ecological model (SEM). The potential of behavior change within a population group is considered within the social context which includes family, friends, work, neighborhood associates, and community organizations (Bronfenbrenner, 1979).

Roubideaux (2008) studied the relationship between the level of American Indian and Alaska Native diabetes education program services and quality of care indicators to determine if more comprehensive diabetes services are associated with better quality of diabetes care. Roubideaux used the IHS Integrated Diabetes Education Recognition Program to rank program services into one of three levels of comprehensiveness, ranging from lowest (developmental) to highest (integrated). The quality of care indicators was compared among programs of differing levels of the 2001 IHS Diabetes Care and Outcomes Audit. Quality indicators included patients having recommended yearly examinations, education, and laboratory tests and achieving recommended levels of intermediate outcomes of care (Roubideaux, 2008). Roubideaux concluded that out of the 86 participating programs, most were classified at or below the developmental level; only nine programs (11%) were ranked at higher levels. After adjusting for patient characteristics, program factors, and correlation of patients within programs, the programs that were more comprehensive had higher completion rates of yearly lipid and hemoglobin A1c tests ($p < .05$). Roubideaux found system wide improvements in diabetes education were associated with better diabetes care. The results of Roubideaux ‘s study can help inform the development of other diabetes education programs. The

National Institute of Diabetes and Digestive and Kidney Diseases [NIDDKD] supports a wide range of research related to the Diabetes Prevention Program [DPP], such as studies that assess cost effective methods of delivering lifestyle modifications in group settings and over the Internet, as well as methods to sustain behavior change and weight loss. Other researchers are testing interventions similar to those used in the DPP to help prevent the development of or treat existing Type 2 diabetes in children and youth (NIDDKD, 2011).

Looker, Dallman, Carroll, Gunter, and Johnson (2010) investigated the guidelines for diabetes treatment, and found diabetes treatment guidelines have become increasingly stringent and researchers have shown that more aggressive intervention reduces risks for complications. Looker et al. conducted an analysis of a longitudinal population based study of American Indians from 10 independent three-year time intervals between 1975 and 2004. Trends in drug use were assessed by logistic regression models and trends in glycaemia, blood pressure and cholesterol were evaluated by linear models (Looker et al., 2010). Looker et al. found among study participants that use of any medicine for treatment of diabetes increased from 53% in 1975-78 to 67% in 2002-04, ($p < 0.0001$). Looker et al. also found the use of insulin as a single agent declined and use of combinations of insulin and oral agents increased. In 1990-92, 23% of subjects had an HbA1c < 7% and by 2002-04 the proportion had increased to 33%, ($p < 0.0001$). Looker et al. discovered the use of antihypertensive medicine increased from 21% in 1975-77 to 58% in 2002-04, ($p < 0.0001$), coincident with a decline in mean systolic blood pressure from 137 mmHg in 1975-77 to 123 mmHg in 2002-04, ($p < 0.0001$). Lipid lowering medicine use also increased with an accompanying increase in HDL and a decrease in non-HDL cholesterol concentration (Looker et al., 2010). Looker et al. concluded the changes in community treatment patterns for diabetes and related conditions coincided with improvements in glycemia, blood pressure, and cholesterol. The goal was to reduce risks and complications of diabetes.

Pathophysiology of Type 2 Diabetes

The pathophysiology of Type 2 diabetes is characterized by peripheral insulin resistance, impaired regulation of hepatic glucose production, and declining *b*-cell failures (Mahler & Adler, 1999). The initial events of diabetes mellitus are an early deficit in insulin secretion and, in many patients, relative insulin deficiency in association with peripheral insulin resistance, impaired regulation of hepatic glucose production, and declining *b*-cell failures (Mahler & Adler, 1999). The pathophysiology of Type 2 diabetes indicates that hyperglycemia is produced by a lack of endogenous insulin, which is either absolute, as in Type 1 diabetes mellitus, or relative, as in Type 2 diabetes; when relative insulin deficiency usually occurs, it is because of resistance to the actions of insulin in muscle, fat, liver and an inadequate response by the pancreatic beta cell (Mahler & Adler, 1999). Mahler and Adler (1999) specified pathophysiologic abnormality results in decreased glucose transport in the muscle, elevated hepatic glucose production, and increased the breakdown of fat. Considerable debate exists regarding the primary defect in Type 2 diabetes because many people with insulin resistance, particularly patients who are obese, do not develop glucose intolerance (Beebe, 2008). Insulin deficiency is necessary for the development of hyperglycemia, and patients may have high insulin levels but the insulin concentrations are inappropriately low for the level of glycemia as maintained by (Ligaray & Isley, 2008).

Presumably, the defects of diabetes Type 2 occur when a diabetogenic lifestyle (i.e., excessive calories, inadequate caloric expenditure) and obesity are superimposed upon a susceptible genotype; overweight patients from Asia may not be overweight by western standards, but excess weight is often much more prevalent in these ethnic groups (Prentski & Nolan, 2006). Bramlage et al. (2004) found that most obese patients are aware that they are overweight, and most of them recognize that their weight is a health risk. Bramlage et al. stated obesity in the primary care setting is poorly understood, although fundamental for the initiation and reinforcement of appropriate health interventions. Bramlage et al. found while it can be argued that lifestyle interventions include weight reduction they should be applied to everyone with Type 2 diabetes. Zimmet, Alberti, and Shaw (2001) indicated for the tide of diabesity to be turned; there is an urgent need to reexamine the attitudes and the assessment of obesity in primary care. Thomas, Zimmet, and Shaw (2008) argued if patients are to lose weight, clinicians have to be prepared to identify obesity and openly discuss the complex issues surrounding it.

The socio ecological model will be the conceptual basis for further understanding the potential link between birth weight, gestational age, and Type 2 diabetes. The socio ecological framework theorizes that the domains of interpersonal, organization, community and public policy influence on individual health behaviors (CDC, 2009).

Native Population

The CDC (2006) compared prevalence estimates in chronic disease risk factors and health status between American Indian and Alaska Natives and white elders. The CDC found and it may be useful to develop health prevention interventions to prevent and control diseases. A review of the current and previous literature of diabetes research has typically conceptualized American Indians and Alaska Natives as belonging to one population group (CDC, 2006). There is a dearth of information about the SEA Native population and their relationship to Type 2 diabetes. Available information usually discusses the Native population's health disparities as a whole, which includes shorter life expectancy and higher rates of diabetes, cancer, heart disease, stroke, substance abuse, infant mortality, and low birth weight (CDC, 2007).

The IHS is a government agency was established in 1955 by the United States Public Health Service (IHS, 2005). This agency provides comprehensive health care to Native Americans and Alaska Natives; of the estimated 2.32 million Native Americans and Alaska Natives who resided in the United States in 1997, 1.43 million (60%) resided on or near reservations (IHS, 2005). Of this group, 1.29 million (90%) used IHS facilities for their health care (IHS, 2005). The National Institutes of Health ([NIH], 2004) of the complex interaction among several factors such as biology, the environment, and specified health disparities are a result specific behaviors significantly affected by a shortage of racial and ethnic minority health professionals, discrimination, and inequities in income, education, and access to health care (NIH, 2004).

Social Determinants

There has been a great deal of literature published on the socioeconomic, racial, and ethnic disparities in the availability to healthcare in the United States (Dalen, 2000; Fiscella, Franks, Gold, & Clancy, 2000). The variables of race, ethnicity and socioeconomic status do not themselves provide a reason for the shortcomings of the health care delivery system, although it is known that nonHispanic whites are more likely to have access to and to use certain medical services than those who are not nonHispanic whites (Dalen, 2000). Some people in the United States have access to optimal health care while others have none or receive minimal care (Dalen, 2000; Fiscella et al., 2000). There are, however, behavioral traits of certain segments of society that are intertwined with race, gender, education, and income that contribute to disproportionate burdens of care and disease prevalence (Airhihenbuwa, Kumanyika, TenHave & Morssink, 2000).

Diabetes Mellitus is a chronic disease that impacts Native Americans and Alaska Natives more than any other racial or ethnic group (Wilson et al., 2005). The continuous long term healthcare required to maintain a person with diabetes is costly, and the disease process creates many health complications, direct and indirect medical expenses for people with and without diabetes were estimated for 2002 (Hogan, Dall & Nikolov, 2003). The direct expenditures totaled $91.9 billion, including $23.2 billion for direct diabetes medical care, $24.6 billion for diabetes related complications, and $44.1 billion for care associated with health conditions more prevalent in people with diabetes (Hogan et al., 2003). Indirect expenditures totaled $39.8 billion which includes expenses associated with diabetes, such as related lost workday spending, restricted activity days, mortality, and permanent disability (Hogan et al., 2003). The direct and indirect expenditures for diabetes totaled $132 billion (Hogan et al., 2003). The per capita medical expenditures were $13,243 for people with diabetes versus $2,560 for people without diabetes (Hogan et al., 2003). After adjusting age, sex, and race/ethnicity, medical expenses were 2.4 times higher for people with diabetes than those without diabetes (Hogan et al., 2003).

Hogan et al. (2003) indicated diabetes imposes a substantial cost burden to society and, in particular, to those individuals with diabetes and their families. Eliminating or reducing the health problems caused by diabetes through factors such as better access to preventive care, more widespread diagnosis, more intensive disease management, and the advent of new medical technologies, could significantly improve the quality of life for people with diabetes and their families while at the same time potentially reducing national expenditures for health care services and increasing productivity in the U.S. economy (Hogan et al., 2003).

Moscovice & Wakefield (2007) identified uninsured Native American elders are more than twice as likely to indicate they have no regular personal doctor or health provider as insured Native elders (43% versus 20.4%). According to Moscovice and Wakefield (2007), access to a regular source of care is also more problematic for rural Native elders (27%) compared with urban Native elders (19%). Native elders face low levels of adequate insurance coverage, and as a consequence, less access to needed health care, relative to the levels of coverage and access for the general population (Moscovice & Wakefield (2007). Moscovice & Wakefield (2007) suggested disparities in health care and the lack of health insurance serves as a barrier to accessing health care services, but it is not the only barrier. In addition to cost, other reasons for not getting health care when it it needed included long waiting times and transportation problems (Moscovice & Wakefield, 2007). Transportation is a particularly challenging barrier to overcome because, even if they have health insurance, transportation costs are often not covered by health insurance, and reliable, affordable transportation may not be available (Moscovice & Wakefield, 2007).

Infant mortality rates were 48% higher for American Indian and Alaska Native women (8.28); compared with nonHispanic white women (5.58) (CDC, 2010). Racial difference in infant mortality rates might reflect, in part, differences in maternal socio demographic and behavior risk factors (i.e., infant mortality rates are higher than the United States average among infants born to mothers who are adolescents, unmarried, smokers, or have lower educational levels). Substantial racial disparities in income and access to health care also might contribute to differences in infant mortality, had a fourth or higher order birth, or did not obtain adequate prenatal care (CDC, 2010). Alaska health care providers have battled high infant mortality rates for decades, especially in the bush; medical services are lacking quality care and most villagers visit health aides for healthcare (DeMarban, 2006). The villagers must fly to hospitals in larger cities to see physicians and other health specialists (DeMarban, 2006).   The goals of Healthy People (2010) stated that Alaska has not made adequate progress toward achieving the Health People 2010 goals for early or adequate prenatal care; both of these measures remain well below the 90% 2010 targets. Prenatal care in the first trimester among Alaskan women was slightly lower compared to the nation as a whole, in comparison to women in the United States as a whole, adequate prenatal care among Alaskan women was significantly lower (State of Alaska, 2005).

Castor et al. (2006) examined national data from the U.S. Census 2000 as well as death certificates from 1990 to1999, and birth certificates from 1991 to 2000. Castor et al. linked infant death 1995 to 2000 data from the National Center for Health Statistics in a nationwide, population based study identifying health disparities between American Indians and Alaska Natives and the general populations living in select urban counties. The purpose of the study was to examine the health status of American Indian and Alaska Native populations living in urban areas (Castor et al., 2006).

Castor et al. revealed disparities in socioeconomic, maternal and child health, and mortality indicators between American Indians and Alaska Natives and the general populations in urban Indian health organization service areas and nationwide. American Indians and Alaska Natives are approximately twice as likely as the general populations to be poor, to be unemployed, and to not have a college degree (NCBI, n.d.). Similar differences were observed in births among mothers who received late or no prenatal care or consumed alcohol and in mortality attributed to sudden infant death syndrome, chronic liver disease, and alcohol consumption (Castor et al., 2006).

Castor et al. concluded that health disparities can be addressed through improvements in health care access, high quality data collection, and policy initiatives designed to provide sufficient resources and a more unified vision of the health of urban American Indians and Alaska Natives.

James et al. (2009) identified that an individual's health and patterns of health care use are influenced by numerous factors beyond whether or not they have health coverage. While much of the policy focus has been on personal behaviors (e.g., smoking, diet, nutrition, help seeking), there is growing evidence that social factors (e.g. early life experiences, psychosocial work environment, neighborhoods, and housing) can have a direct or indirect influence on health outcomes. One of the largest social determinants of health and health care use is socio economic status, or social class. Social class is often measured by income, education, and occupation. Women are more likely to live in poverty than men, and women of color are more likely than non Hispanic white women to live below the poverty line (James et al., 2009). These differences in poverty levels are related in part to the fact that women continue to shoulder the major responsibility for raising children. Socioeconomic disadvantage, whether defined by income, education, or occupation, is associated with high risk health behaviors, poor access to health care and poorer health outcomes (James et al., 2009).

Intrauterine Exposure and Maternal Diabetes

For the management of diabetes, it is important to detect diabetes early and have a diagnostic risk profile at birth, to reduce the risk of obesity and chronic disease later in life (Hediger et al., 1998). There is a growing interest in the extent to which body composition, both short and long term, differs in infants and children born at the extremes of birth weight (Hediger et al., 1998).

Intrauterine Exposure

Hediger et al. (1998) conducted a study using measurements of infants and children taken from the nationally representative sample of the National Health and Nutrition Examination Survey [NHANES III]. The research was from 1988 to 1994. The NHANES III was a cross sectional, statistical probability sample of the civilian population that is noninstitutionalized in the United States. The target sample consisted of 5,566 infants and children who were examined and measured anthropometrically. Infants and children were categorized by birth weight and gestational age status. Hediger et al. revealed that there were persistent associations of birth weight for gestational age status with anthropometric indices of body composition in infancy and early childhood. The overall prevalence of Small for Gestational Age (SGA) in this sample was 8.6%, 80.9% of infants were born AGA and 10.5% were born LGA.

The findings have implications for the importance of the assessment of nutritional status in infancy and young childhood. Hediger et al. suggested that, together with current anthropometric data, birth weight status and gestational age may be useful in assembling a prognostic risk profile. For example, SGA infants who appear to be gaining adequate weight may instead have increasing fat but poor growth in lean body mass. To the extent that diet and physical activity can modify body composition, it may be possible to identify at an early age infants and children who might benefit from nutritional and physical activity management by their providers. Although additional research is warranted in this area, early intervention and prevention predicted on a risk profile beginning at birth could reduce the likelihood of obesity and chronic disease in later life (Hediger et al., 1998).

Type 2 diabetes is a major global public health problem, increasing in all regions of the world (Hales, Barker, & Clark, 1991). Whincup et al. (2008) conducted a systematic review of relevant studies published before June 2008 and were identified through literature searches using EMBASE from 1980, MEDLINE from 1950, and Web of Science from 1980, with a combination of text words and medical subject headings. Studies with either quantitative or qualitative estimates of the association between birth weight and Type 2 diabetes were included. Estimates of association (odds ratio [OR]) per kilogram of increase in birth weight were obtained from authors or from published reports in models that allowed the effects of adjustment (for body mass index and socioeconomic status), and the impact of exclusion (for macrosomia and maternal diabetes) were examined (Whincup et al., 2008). Estimates were pooled using random effects models, allowing for the possibility that direct associations differed between populations (Whincup et al., 2008). Whincup et al. synthesized data from 327 reports identified, 31 were found to be relevant, and data was obtained from 30 of these reports (31 populations, 6,090 diabetes cases; 152,084 individuals). Whincup et al. specified inverse birth weight and Type 2 diabetes associations were observed in 23 populations (9 populations were statistically significant). Appreciable heterogeneity between populations (p=66%; 95% confidence interval [CI], 51%-77%) was largely explained of the 31 populations studied. A positive association was found in 2 native North American populations with high prevalence of maternal diabetes and in one other population of young adults (Whincup et al., 2008). In the remaining 28 populations, the pooled OR of Type 2 diabetes, adjusted for age and sex, was 0.75 (95%CI, - 0.70-0.81) per kilogram (Whincup et al., 2008). The shape of the birth weight Type 2 diabetes associations was strongly graded, particularly at birth weights of 3kg or less (Whincup et al., 2008). Adjustment for current BMI slightly strengthened the association (OR, 0.76 [95% Cl, 0.70-0.82] before adjustment and 0.70 (95% Cl, 0.65-0.76] after adjustment) (Whincup et al., 2008). Adjustment for socioeconomic status did not materially affect the association (OR, 0.77 [95% Cl, 0.70-0.84] before adjustment and 0.78 [95% Cl, 0.72-0.84] after adjustment) (Whincup et al., 2008). Whincup et al. specified there was no strong evidence of publication or small study bias, but concluded the systematic review showed that in most populations studied, birth weight was inversely related to Type 2 diabetes risk (Whincup et al., 2008).

Xiao et al. (2008) investigated chronic noncommunicable diseases and if they originate as a result of the joint effects of genetic and environmental risk factors. Xiao et al. specified traditional risk factors associated with adult lifestyles, such as smoking, diet, and exercise habits, have attracted a great deal of interest. In more recent years, attention has also been paid to distal risk factors in early life (Xiao et al., 2008). The intrauterine environment is now generally accepted as an important determinant of risk of disease in adulthood (Xiao et al., 2008). Many studies have demonstrated an inverse relationship between body size at birth, as a marker of fetal growth, and diabetes or impaired glucose tolerance in adult life; however, many of these studies included only a few hundred individuals from developed countries (The United States and Europe) (Xiao et al., 2008).

Xiao et al. studied the influence of birth weight, a marker of fetal growth, on the development of later impaired glucose metabolism throughout the life span of people living in China, the research design and methods included recording detailed anthropometric data including height, weight, health status and measured blood glucose levels. Xiao et al. specified insulin concentrations were measured after a fasting glucose and at 120 minutes of a standard oral glucose tolerance test from 2,019 eligible subjects born between 1921 and 1954. The study investigated to the risk of developing type 2 diabetes and impaired glucose regulation [IGR], (Xiao et al., 2008).

Xiao et al. (2008) concluded that diabetes and IGR groups were characterized by significantly lower birth weight by using a ponderal index. The ponderal index in newborns (birth weight/height^3 x 100) was used as an indicator of fetal growth status ($p < 0.001$), smaller head circumference ($p < 0.001$), smaller ponderal index ($p = 0.007$), and shorter length ($p = 0.004$) compared with those in the normal glucose tolerance group. Using multiple logistic regression analysis birth weight remained significantly associated with diabetes and IGR after adjustments for possible confounding variables at birth and in adult life such as sex, age, central obesity, smoking status, alcohol consumption, dyslipidemia, family history of diabetes, and occupational status ($p = 0.027$) (Xiao et al, 2008). There was a significant increase in the risk of getting diabetes and IGR for those with low birth weight (odds ratio 1.74[95%*Cl*, 1.018-3.001], $p = 0.043$) (Xiao et al., 2008). Xiao et al. found the results of this study confirmed that lower birth weight is an independent risk factor for later diabetes or IGR. The study showed for the first time that this risk factor also applies to a Chinese population (Xiao et al., 2008).

Maternal Diabetes

The (ADA, 2005) examined the 1980 National Natality Survey and provided data on weight gain during pregnancy, infant birth weight, and an assortment of maternal characteristics. Neonatal nutrition and weight during pregnancy analyzed the scientific evidence pertaining to weight gain during pregnancy formulated recommendations for gestational weight gain. The subcommittee's work on tracing trends in selected aspects of prenatal care included maternal nutritional status and the course and outcomes of pregnancy (i.e.; fetal growth, birth weight and postpartum weight retention). The study included total gain, the pattern of gain, and composition of the tissue. The practicality and usefulness of anthropometric measurements in the clinical setting were assessed. The emphasis on birth weight reflected importance in child mortality, morbidity, and physical and mental performance (ADA, 2005).

Childhood obesity has contributed to an increased incidence of diabetes Type 2 and metabolic syndrome [MS] among children. Intrauterine exposure to diabetes and size at birth are risk factors for Type 2 diabetes (Boney, Verma, Tucker, & Vohr, 2005). Boney et al. (2005) conducted a longitudinal cohort study of children at ages 6, 7, 9, and 11 who were LGA (n = 84) or AGA (n = 95) and offspring of mothers with or without gestation diabetes were investigated. The measurements included obesity, hypertension, dyslipidemia, and glucose intolerance. There were no differences in baseline characteristics (gender, race, socioeconomic status, and maternal weight gain during pregnancy) for the four groups except for birth weight. There was a trend toward a higher prevalence of maternal obesity before pregnancy in the LGA group. Boney et al.

concluded that LGA offspring of diabetic mothers was at significant risk of developing MS in childhood. This effect of LGA with maternal GDM on childhood MS was previously demonstrated for Pima Indian children but not the general population. Boney et al. also found that children exposed to maternal obesity were at increased risk of developing MS. Because of the increase in obesity prevalence, these findings have implications for perpetuating the cycle of obesity, insulin resistance, and their consequences in subsequent generations (Boney et al., 2005).

Dabelea et al. (1999) researched childhood obesity and its contribution to an increased incidence of Type 2 diabetes mellitus [DM] and metabolic syndrome [MS] among children. The method of the research used major components of MS (obesity, hypertension, dyslipidemia, and glucose intolerance. These components of MS were evaluated in a longitudinal cohort study of children at age 6, 7, 9, and 11 years who were LGA (n = 84) or AGA (n = 95) offspring of mothers with or without gestational diabetes [GDM]. Dabelea et al. specified that there were no differences in baseline characteristics (gender, race, socioeconomic status and maternal weight gain during pregnancy) for the four groups except for birth weight but there was a trend toward a higher prevalence of maternal obesity before pregnancy in the LGA/GDM group. In this group, 50% were at risk for MS and 15% met the definition of (> 3 risk factors) of MS (Dabelea et al., 1999).

Dabelea et al. (1999) concluded LGA offspring of diabetic mothers were at significant risk of developing MS in childhood, and the prevalence of MS in the other groups was similar to the prevalence (4.8%) among white adolescents. This effect of LGA with maternal GDM on childhood MS was previously demonstrated for Pima

Indian children but not the general population, and the study also found that children exposed to maternal obesity were at increased risk of developing MS (Dabelea et al., 1999). Children who are LGA at birth and exposed to an intrauterine environment of either diabetes or maternal obesity are at increased risk of developing MS, and the increase in obesity prevalence have implications for perpetuating the cycle of obesity, insulin resistance, and their consequences in subsequent generations (Dabelea et al., 1999).

Hypponen, Smith, & Power (2003) inquired into the fetal insulin hypothesis, shared genetic factors lead to suboptimal prenatal growth and insulin resistance in patient’s later life if this assumption is true, it is expected that noninsulin dependent diabetes in parents would be associated with lower birth weight among their offspring. Some evidence supports an inverse association between birth weight of offspring and paternal diabetes (Hypponen et al., 2003). The association between fetal LGA birth weight and a mother's diabetes during pregnancy has been established (Hypponen et al., 2003). Hypponen et al. (2003) used data from a large cohort study of British births in 1958 to evaluate whether a father's noninsulin dependent diabetes or a mother's diabetes starting after childbirth is associated with the birth weight of their offspring. Hypponen et al. included members of the cohort study born during the week of March 3 through 9 in 1958. Between 1999 and 2000, 96 cohort members reported having diabetes (controlled by diet or tablets), and participants were excluded with other types of diabetes (*n* = 100). The 11,276 participants contacted at age 41 years, 3,777 mothers and 4,364 fathers gave information on the birth characteristics for at least one singleton live born child

(Hypponen et al., 2003). A total of 34 men with diabetes had children, and 24 women had become diabetics after childbirth, and the study used random effect models on birth weight (adjusted for gestational age) to allow for dependence between a parent's subsequent births. The North Thames Multicenter Research Ethics Committee approved the 41-year survey (Hypponen et al., 2003).

Hypponen et al. (2003) concluded the offspring of the fathers with diabetes weighed on the average less by a difference of -186g (95% confidence interval -330g to 044g) than other children. Father’s adult height or social class did not explain the association between a father's diabetes and the birth weight of his offspring (Hypponen et al., 2003). The child's birth order mad no difference to the effect of a father's diabetes on the birth weight of his offspring ($p= 0.21$), and the mean difference in the birth weight of offspring between diabetic and non-diabetic women (133g-29g to 296g) was not significant ($p = 0.11$), but there was a positive interaction between mother's diabetes and child's birth order ($p < 0.001$) (Hypponen et al., 2003). The association between mother's diabetes and offspring birth weight seen in second born and subsequent births was not seen for first born babies (difference +15g-172g to 202g) but, the data showed a decrease in birth weight per year from birth to the onset of diabetes in the mother (change per year of -54g;-147g to 38g) (Hypponen et al., 2003).

Ragahpathy et al. (2010) conducted research into the newborn size and postnatal growth to glucose intolerance in south Indian adults was conducted. The research design included 2,218 men and women ($m = 28$ years) were studied from a population based birth cohort born in a large town and adjacent rural villages. The prevalence of adult

Diabete Mellitus and impaired glucose tolerance [IGT] and insulin resistance and insulin secretion (calculated) were examined in relation to BMI and height at birth, and in infancy, childhood and adolescence and changes in BMI between these stages (Raghapathy et al., 2010).

Raghapathy et al. (2010) concluded 62 (2.8%) of the subjects had Type 2 diabetes DM and 362 (16.3%) had impaired glucose tolerance. IGT and DM combined (IGT/DM), and insulin resistance were associated with lower childhood BMI ($p < 0.001$ for both) and above average BMI gain during childhood or adolescence and adult life ($p < 0.001$ for both) (Raghapathy et al., 2010). There were no direct associations between birth weight and infant size and IGT/DM, however adjusting for adult BMI, lower birth weight was associated with an increased risk (Raghapathy et al., 2010).

Clausen et al. (2008) conducted research into intrauterine hyperglycemia, and future risk of Type 2 diabetes in human offspring was conducted. The research studied glucose tolerance in adult offspring of women with either GDM or Type 1 diabetes, taking the impact of both intrauterine hyperglycemia and genetic predisposition of type 2 diabetes into account (Clausen et al., 2008). The research design and method included glucose tolerance status following a 2 hour 75g oral glucose tolerance test [OGTT] of 597 subjects, primarily Caucasians, aged 18-27 years were evaluated, and subdivided into four groups according to maternal glucose metabolism during pregnancy and genetic predisposition to Type 2 diabetes: 1) offspring of women with diet-treated GDM (O-GDM), 2) offspring of genetically predisposed women with a normal OGTT (O-No GDM), 3) offspring of women with Type 1 diabetes (O-type 1), and 4) offspring of women from the background population (O-BP) (Clausen et al, 2008). The results showed a prevalence of Type 2 diabetes and prediabetes (impaired glucose tolerance or impaired fasting glucose) in four groups was 21, 12, 11, and 4% (Clausen et al., 2008). In multiple logistic regression analysis, the adjusted odds ratios [ORs] for Type 2 diabetes and prediabetes were 7.76 (95%*Cl* 2.58-23.39) in O-GDM and 4.02 (1.31-12.33) in O-type 1 compared with O-BP. In O-type 1, the risk of Type 2 diabetes and prediabetes was significantly associated with elevated maternal blood glucose in late pregnancy: (*OR* 1.41 (1.04-1.91 per mmol/l) (Clausen et al., 2008). The findings revealed a hyperglycemic intrauterine environment appears to be involved in the pathogenesis of Type 2 diabetes and pre diabetes in adult offspring of primarily Caucasian women with either diet treated GDM or Type 1 diabetes during pregnancy (Clausen et al., 2008).

Lyssenko et al. (2008) studied the impact of early environmental factors and genetic variants in the pathogenesis of Type 2 diabetes. The aim of the research was to investigate whether there is an interaction between birth weight and common variants in the TCF7L2, HHEX, PPARG, KCNJ11, SLC30A8, IGF2BP2, CDKAL1, CDKN2A/2B and JAZF1 genes in the risk of developing Type 2 diabetes (Lyssenko et al., 2008). The research method included 2,003 participants from the Helsinki Birth Cohort Study, 311 of who were diagnosed with Type 2 diabetes by an OGTT and were genotyped for the specified variants, and indices for insulin sensitivity and secretion were calculated (Lyssenko et al., 2008). Lyssenko et al. found low birth weight was associated with Type 2 diabetes ($p = 0.09$) and the risk variant in the CDKN2A/2B locus were associated with high birth weight ($p = 0.01$) (Lyssenko et al., 2008). The TCF7L2 risk allele was associated with increased risk of Type 2 diabetes, and pooling across all nine genes found each risk allele increased the risk of Type 2 diabetes by 11% (Lyssenko et al., 2008). The risk variants in the HHEX, CDKN2A/2B and JAZF1 genes interacted with birth weight so that the risk of Type 2 diabetes was highest in those with lower birth weight ($p \leq 0.05$), and the interaction was also present in the pooled data (Lyssenko et al., 2008). Lyssenko et al. concluded the possible association of some common variants (HHEX, CDKN2A/2B, and JAZF1) with Type 2 diabetes and these findings should be replicated in independent cohorts (Lyssenko et al., 2008).

Leibson et al. (2005) studied birth weight as a risk factor for both diabetes and mortality. The inquiry was into birth weight as a predictive of diabetes and associated mortality; if abnormal birth weight is a risk factor, it could help identify high-risk diabetic individuals (Leibson et al., 2005). Leibson et al. specified because birth weight is modifiable, the risk of death associated with diabetes could be reduced in the future. The research design and method included 2,508 Rochester, Minnesota residents who first met research criteria for adult onset diabetes from 1960 to 1995 (Leibson et al., 2005). The 171 residents were born locally in a hospital after 1922 as singleton term infants, and each case subject and two age and sex matched non diabetic control subjects (born locally, residing locally when the case subject met the criteria for diabetes) were followed through December 2000 for vital status (Leibson et al., 2005).

Leibson et al. (2005) concluded diabetic case subjects 16% (27 of 171) died versus 7% (25 of 342) of control subjects ($p = 0.004$). The difference was smaller for normal birth weight (2,948g to < 3,856g) individuals 12% (12 of 102) versus 8% (20 of

246, $p = 0.31$) than for unaceptable birth weight individuals (Leibson et al., 2005). The low birth weight 20% (8 of 39) versus 2% (1 of 46), ($p = 0.01$), and the high birth weight individuals 23% (7 of 30) versus 8% (4 of 50), ($p = 0.16$) (Leibson et al., 2005). Leibson et al. concluded the excess mortality observed for diabetes appears disproportionately concentrated among unaceptable birth weight individuals. Thus, it is important to identify a subset of at risk diabetes individuals and reinforce the importance of normal birth weight deliveries (Leibson et al., 2005).

Native Americans and Diabetes

Wei et al. (2003) with the Chinese Foundation of Health [CFH] studied interactions between fetal growth in utero and early postnatal environmental exposures have been considered pivotal to the manifestation of diabetes in later life. Such early adaptations to the nutritional environment might lead to permanent change in the physiology of fuel metabolism and result in the expression of metabolic disturbances in adults; a process termed metabolic programming (Wei et al., 2003). Several epidemiological studies suggest for both men and women, those born with low birth weight were at an elevated risk for Type 2 diabetes and other health outcomes during adulthood (Wei et al., 2003). Wei et al. (2003) studied the effect of birth weight on risk of Type 2 diabetes in the school children in Taiwan from 1992 to 1997 and included all schoolchildren ages six to18 years that were screened for diabetes in a Taiwan Province.

Wei et al. (2003) cohort study consisted of 1,966 patients with diabetes and 1,780 randomly selected subjects with normal fasting glycemia. Wei at al. included a questionnaire interview design to classify diabetes, and the birth weight was obtained from the Taiwan's Birth Registry (Wei et al., 2003). After merging the data, there were 978 subjects, including 429 with Type 2 diabetes and 549 with normal fasting glycemia enrolled in the present analysis (Wei et al., 2003).

Wei et al.(2003) concluded the odds ratios (95%*CI*) for Type 2 diabetes and after adjusting for age, sex, BMI, family history of diabetes, and socioeconomic status, were 2.91 [1.25,6.76] for children with low birth weight (< 2,500*g*) and 1.78 [1.04,3.06] for those with high birth weight (> 4,000*g*) when compared with the referent group (birth weight 3,000-3,499*g*). Wei et al. found the risk of diabetes was still 64% higher in the high birth weight group [*OR* 1.64 (95%*Ci* 0.91-2.96)], even after adjustment for gestational diabetes mellitus. Wei et al. also found patients with Type 2 diabetes who were born with high birth weight were more likely to have a higher BMI and diastolic blood pressure as well as a greater family history of diabetes compared with those with low birth weight (Wei et al., 2003).

Wei et al. identified a U shaped relationship between birth weight and risk of Type 2 diabetes was found in the schoolchildren ages 6 to 18 years in Taiwan. Schoolchildren with Type 2 diabetes who were born with low birth weight had different metabolic phenotypes compared with those born with high birth weight (Wei et al., 2003). It is possible that birth weight and different metabolic phenotypes contribute to the prevalence of diabetes Type 2 among Native Americans (Wei et al., 2003).

The (CDC, 2003a) in a state based behavioral risk factor surveillance system [BRFSS], random digit dialed telephone survey investigated U.S. civilian, noninstitutionalized population ages < 18years. Table 2 demonstrates the prevalence among American Indians and Alaska Native and the overall U.S. population was compared from 1994 to 2002. The surveys were conducted in all 50 states, the District of Columbia, and three U.S. territories; in 2002. During 1994 to 2002, the age adjusted prevalence of diabetes increased 54% (95% *CI*=46.7%-61.4%) among U.S. adults, from 4.8% to 7.3%, and increased 33.2% among American Indians and Alaska Native adults, from 11.5% to 15.3% (CDC, 2003a). Throughout the surveillance period, the overall age adjusted prevalence for American Indians and Alaska Native adults was more than twice that of U.S. adults overall (CDC, 2003a).

Table 2

Prevalence of diagnosed diabetes among adults aged > 20 years in the American Indian/Alaska Native (AI/AN) and overall U.S. populations, by age group and sex-United States, 1994 and 2002*

	AI/AN population		US population			
	1994	2002	1994		2002	
Age group (yrs)	**(%)**	**(%)**	**(%)**	**(95%Cl)**	**(%)**	**(95%Cl)**
Men						
20-34	1.6	2.7	0.8	(0.6-1.0)	1.1	(0.9-1.4)
35-44	6.1	9.2	2.0	(1.6-2.4)	3.3	(2.9-3.8)
45-54	14.4	18.4	5.1	(4.2-6.0)	8.0	(7.3-8.7)
55-64	20.1	29.0	9.6	(8.3-10.9)	14.7	(13.5-15.9)
≥ 65	18.6	26.3	13.0	(11.7-14.3)	18.7	(17.6-19.8)
≥ 20	7.6	11.8	4.6	(4.2-4.9)	7.3	(7.0-7.6)
≥20§	10.3	14.5	5.1	(4.8-5.5)	7.7	(7.4-8.0)
Women						
20-34	1.9	3.4	1.0	(0.8-1.3)	1.4	(1.2-1.6)
35-44	6.7	9.5	2.0	(1.6-2.4)	4.1	(3.6-4.6)
45-54	16.3	19.6	4.8	(4.1-5.4)	7.2	(6.6-7.8)
55-64	25.6	30.9	8.7	(7.7-9.7)	12.7	(11.9-13.6)
≥ 65	23.3	29.8	10.1	(9.3-10.9)	15.7	(14.9-16.6)
≥ 20	9.4	13.5	4.5	(4.3-4.8)	7.3	(7.1-7.6)
≥ 20§	12.4	15.9	4.5	(4.3-4.8)	7.1	(6.8-7.3)
Total						
20-34	1.8	3.1	0.9	(0.8-1.0)	1.3	(1.1-1.4)
35-44	6.4	9.4	2.0	(1.7-2.3)	3.7	(3.4-4.1)
45-54	15.4	19.0	4.9	(4.4-5.5)	7.6	(7.1-8.0)
55-64	23.2	30.0	9.1	(8.3-9.9)	13.7	(13.0-14.4)
≥ 65	21.3	28.3	11.3	(10.6-12.0)	16.9	(16.3-17.6)
≥20	8.6	12.7	4.5	(4.3-4.7)	7.3	(7.1-7.5)
≥20§	11.5	15.3	4.8	(4.6-5.0)	7.3	(7.1-7.5)

* Based on Indian Health Service ambulatory patient care data and the Behavioral Risk Factor Surveillance System

t Confidence Interval

§ Age-adjusted based on the 2000 U.S. population

The (Diabetes Prevention Program Research Group [DPPRG], 1999) investigated underlying mechanisms associated with birth weight and Type 2 diabetes. The study included 3,061 Pima Indians ages 5 to 29 years. The Pima Indians reside in the Gila River Indian Community in central Arizona and have the world's highest recorded prevalence and incidence of Type 2 diabetes. The purpose of the study was to investigate the mechanisms underlying the association between birth weight and Type 2 diabetes in a population-based study of Pima Indian children, adolescents, and young adults (DPPRG, 1999).

DPPRG (1999) research design and methods consisted of a longitudinal study of diabetes and its complications. DPPRG conducted the research among the American Indian population of the Gila River Indian Community in Arizona. All residents age five years and older were invited to participate in research examinations every two years, regardless of health status. Standardized biennial examinations included measurements of venous plasma glucose 2 hours after a 75g oral glucose load. Plasma glucose, serum insulin (fasting and 2 hours after the glucose load) was measured since 1973. DPPRG (1999) reported people whose heritage was at least half Pima or Tohono O'odham (or a mixture of these two closely related tribes) who have had at least one 75g oral glucose tolerance test between 1965 and 1997 when they were 5 to 29 years of age, diabetes was diagnosed using WHO criteria. Relationships between birth weight, height, weight, fasting and post load concentrations of glucose and insulin were examined with multiple regression analysis, and the DPPRG found birth weight was positively related to current weight and height ($p < 0.0001$, controlled for age and sex, in each age group) (DPPRG, 1999). The 2 hour glucose concentrations showed a U-shaped relationship with birth weight in subjects >10 years of age, and this relation was independent of current body size, and in 2,272 nondiabetic subjects, after adjustment for weight height, 2-hour insulin concentrations were negatively correlated with birth weight (DPPRG, 1999). DPPRG concluded low birth weight Pima Native Americans are thinner at ages 5 to 29 years, yet they are more insulin resistant relative to their body size than those of normal birth weight. By contrast, those with high birth weight are more obese but less insulin resistant relative to their body size. The level of insulin resistance and birth weight among Pima Indians may explain their increased risk and high prevalence of diabetes Type 2 (DPPRG, 1999).

Literature Relating to Method

Intrauterine Exposure

Rhodes et al. (2010) conducted research on the optimal diet for pregnancy that is complicated by excessive weight. The study compared effects of a low glycemic load versus standard diet for pregnancy on outcomes related to risk for obesity, diabetes, and heart disease in both mother and infant (Rhodes et al., 2010). The research included 46 overweight, or obese pregnant women received a low glycemic load or low fat diets, and participants received carbohydrate rich foods, fats, and snack food through delivery and home visits (Rhodes et al., 2010). The primary outcome was birth weight *Z* score; the other endpoints included infant anthropometric measurements, gestational duration, maternal weight gain, and maternal metabolic parameters (Rhodes et al., 2010).

Rhodes et al. (2010) concluded there were no significant differences in birth weight Z score or other measures of infant adiposity between groups, however, in the low glycemic load group compared with the low fat group, gestational duration was longer [mean + *SD*: 39.3 + 1.1 compared with 37.9 + 3.1 weeks ;($p = 0.05$)] and fewer deliveries occurred at < 38.0 weeks (13% compared with 48% ($p = 0.02$), with exclusion of planned cesarean deliveries: (5% compared with 53%, ($p = 0.002$). Rhodes et al. found a low glycemic load diet resulted in longer pregnancy duration, greater infant head circumference, and improved maternal cardiovascular risk factors. Large scale studies are warranted to evaluate whether dietary intervention during pregnancy aimed at lowering glycemic load may be useful in the prevention of prematurity and other maternal and infant outcomes (Rhodes et al., 2010).

Native Americans and Diabetes

Acton et al. (2002) examined American Indian and Alaska Native children (< 15 years), adolescents (15 to19 years), and young adults (20 to 34 years) with diabetes. The subjects were identified from IHS outpatient databases; among the population living within IHS contract health service delivery areas was determined from census data. Acton et al. (2002) research method included IHS computerized database that contained clinical and demographic information on outpatient encounters including laboratory and pharmacy data in 550 IHS and tribal health facilities. Acton et al. (2002) specified the facilities were grouped into 151 service units and after the exclusion of missing or incompletely reported data, an analysis of IHS outpatient data from 105 service units, representing approximately 84% of the IHS populations. The IHS database was used to identify American Indians and Alaska Natives younger than 35 years with at least 1 of the ten diagnostic codes for diabetes according to the ninth revision of the ICD (250.0-250.9) for each fiscal year from October 1990 to September 1998 (Acton et al., 2002). Compared with chart review was one diagnostic code for diabetes from the IHS computerized database, and identified diabetes cases with a sensitivity of 92% and a specificity of 99% (Acton et al., 2002).

Acton et al. concluded that between 1990 to 1998 the number of American Indian and Alaska Native children, adolescents, and young adults with diagnosed diabetes who used IHS or tribal health facilities increased by 71% (from 4,534 to 7,736 persons); the crude prevalence of diagnosed diabetes increased by 46% (6.4 per 1,000 to 9.3 per 1,000). Throughout the period, the prevalence increased by 68% among adolescents aged 15-19 years (3.2 per 1,000 to 5.4 per 1,000) and by 47% among adults aged 20-24 years (7.8 per 1,000 to 11.5 per 1,000). Prevalence among children younger than 15 years remained unchanged (1.2 per 1,000) (Acton et al., 2002).

Castor et al. (2006) examined the health status of American Indian/Alaska Native populations served by 34 federally funded urban Indian health organizations. The primary goal was to assess the health status of the urban Alaska Natives and American Indian population served by Urban Indian Health Organization [UIHO]. The data used was national data from the 2000 U.S. Census as well as death certificates from 1990 to 1999, birth certificates from 1991 to 2000 and linked infant death information from 1995 to 2000 data from the National Center for Health Statistics [NCHS]. Included was all of the 34 UIHO's which are located in 19 states. The cause of death was classified according to the ICD-10th revision [ICD-10]. The data collected was converted before 1999 to ICD-10 based causes using ICD-9 equivalents, adjusting discrepancies through the use of NCHS comparability ratios. The results found in the 2000 census of approximately 4.1 million Americans who reported American Indian or Alaska Native heritage (alone or mixed race), 60% (2.5 million) reported American Indian or Alaska Native heritage alone 61% (1.5 million of the American Indian and Alaska Native alone group lived in urban areas, and 34% (500,000) of these urban residents lived in counties served by the UIHO's). The number of American Indians and Alaska Natives living in different UIHO service areas ranged from 700-77,000 (Castor et al., 2006).

Castor et al. (2006) revealed striking health disparities between the American Indians and Alaska Natives and general populations both in UIHO service areas and nationwide, and it is likely that disparities in socioeconomic status contribute to many of the other disparities identified. American Indians and Alaska Natives were approximately twice as likely as the general populations of these areas to be poor, to be unemployed, and to not have a college degree (Castor et al., 2006). Similar differences were observed in births among mothers who received late or no prenatal care or consumed alcohol; mortality was attributed to Sudden Infant Death Syndrome [SIDS] and chronic liver disease (Castor et al., 2006). Most striking was the alcohol consumption rate among American Indians and Alaska Native mothers, which was as much as 3 to 4 times that of all mothers combined (Castor et al., 2006). The disparities observed in maternal and child health were consistent with the results of previous studies, whereas percentages of American Indians and Alaska Native infants with low birth weights varied between individual UIHO service areas, the overall UIHO service area, and nationwide, the American Indian and Alaska Native percentages were lower than those of the corresponding general populations (Castor et al., 2006).

Prevalence of Diabetes

Boyko (2000) investigated trends in diabetes prevalence among Native Americans and Alaska Natives with a research design and method that included data from 1990 to 1997 among Native Americans and Alaska Natives with diabetes. The subjects were identified from the IHS National Outpatient Database, and the prevalence was calculated using these cases and estimates of the Native American and Alaskan population served by IHS and tribal health facilities, and the prevalence were age adjusted by the direct method based on the 1980 U.S. population (Boyko, 2000).

Boyko (2000) concluded between 1990 and 1997 the number of Native Americans and Alaska Natives of all ages with diagnosed diabetes increased from 43,262 to 64,474 individuals, and the prevalence of diagnosed diabetes increased by 29%. In 1997, the prevalence among Native Americans and Alaska Natives was 5.4% and the age adjusted prevalence was 8.0% (Boyko, 2000). During the entire period from 1990 to 1997 the prevalence among women was higher than that among men, but according to Boyko (2000), the rate of increase was greater among men than women (37% versus 25%). In 1997 the age adjusted prevalence of diabetes varied by region and ranged from 3% in the Alaska region to 17% in the Atlantic region (Boyko, 2000). The increase in prevalence from 1990 to 1997 ranged from 16% in the Northern Plains region to 76% in the Alaska region (Boyko, 2000). Boyko (2000) found diabetes common among Native Americans and Alaska Natives, and it increased substantially during the 8-year period examined. Effective interventions for primary, secondary, and tertiary prevention are needed to address the substantial and rapidly growing burden of diabetes among Native Americans and Alaska Natives (Boyko, 2000).

Prevalence, Progression, and Programs

The most common form of diabetes is Type 2 diabetes, which constitutes about 85% to 95% of all diabetes in developed countries (WHO, 2004), and accounts for an even higher percentage in developing countries. The prevalence of diabetes is increasing worldwide, and is a global health problem related to the increasing prevalence of obesity due to western lifestyles (WHO, 2004). Ahmed, Muniandy and Ismail (2010) found in 1997 there were 124 million persons with diabetes in the world. It was predicted this number would grow to 221 million in 2010 (Songer & Zimmet, 1995). In the United States, the populations disproportionately affected by diabetes are Native Americans, particularly in the desert southwest along the Gila River in Arizona (ADA, 2005). The Pima tribe in Arizona has the highest rate of diabetes in the world; about 50% of adult Pima Indians between the ages of 30-64 have diabetes (ADA, 2005). Early intervention in diabetes can reduce the risk of manifestations of disease associated with Type 2 diabetes (Novoa et al., 2005).

Summary and Transition

Alaska Native women have historically suffered from inadequate prenatal care including late initiation of care and infrequent prenatal visits. According to a report by the (State of Alaska, 2005) inadequate prenatal care, including late initiation of care, infrequent prenatal visits or total lack of care, has been associated with poor infant and maternal outcomes. In 2005, nearly, 1 in 3 Alaskan women who delivered an infant received less than adequate prenatal care and nearly 1 in 7 received inadequate or no care at all (State of Alaska, 2005). There is an urgent need for maternal and fetal nutritional and weight assessments during pregnancy. The use of a prognostic risk profile may reduce the incidence of diabetes and chronic disease among SEA natives.

Chapter 3 outlines the methodological approach to investigating SEA natives, LGA birth weight, and the prevalence of Type 2 diabetes. This chapter includes information regarding the participants in this study and how they were selected, the data collection methods, instrumentation, and the methods for data analysis.

Chapter 3: Methodology

Introduction

The purpose of this study was to examine the role of gestational age on birth weight and incidence of adult Type 2 diabetes among Natives born in SEA. I gathered data from medical records in the electronic medical record database at SEARHC Mt. Edgecumbe Hospital. Other study parameters including an identification of the variables and the methods through which they were measured were explored. The chapter included a description of this study's design, sample, instrumentation, data analysis, and ethical considerations, and a rationale for research design selection. The data collection process and analysis are discussed herewith.

Research Design and Approach

This study was a correlational research design with secondary data analysis. The dependent variable is the presence or absence of Type 2 diabetes in patients receiving care at SEARHC Mt. Edgecumbe Hospital in Sitka, Alaska. The independent variables birth weight and gestational age categories: small for gestational age (SGA), average for gestational age (AGA) and large for gestational age (LGA). The categories were based on the Association of Women's Health, Obstetrics and Neonatal Nurses (AWHONN) standards and guidelines for pediatric birth weight (see Appendix C).

According to Alaska Ethnic Groups (AEG, 2010) Native Americans accounted for 15.6% of Alaska's population, primarily Athabaskan (14,520) and Tlingit-Haida (14, 825) living in southeastern Alaska, and numbered around 29, 345. There are also small numbers of Tsimshian living in this area (AEG, 2010).

Setting and Sample

Inclusion Criteria

The patients born between 1970 and 1980 and receiving care at Mt. Edgecumbe Hospital were included in the study. The patient population low estimation was 379 and was divided into two groups. The outpatient computerized database contained clinical and demographic information including the birth weight of 541 tribal and IHS facilities (IHS, 2005). The present study used IHS database to identify individuals with the diagnosis of diabetes Type 2; per the 10th revision of ICD codes 250.0 (ICD, 2011). The second group included all other patients receiving care at SEARHC that did not have Type 2 diabetes and without ICD codes of 250.0. The patients' birth information recorded in the delivery journal was obtained from Mt. Edgecumbe hospital's medical records department and online medical information was accessed through the hospitals online records system.

Exclusion Criteria

Records of patients that did not have a birth weight and gestational age recorded in their personal charts were excluded. Patients that were not born within the SEARHC medical system were excluded because of unavailability of birth weight information data in their medical charts. Patients with a diagnosis of Type 1 diabetes were also excluded.

Sample Size

The sample size was determined by using MaCorr statistical software. The sample size determined by MaCorr was 379 Native infants born at Mt. Edgecumbe Hospital in Sitka, Alaska from 1970 to 1980 and were reviewed for this study. The sample size calculation included a five interval level with a 95% confidence level. The power analysis was used to determine the minimum number of participants needed for a study to detect statistical significance (Faul, Erdfelder, Lange, & Buchner, 2007).

Materials and Instrumentation

The birth weight of all infants born between 1970 and 1980 was categorized using AWHONN standards and guidelines and assigned a numerical value. They were a primary division of the population receiving healthcare at Mt. Edgecumbe Hospital divided into two groups of patients. The infants' sex and maternal age were also extracted for further use in research.

The first group comprised of patients with Type 2 diabetes. The second group consisted of nondiabetic patients. The two group's birth weight and gestational age were extracted from birth journals. The individual birth weights were given a number and recorded as (1) small, (2) average or (3) large for gestational ages (Table A1). The chi square goodness of fit test was used to determine whether the sample of data came from the population with a specific distribution category. A feature of the chi square goodness of fit test is that it can be applied to any univariate distribution in which cumulative distribution function can be calculated (Snedecor & Cochran, 1989). The research data was used as a basis for a health promotion campaign that would promote increased surveillance of fetal weight gain during pregnancy in SEA.

This study design had several benefits (Blumenthal & DiClemente, 2004). The use of retrospective data enabled the researcher to gather data from many records within a specific time frame. This approach increased the number of available records of SEA native patients. The retrospective analysis is often used in medical research (Blumenthal & DiClemente, 2004). Medical records can be gathered and analyzed within a shorter timeframe than the time required for an experimental or other study designs. A retrospective design can also be completed without significant financial expenditures (Blumenthal & DiClemente, 2004).

The data collected from the Southeast Alaska Regional Health Consortium (SEARHC) database were designed to evaluate the correlation between gestational age birth weight and Type 2 diabetes among SEA natives. It included variables on small for gestational age (SGA), average for gestational age (AGA) and large for gestational age (LGA) birth weight categories at the time of birth recorded in birth journals from 1970 to 1980. The patient charts had the International Classification of Diseases (ICD) code in the Indian Health Service (IHS) database to identify individuals with the diagnosis of diabetes Type 2; per the 10^{th} revision of ICD codes 250.0 that represent the patient's condition or diagnosis. All patients identifying data, such as names and addresses of those whose records included in this database were removed to protect the confidentiality of patients. This information was included in the application to Walden University's IRB for permission to conduct this study. The variables available for analysis from the birth journals including birth weight were recorded in pounds and ounces and in gram weight. Recall of each variable is listed in Table 1.

Research Questions and Hypotheses

1. Was there a relationship between gestational birth weight and incidence of Type 2 diabetes among adult SEA Natives?

$H_0 1$: There were no differences in gestational birth weight between SEA Natives of SEARHC with Type 2 diabetes and those without Type 2 diabetes.

$H_a 1$: There were differences in gestational birth weight between SEA Natives of SEARHC with Type 2 diabetes and those without Type 2 diabetes.

Statistical Plan: To examine hypothesis one, and determine whether there were significant differences in the gestational birth weight of SEA natives of SEARHC with and without Type 2 diabetes, an independent sample *t* test was conducted. The categorical grouping variable was Type 2 diabetes while the continuous dependent variable was gestational birth weight.

2. Was there an association between gestational age birth weight category and instances of Type 2 diabetes among SEA Natives?

$H_0 2$: There were no differences in group placement into gestational age birth weight categories depending on Type 2 diabetes status among SEA Natives of SEARHC.

$H_a 2$: There were differences in group placement into gestational age birth weight categories based on Type 2 diabetes status among SEA Natives of SEARHC.

Statistical Plan: The Independent Variable was gestational age birth weight category (SGA, AGA, and LGA). Dependent Variable was Type 2 Diabetes (Yes/No); statistical test utilized the chi square goodness of fit test.

Data Analyses

A total of 540 records were obtained for the study. Table 3 presents descriptive measures on the variables related to the study sample. The distributions of patient records were evenly divided across the years of study (1970-1980).

Table 3

Birth Category and Percent of Patients Diagnosed with Type 2 Diabetes (N = 540)

Variable	Total Births	Diagnosed with Type 2 diabetes	Percentage
SGA	70	1	1.42%
AGA	194	17	8.76%
LGA	276	98	35.25%
Total	540	116	

Table 3 represents an analysis performed on 540 Alaskan Native births (N = 540). The majority of patients 424 (78.51%) were not diagnosed with Type 2 diabetes. The patients that were diagnosed with Type 2 diabetes at SEARHC were 116 (21.48%). Additionally, patients were between the ages of 43-53 years of age.

The level of significance was tested at the 0.05% level for all analyses run for this study. The sample included patients who had been born at SEARHC Mt. Edgecumbe Hospital in Sitka, Alaska between 1970 and 1980. A total of 540 births were included in the study. This sample size represented an average of 54 births per year. There were 540 individual patient charts, each representing an SEA native receiving healthcare at SEARHC Mt. Edgecumbe Hospital in Sitka, Alaska.

Protection of Participant's Rights

The measures taken to protect participant's rights are described in this section. The data were initially collected by ethical principles that originated from the Declaration of Helsinki and were consistent with good clinical practice (NIH, 2004). The first measure to protect the research participants' rights and support ethical principles was the submission of the study protocol to a special committee who assured that the rights of research participants were protected, and potential participants were not harmed (NHGRI, 2010). The final study protocol, including the final version of the informed consent form, was approved by IRB for the protection of the rights of research participants (NHGRI, 2010). This committee was the Alaska Native Institutional Review Board [IRB]. The Alaska Native IRB and Walden University IRB approved the study. The IRB also required notification of any changes to the study protocol (NHGRI, 2010). The concerns of human participants or contact with participants were eliminated with the use of previously collected data (United States Department of Health and Human Services [DHHS], 2009). Another concern of the IRB was anonymity of research participants (NHGRI, 2010). Several measures were utilized to protect the anonymity of the participants. Data collection sheets, data analysis records, and electronic records were secured. Paper records were locked in a secure cabinet. Electronic data was also secured on a password protected computer located in the researcher's office.

Electronic hospital medical charts were stored in medical records at the hospital facility. The hospital's information services department assures that only employees whose job requires access to the records can view them would regularly monitor accesses to medical charts. Only the researcher and hospital based employees had access to medical files. The investigator would be able to obtain access to participants electronic and paper records at the hospital study site because of Alaska IRB approval.

This study also followed the IRB protocols of Walden University and the Alaska Native Institutional Review Boards. These protocols included statements of consent and assurance of confidentiality, benefits to the participant, and benefits to SEA Natives and their families. Upon completion of the project, participants can request the results of the study. All data collected including information from the electronic database, and patient's medical charts will be stored in researcher's locked home office for 5 years

Summary and Transition

Chapter 4 comprises the findings that test the hypotheses and addresses the research questions of the study. A correlational research study with secondary data analysis examined if the birth weight of Southeast Alaska Natives (SEA) had an influence on developing Type 2 diabetes.

The chapter was divided into three sections: (a) research tools, (b) data analysis, and (c) conclusion. A series of statistical analyses were performed to investigate and test the hypotheses and answer research questions. Results of the analysis are presented according to the statistical tests performed. The Statistical Analysis Software (SAS) 9.2 statistical program and specifically, the chi square analysis was used in all data analyses. The conclusion provides a summary of the test results or findings.

Electronic medical record data and patient's charts of Type 2 diabetic patients of SEA were used to compare gestational age birth weights. The analyses were used to determine whether birth weight was a predisposing factor to Type 2 diabetes. The data analyses and results are presented in chapter 4. Findings and potential implications for the study, policy and practice are presented in chapter 5.

Chapter 4: Results

Introduction

The purpose of this study was to examine the role of gestational age on birth weight and incidence of adult Type 2 diabetes among Natives born in SEA. The chapter describes the characteristics of the sample of patients giving birth at SEARHC Mt Edgecumbe Hospital. The statistical tests and associated assumptions were described as performed to answer the research questions. Each hypothesis includes a statement on whether the null or alternative was supported based on the significance level. The chapter concludes with a summary of the chapter.

Characteristics of Sample

As shown in Table 4, a total of 540 records of patients ages 43-53 were available with complete data. Over a fifth (21.4%) of the sample was diagnosed with Type 2 diabetes as adults. Two thirds (65%) were not married. All patients were covered by private, government or public health insurance, although more patients had government or public health insurance (N = 421, 78%).

Table 4

Frequency Counts and Percentages of Patients Demographics (N = 540)

	Demographics	
	Frequency	Percentage
Diagnosed with Type 2 Diabetes	116	21.4%
Age Group	43-53	100.0%
Race/Ethnicity	SEA Native	100.0%
Not Married	351	65.0%
Health Insurance Status	421	78.51%

Research Questions and Hypothesis Testing

1. Was there a relationship between gestational birth weight and incidence of Type 2 diabetes among adult SEA Natives?

$H_0 1$: There were no differences in gestational birth weight between SEA Natives of SEARHC with Type 2 diabetes and those without Type 2 diabetes.

$H_a 1$: There were differences in gestational birth weight between SEA Natives of SEARHC with Type 2 diabetes and those without Type 2 diabetes.

To examine hypothesis 1 and determine whether there were significant differences in the gestational birth weight of SEA natives of SEARHC with and without Type 2 diabetes, an independent sample *t* test was conducted. The categorical grouping variable was Type 2 diabetes, while the continuous dependent variable was gestational birth weight.

Prior to analysis, the assumptions of the independent sample *t* test were assessed. For the independent sample *t* test to be conducted accurately the data should follow an approximately normal distribution and variances in birth weight should be similar between the two groups of interest. To test the normality of the data, a one sample Kolmogorov-Smirnov (KS) test was conducted. Results of the KS test indicated that the participants' birth weights were not normally distributed ($p < .001$). However, Stevens (2009) cited the central limit theorem when he stated that normality can be assumed when a sample exceeds 30. Because a total of 422 participants without diabetes and 117 with diabetes were included, normality may be assumed. To assess the equality of variances between groups, Levine's test was conducted. Results of Levine's test indicated that the variances in birth weight were not equivalent between the two groups ($F = 51.54$, $p < .001$). To correct for this, the results were interpreted using outcomes that do not assume equal variance.

Results of the independent sample *t* test with equal variances not assumed indicated that there was a significant difference in gestational birth weights between participants with and without Type 2 diabetes ($t_{(285)} = 13.91$, $p < .001$). Examination of the group means for gestational birth weight indicated that those with Type 2 diabetes had an average gestational birth weight of 4,287.80 grams while those without Type 2 diabetes had an average gestational birth weight of 3,554.27 grams. This difference in birth weight suggests that SEA Natives of SEARHC with Type 2 diabetes had an average gestational birth weight 733.53 grams heavier than those without Type 2 diabetes. Results of the independent sample *t* test are presented in Table 5.

Table 5

Independent Sample t test for Gestational Birth Weight by Type 2 Diabetes

			Gestational Birth Weight			
			Type 2 diabetes		No Type 2 diabetes	
Variable	$t_{(285)}$	*p*	*M*	*SD*	*M*	*SD*
Type 2 diabetes	-13.91	< .001	4,287.80	442.81	3,554.27	683.03

Results of the independent sample *t* test for birth weight and Type 2 diabetes returned statistically significant results ($p < .001$) with differences in birth weight based on whether the participant had Type 2 diabetes or not. Thus, the null hypothesis is rejected. There were differences in birth weight between SEA Natives of SEARHC with Type 2 diabetes and those without Type 2 diabetes.

2. Was there an association between gestational age birth weight category and instances of Type 2 diabetes among SEA Natives?

$H_0 2$: There were no differences in group placement into gestational age birth weight categories depending on Type 2 diabetes status among SEA Natives of SEARHC.

$H_a 2$: There were differences in group placement into gestational age birth weight categories based on Type 2 diabetes status among SEA Natives of SEARHC.

Cross tabulations of gestational age birth weight categories and percentages for Type 2 diabetes are presented in Table 4. The results were statistically significant [$x^2_{(12)} = 63.29$, p < .0005] indicating significant differences in group placement into gestational age categories depending on Type 2 diabetes status. Counts of the SGA categories showed that Type 2 diabetes occurred less frequently among SGA group (1.42%), followed by the AGA group with a prevalence of 8.76%, and over a third (35.25%) of those in the LGA group had the greatest prevalence of Type 2 diabetes. The frequency of Type 2 diabetes diagnosis increased as the birth weight increased. The total percentage with a Type 2 diabetes diagnosis among this population group (*N* = 540) was 45.43%. Thus, the null hypothesis is rejected. There were differences in group placement into gestational age birth weight categories and instances of Type 2 diabetes of SEA Natives of SEARHC.

Figure 3 is a bar chart that presents the proportion of Type 2 diabetes diagnoses in each of the gestational age groups. The chart shows that Type 2 diabetes increased with gestational age category. Prevalence is greater in the LGA group followed by the AGA group and the SGA group.

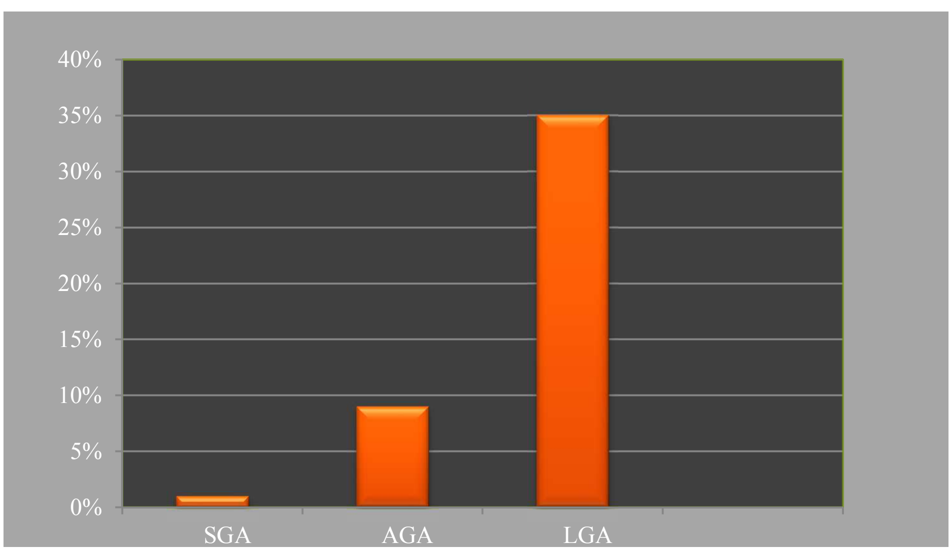

Figure 3. Prevalence of Type 2 diabetes by birth weight gestational age. SGA, AGA, and LGA represent AWHONN birth weight standard categories

Results of the chi square test of independence comparing gestational age groups returned statistically significant results ($p<.0005$), indicating that there are differences among gestational age categories. The null hypothesis is rejected in support of research question 2. In addition, LGA category had the greater proportion of Type 2 diabetes among birth weight categories. There is statistical evidence to indicate a difference in the frequency of Type 2 diabetes among birth weight; therefore, the null hypothesis is rejected in support of Research Question 1.

Summary and Transition

Chapter 4 originated with descriptions of the variables used for the statistical analyses in the study. Information concerning the required assumptions of statistical analysis was presented, and assumptions were assessed before analysis. Where assumptions were violated, all necessary precautions were taken to ensure the statistical validity of the analyses. Statistical analyses were performed using an independent sample *t* test and chi square tests of independence. Both analyses were conducted as planned and showed statistical significance for all variables of the study. A description of the population using patient data was explored and showed that a greater proportion of LGA birth weight infants was diagnosed with Type 2 diabetes. This confirmed the findings from the independent sample *t* test that showed that significantly heavier gestational birth weights were found within the group of SEA Natives of SEARHC, who were diagnosed with Type 2 diabetes.

Chapter 5 provides a more detailed discussion and interpretation of the results including a recommendation for future studies and recommendations for action. The chapter concludes with a summary and implications for social change to improve the health of SEA natives of SEARHC.

Chapter 5: Summary, Conclusion, and Recommendations

Introduction

Evidence shows that diabetes disproportionately affects American Indians and Alaska Natives in general however, there is no recognized association between gestational age birth weight and the development of Type 2 diabetes among Natives born in SEA. Up to this point, the available research has been unclear about the existence of Type 2 diabetes among SEA Natives. This chapter contains an examination and analysis of study results, linking them to the body of literature presented in Chapter 2 with an emphasis on contributions and added value. The overview includes a review of limitations and the delimitations of the study and how these may have impacted the findings of the study. This chapter also includes an explanation of how the study findings support the theoretical framework, emphasize their implications for social change, and offer recommendations for health care administrators, policy makers, and future researchers.

Summary of Study

The present study results indicated that the incidence of Type 2 diabetes in patients with LGA birth weight was higher than those patients with AGA or SGA birth weight. The study was statistically significant in associating LGA birth weight with Type 2 diabetes.

Previous research revealed a potential association between gestational age birth weight and Type 2 diabetes. However, the majority of the studies were not designed to investigate this specific association. Whincup et al. (2008) performed one of the most relevant studies in the area. Their results showed that in most populations studied, birth weight was inversely related to Type 2 diabetes risk. The study by Whincup et al. was limited because it did not include the Alaskan Native population. The current study went beyond the work done by Whincup et al. by using a representative sample of Alaskan Native people and with higher statistical power.

Hediger et al. completed a similar study in this area in 1998. The authors assessed measurements of infants and children taken from the nationally representative sample of NHANES, III (Hediger et al., 1998). These researchers later revealed that there was a persistent association between birth weight for gestational age status with body composition during infancy and childhood.

Recently, Raghapathy et al. (2010) published a study that investigated newborn size and postnatal growth to glucose intolerance in South Indian adults. The conclusion of the study indicated that birth weight was associated with risk of developing diabetes mellitus (Raghapathy, 2010).

The high prevalence of Type 2 diabetes in the United States is of great concern to the American population (CDC, 2011). The disease which is specifically prevalent among the Native American population is nearly twice the rate for nonHispanic Whites (CDC, 2008). Native Americans comprise one of the largest ethnic minority group in the United States (USCB, 2010) and continue to face significant health care disparities, despite their membership in health care organizations (Bachman et al., 2008).

American Indians and Alaska Natives are located primarily in rural areas. Culturally competent diabetes education has emerged as a potential solution to improve the quality of care to minorities (The Commonwealth Fund, 2006). Although researchers have demonstrated that culturally competent health education improves health outcomes for minorities with Type 2 diabetes in the community based studies reviewed (Brown et al., 2002; Lorig et al., 2008; Rosal et al, 2005), information on this type of health care education lacks in the rural settings of Southeast Alaska Natives (SEA).

The research questions addressed in the study were used to determine whether gestational age and birth weight affected Type 2 diabetes later in life. For the current study, large for gestational age (LGA) birth weight was deemed a predisposition to Type 2 diabetes. The results of the study included evidence of gestational age birth weight of the patients were the most significant factor in Type 2 diabetes diagnosis. The study also identified a few opportunities for research relating to the care of pregnant women of SEA.

Discussion and Interpretation of Findings

This study involved determining whether gestational age birth weight affected a diagnosis of Type 2 diabetes later in life among SEA natives. The results of the study were divided into gestational age, and birth weight, and results confirmed that Type 2 diabetes diagnosis was more prevalent in patients born LGA.

The results of the current study using birth records from the 1970-1980 period also concurred that LGA birth weight is significant in the development of Type 2 diabetes versus small for gestational age (SGA) and average for gestational age (AGA) birth weight. Since the data on diagnosis of Type 2 diabetes was prospective, the statistical trends indicated causal relationships. Data indicate that diagnosis of Type 2 diabetes and gestational age birth weight were increasing exponentially with the prevalence of diabetes.

Although a large body of literature exists on the merits of child birth education during pregnancy and its effectiveness, most of the literature reviewed concentrates on quality and types of interventions and did not identify the most effective form of diabetes prevention education and monitoring birth weight during pregnancy for specific population outcomes. These studies also failed to develop effective, multi component, culturally sensitive child birth education programs that could be delivered in either primary health care settings or rural Alaska Native community sites.

The results of this study pointed to a relatively overlooked component of intervention and health promotion agendas including the effectiveness of child birth education classes and weight gain during pregnancy protocol and how it can affect the development of Type 2 diabetes. The findings suggest that compliance with weight gain during pregnancy protocol and the barriers to optimal child birth care must also be addressed for research to be translated into clinical practice and used for the benefit of all patients.

Support for Theoretical Framework

The social ecological model (SEM) developed by Bronfenbrenner (1979), provides a framework that helps researchers attempt to explain health behaviors. The SEM seeks to explain individual knowledge, development, competencies and the social change over time, which could provide cumulative effects on individual choices.

As indicated in the current study, the combination of the SEM and cultural competency as an effective health care model for a particular sector of SEA Natives is supported. Specifically, positive results occurred in the LGA birth weight patients who were born LGA and categorized in the birth journals as LGA and, therefore, supported this model as an effective predictor of health care behaviors within these parameters.

The present study involved comparing birth weight and gestational age categories based on the SEM: a culturally adapted childbirth education class that would incorporate normative weight gain during pregnancy. In a 10-year time frame, patients with a higher birth weights would be more likely to have Type 2 diabetes later in life. As discussed in chapter 2, because child birth education classes would be based on the SEA, it could be argued that the difference in patient outcomes could be related to the integration of cultural components.

Because patients with higher birth weight demonstrated greater frequency of developing Type 2 diabetes, these patients may have believed that their weight gain in pregnancy was not serious and were not monitoring their weight gain during pregnancy, thus delivering LGA birth weight infants. Complications that arise from Type 2 diabetes, such as end stage renal disease, peripheral vascular disease, amputations, and retinopathy, are to be emphasized in the child birth education curriculum. The perceived threat of Type 2 diabetes coupled with culturally adapted education about maternal weight gain and the disease process may contribute to better and more immediate patient compliance among this patient population.

One cannot assume, however, that the SEM is an effective model for explaining health care behavior among SEA Natives with Type 2 diabetes. Because this study was retrospective in nature, it did not evaluate the viability of the specific tenets of the SEM on SEA and maternal weight gain during pregnancy, which can only be evaluated by a prospective study. As stated in the literature review, few researchers, to date, have reported SEM's applicability to culturally distinct populations.

The basis for using the SEM as the theoretical framework in this study was grounded by the SEM premise that people's health seeking behavior is intricately connected to the extent to which they value health (Schwab et al., 1994) and beliefs and knowledge about Type 2 diabetes are likely to be at least in part driven by the cultural value system (Chin, 2000). While this generalization can be applied to the majority of patients in the present study, it does not apply equally well to every population, time frame, or education received.

The efficacy of culturally adapted childbirth education on weight gain for SEA Natives women is complex and dependent upon a number of factors. It would be inaccurate to assume that culturally competent child birth education is the best option for all patients in all situations. However, identified in the findings from the current study are variables that might positively influence the reduction of patients with Type 2 diabetes and clearly demonstrate clinically relevant short term improvements of Type 2 diabetes occurrence as a direct result of culturally adapted childbirth education for SEA Natives.

Of the 540 patients assessed for this study, 70 were SGA at birth with 1 diagnosis of Type 2 diabetes, 194 were AGA with 17 diagnosed with Type 2 diabetes, and 276 were LGA with 98 diagnosed with Type 2 diabetes. Although the study did not assess the differences in patients gestational age birth weight, it was found that 1.42% born SGA were diagnosed with Type 2 diabetes, 8.76% born AGA were diagnosed with Type 2 diabetes, and 35.25% born LGA were diagnosed with Type 2 diabetes.

Limitations

Alaska Native subgroups (from islands or villages in SEA) of the study sample were not identified or analyzed because the study was retrospective in nature and these data were not available in the birth journals. However, according to the U.S. Census Bureau (USCB, 2010), Southeastern Alaska is the traditional territory of the Tlingit, Haida, and Tsimshian Indian tribes. Of the 12,831 Alaska Natives living in Southeast Alaska, 4,571 (or 36%) live in 10 coastal villages. Natives constitute 70 percent of the population of these villages (and their surrounding areas) which stretch the length of the panhandle from Yakutat in the north to Metlakatla in the south.

Culturally adapted childbirth education may lead to much needed childbirth care knowledge, which will, in turn, help patients understand how to manage weight gain during pregnancy. However, because this study was retrospective, patient literacy and education levels were unavailable for analysis.

Retrospective cohort studies have inherent limitations. The disadvantages of a retrospective design are (a) vulnerability to selection bias, (b) dependence upon the adequacy of medical records. In addition, certain variable could not be controlled for in the study, including SEA subgroup, socioeconomic status, educational level, and physician influence on maternal weight gain during pregnancy.

Finally, the predictive chi square goodness of fit model generated by the study may provide higher predictive values in this data set than in independent data sets because the model was developed in conjunction with this particular data set. The more realistic predictive value of this model will be ascertained when independent data sets are analyzed using the same model in future studies.

Recommendations for Further Research

To establish a causal relationship between culturally and linguistically adapted childbirth education classes and health outcomes, a prospective randomized control trial is warranted. According to the results of the current study, a larger sample of patients with birth weight and gestational age categories should be studied for a future randomized control trial. Through such a study, a researcher may demonstrate the magnitude of increased efficacy with the integration of the culturally adapted childbirth education intervention.

Further studies are warranted in which researchers evaluate whether attending culturally adapted childbirth education classes decreases the incidence of Type 2 diabetes, which is deemed a successful outcome according to research from the Diabetes Control and Complications Trial. Future studies in which researchers evaluate whether patients with SGA or AGA birth weight are susceptible to Type 2 diabetes are also warranted.

As a result of the current obesity epidemic, Type 2 diabetes is more relevant to the younger population than ever before (Corkery et al., 1997). Consequently, younger patients with Type 2 diabetes have the potential to experience chronic complications for a long period. In addition, chronic diabetes related complications within the SEA population have negative long term public health and societal ramifications (Copeland, Becker, Gottschalk, & Hale, 2005).

Fortunately, younger age groups may benefit tremendously from early weight gain management intervention that will allow them not to have as many comorbidities as older populations (Corkery et al., 1997; Greenfield et al., 2009). They may more easily and readily incorporate healthy diet and exercise habits (Knowler et al., 2002). An indepth exploration of the factors that both enhance and hinder SEA patients' involvement in childbirth education is warranted. Programs and strategies for engaging this demographic in self care and diabetes prevention activities should also be studied.

Recommendations for Action

The results of the current study not only provided helpful insights into the effects of maternal and fetal weight on health outcomes but clarified further understanding in areas for improvement. The following is an overview of several opportunities for health administrators and researchers to explore in future research.

Recommendations for Health Administrators

Even when patients have access to health insurance, other barriers within the health care system may still inhibit optimal health care (Bachman et al., 2008; DeLaet et al., 2002). For example, SEA Natives belonging to SEARHC living in rural villages are more likely than SEA Natives living in cities to report unmet health care needs, are less likely to receive preventive screening and treatment, and are more likely to report poor patient physician communication (The Common Wealth Fund, 2004). Culturally adapted child birth education may help to eliminate some of these health care barriers. Of the 12,831 Alaska Natives living in Southeast Alaska, 4,571 (or 36%) live in 10 coastal villages. Natives constitute 70 percent of the population of these villages (and their surrounding areas) which stretch the length of the panhandle from Yakutat in the north to Metlakatla in the south (USCB, 2010).

It is recommended that administrators understand and address the cultural obstacles inherent in disseminating information to SEA Natives living in rural areas through culturally competent programs. Simply targeting culturally adapted child birth education classes would potentially result in a significant reduction of Type 2 diabetes as demonstrated by the findings in the current study.

Educational interventions have the potential to be adapted to clinical or community settings, which would allow organizations to offer culturally, adapted child birth education to its members in community venues, such as churches or community centers. This type of accessibility not only provides patients with the sense of comfort generated from familiar settings, but it may also generate more attendance based on proximity and convenience. Furthermore, this type of program can be offered in clinics that are geographically remote from a centralized medical center campus where classes are typically offered, thus expanding the program’s reach to a greater number of patients.

Administrators and policy makers should explore the ability of the health care organization to adopt cultural competence into its policy, practices, and procedures in order to serve its members effectively. Therefore, the infrastructure of the health care organization must be evaluated and should be completed with a focus toward implementing culturally competent policies and procedures that ensure the work of culturally competent practitioners is adequately supported on an institutional level.

Implications for Social Change

Demographic changes expected in the next few years underscore the critical importance of addressing disparities present within the health care system. The population that has experienced inferior health status is expected to increase, thus representing an even greater percentage of the of the U.S. population (USCCR, 2004). With the current accelerated rate of diabetes among Native Americans and Alaskan Natives nationwide (CDC, 2008), complications resulting from Type 2 diabetes will also continue to increase. Therefore, efforts to improve maternal and fetal weight gain during pregnancy are of utmost priority for this patient population.

The current study involved conducting quantitative research specific to the SEARHC and members with health insurance within the Consortium. Even with the managed system, significant health disparities, and health care barriers continue to exist for SEA Natives. Understanding how SEARHC health care systems can best care for SEA patients who are likely to experience cultural barriers is essential for reducing health disparities. Improving health disparities may result in improved circumstances for SEA Natives, both generally within society and specifically within the health care environment.

Evidence based research is necessary to provide health care administrators and practitioners with statistical information to help improve the quality of health care for SEA Natives and other Native American and Alaska Native groups (Betancourt et al., 2005; Brach & Fraser, 2002). The study contributes to the literature and provides evidence that SEA Native receiving healthcare at SEARHC are more likely to be born LGA birth weight and more likely to be diagnosed with Type 2 diabetes. Specifically targeting this patient population with a proven program will help reduce the costs associated with other ineffective educational health care programs. Effective quality health care for SEA patients results in healthier patients within SEARHC and, from there, a healthier community.

Effective culturally competent programs that lead to normalized weight gain during pregnancy may not only decrease human loss and suffering, but also curb the exceedingly high diabetes related costs that currently burden the medical care delivery system, patients, families, and communities (Wagner et al., 2001; Menzin et al., 2001). Health care expenditures are significantly higher for individuals with diabetes than those without (Bjork, 2001). Controlled costs may, in turn, afford organizations the ability to invest in additional cultural programs, which can ultimately provide better care for all Native Americans and Alaska Natives. Knowing how to target this patient population, as demonstrated in the current study, may reduce health care costs associated with educational programs that target Native Americans and Alaska Natives with Type 2 diabetes. Effective culturally competent health care is, therefore, critical from both a humanistic and a business standpoint.

Conclusion

The research provided insight into what role fetal weight gain during pregnancy may have on future health outcomes by analyzing a possible relationship between birth weight and Type 2 diabetes among SEA Natives. The knowledge gained concerning birth weight and Type 2 diabetes may improve health outcomes among Native Americans and Alaska Natives. The conclusion of this research study may imply that there is a need for monthly evaluations of fetal weight throughout each trimester of pregnancy in order to monitor fetal weight gain. The practice now is to estimate fetal weight on initial visit, each prenatal visit and at time of delivery. Prenatal nutrition and maternal health education classes will give women of SEA the knowledge of a healthy diet throughout their pregnancy. Accordingly, health education will help the women with proper nutrition during pregnancy that will affect the birth weight of their unborn children.

The high prevalence of Type 2 diabetes in the United States is a major concern to all Americans. The disease is especially rampant among Native Americans and Alaska Native at nearly twice the rate of nonHispanic Whites (CDC, 2008). This problem is compounded by the fact that American Indians and Alaska Natives comprise the fastest growing minority group in the United States (U.S. Census Bureau, 2010) and continue to face significant health care disparities, despite the tribal affiliation and health care organization Bachman et al., 2008; Brown et al., 2003).

The current study provided an original contribution to the literature. The current study provided a comparative analysis of patients born at SEARHC Mt Edgecumbe Hospital and receives health care through the consortium. This type of comparison was more rigorous from a design perspective that those made in previous studies where American Indians and Alaskan Natives are studied as a group. More importantly, this study utilized prospective data on the development of Type 2 diabetes later in life on a

10-year birth cohort. The retrospective study was conducted at an SEARHC organization during its normal mode of operation.

Finally, the current study is one of the first to contribute to the evidence for SEA Natives of SEARHC. Evidence based practice helps healthcare administrators make decisions based on proven strategies that demonstrate cost efficiency, quality of care, and best health outcomes. Promoting evidence based preventive care is also one of the less controversial provisions in recently passed U.S. Healthcare Reform Act (Kistin, 2011).

The findings from this study are promising and illustrate clinical relevance. Although the current evidence is in the preliminary stages of development, it is clear that patients and health care providers alike stand to benefit from creating, testing and implementing effective culturally competent child birth education in SEARHC organizations.

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Appendix A: Letter of Permission to Conduct Research

Alaska Area Institutional Review Board DATE: July 30, 2013
4315 Diplomacy Drive - RMCC
Anchorage, AK 99508
Phone: (907) 729-3924

TO: Renee Crawford, PhDc
Principal Investigator

FROM: Alaska Area Institutional Review Board (IHS IRB #2)
STUDY TITLE: [471494-1] Birth Weight, Gestational Age and Type 2 Diabetes Among Southeast Alaska Natives
IRB REFERENCE #: 2013-05-018
SUBMISSION TYPE: New Project
ACTION: APPROVED
APPROVAL DATE: July 29, 2013
EXPIRATION DATE: July 28, 2014
REVIEW CATEGORY: Expedited Review

Dear Ms. Crawford:
The Alaska Area Institutional Review Board has given approval through EXPEDITED REVIEW to the protocol 2013-05-018 Birth Weight, Gestational Age and Type 2 Diabetes Among Southeast Alaska Natives. Tribal approval is required in addition to IRB approval. The protocol was approved on July 29, 2013 with the contingency that:

• A privacy consult is required at the Southeast Alaska Regional Health Corporation

The protocol has an **expiration date of July 28, 2014**. As a reminder, the protocol and all Accompanying documents **may not have modifications** for this decision to remain valid. It is your responsibility as Principal Investigator (PI) to maintain the status of your project by tracking and monitoring all activities related to the protocol. All research approved by the Alaska Area IRB is subject to 45 CFR 46 "Protection of Human Subjects" regulations, the US Food and Drug Administration regulations and the principles of the Belmont Report. Investigators are expected to be familiar with these provisions and adhere strictly to all requirements. You are required to have all personnel involved in the research complete the training at www.citiprogram.org, once every 36 months with a 75% proficiency in all modules. Please retain your completion certificates from the Collaborative Institutional Training Initiative (CITI).
Prior to making any changes to the protocol you must receive approval from the Alaska Area IRB. The IRB does not accept modifications and the Status Report and Renewal Application at the same time. Please ensure that project information is complete and submitted to the IRB using the electronic submission process at IRBNet at least four weeks prior to the expiration date of the project.

Sincerely,

Terry J. M. Powell
Alaska Area Institutional Review Board
IRB Administrator
4315 Diplomacy Drive RMCC
Anchorage, Alaska 99508

Appendix B: Data Collection Sheet

Patients Initials: _____________Chart #_______________________________________

Diabetic: ___________________Non Diabetic: _________________________________

Birth Weight: ______________lbs. oz.___________________ grams______________

Age: ___________________Gender____

Residence____