

Gestational Diabetes Mellitus among College Students, Its Effects on Macrosomia and
Risk of Developing Type 2 Diabetes

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Dedication

This thesis is dedicated to my late mother, Hassana S. Dimka, late sisters, Christy S. Dimka, Esther S. Dimka, and Clarah S. Dimka for their encouragement and support in the early part of this journey. Rahila, you are the reason why I kept going throughout this journey. There were days I wished not to carry on, but when I think of how far we have all come, I have no choice but to complete the journey I started. Thank you.

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Abstract

Gestational diabetes mellitus (GDM) and its risk for developing macrosomia (larger than normal birth weight) and Type 2 diabetes among mothers is a growing public health concern. The purpose of the research was to (a) compare the prevalence of macrosomia among college women diagnosed with and without gestational diabetes mellitus, and (b) to determine the association between gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus among mothers. The participants included African Americans/Blacks and Hispanic/Latino college students, ages 18 to 40 who have at least one child. Data was collected using the Pregnancy Risk Assessment Monitoring System (PRAMS) survey. Chi-square test was used to analyze the variables. Results of the study indicated that the prevalence of having macrosomic babies among mothers with and without gestational diabetes mellitus was 21.4% and 9% respectively. Maternal age was also directly proportional to giving birth to macrosomic babies. Hispanic/Latino mothers were almost twice likely to give birth to macrosomic babies than Black mothers. The Relative Risk (RR) indicated that mothers with GDM were 7 times more likely to develop Type 2 diabetes mellitus than those without GDM. This study will not only bring awareness to expected mothers and clinicians, but also provide information for early intervention to reduce gestational diabetes and its negative impacts among the neonates and their mothers.

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Chapter 1: Introduction to the Study

Gestational diabetes mellitus is defined as having high blood glucose levels during pregnancy. It usually begins during the 24th week of pregnancy as a consequence of the body's inability to make and use all the insulin it needs during the gestation period (American Diabetes Association, 2014). Gestational diabetes mellitus can have significant impact on birth outcomes, especially babies having macrosomia. In this thesis, I examined the correlation between gestational diabetes mellitus among college students and its impact on macrosomia along with the risk of developing Type 2 diabetes among mothers. In addition, the study compared the prevalence of macrosomia among students diagnosed with and without gestational diabetes mellitus. It also categorized the prevalence of women who had gestational diabetes mellitus and are at risk for developing Type 2 diabetes. Chapter 1 discussed the background, research questions and hypotheses, purpose of the study, assumptions, limitations, delimitations, and significance of the study. The chapter concludes with a summary as well as an overview of the material discussed in chapters 2, 3, 4, and 5.

Background

Gestational Diabetes Mellitus

Although the true prevalence of gestational diabetes mellitus is unknown, DeSisto, Kim, and Sharma (2014) estimate the current prevalence as 9.2%. According to the Centers for Disease Control and Prevention [CDC] (2011), there is a higher prevalence of gestational diabetes mellitus among African Americans, Hispanic/Latino American, and American Indians than other ethnicities. Also, the age-adjusted incidence

for gestational diabetes among all races and ethnicities increases with the body mass index (Henderson et al., 2012).

Gestational diabetes mellitus knowledge among mothers can help decrease birth complications and outcomes. Findings from Carolan, Heather, & Steele (2010) and Poth & Carolan (2013) showed that the lack of appropriate knowledge of lifestyle and diet to prevent gestational diabetes mellitus contributes greatly to birth outcomes. Sharma & Sharma (2012) confirmed that female illiteracy, employment, and status are closely interlinked with maternal health in all societies. This study also established birth rates and reproductive mortality such as maternal morbidity and infant mortality rates in all countries where female literacy rates are high have been low. Their findings suggested that health knowledge used previously such as changing lifestyle and behavior during gestational period is the key to improving prenatal, maternal health and birth outcomes.

Effects of Gestational Diabetes

Gestational diabetes mellitus has significant impact on birth outcomes. Children who are born to mothers with gestational diabetes mellitus are likely to have health-related complications later in life and are at risk of infant death (Lausen 2008, Davis R., Hofferth, S. L., & Shenassa, E. D., 2014). Nearly all infants born to gestational diabetes mothers are at risk of developing macrosomia (Mitanez, 2010). A detailed discussion of gestational diabetes will be discussed in Chapter 2.

Macrosomia and Its Effects

The most common complication due to gestational diabetes mellitus is macrosomia. This is an excessive weight gain of the fetus due to gestational diabetes

(Mitanchez, 2010). Macrosomia is defined as a birth weight that is greater than 4.5kg (8lbs. 13 oz.) (Campbell, 2014; Dixon, 2009; Evans & Patry, 2004; Olmos, et al., 2012, & Thorsell, Kaijser, Almström, & Andolf (2010). In recent studies, the prevalence of macrosomia ranges from 6.3% to 10.9% in mothers without gestational diabetes and is approximately 14% in mothers diagnosed with gestational diabetes (Campbell, 2014; Elnour et al., 2008; Evans & Patry, 2004). According to Campbell (2014), the mother of a macrosomic baby is susceptible to emergency cesarean section, instrumental delivery, shoulder dystocia and trauma in the birth canal, bladder, perineum, and anal sphincter.

Neonatal morbidity and mortality are known to have increased as a result of macrosomia (Dixon, 2009). Complications for the neonate include increased brachial plexus or facial nerve injuries, fractures to the humerus or clavicle and birth asphyxia (Campbell, 2014). The long-term consequences of neurological injuries and asphyxia as a result of prolong labor caused by shoulder dystocia, may cause central nervous system (CNS) damage in some children (Campbell, 2014).

There is also neonatal hypoglycemia, a complication that can result in coma or death if not detected within the first 2 hours of birth (Evans & Patry, 2004; Olmos, et al., 2012; Thorsell, Kaijser, Almström, & Andolf, 2010). Macrosomic babies are usually born through cesarean section with a complication of dystocia and neonatal hypoglycemia (Weismann-Brenner et al, 2012). According to Ma, Chan, Tam, Hanson, & Gluckman (2013) and Van, Ryan & Voruganti (2008), infants born to gestational diabetes mellitus mothers have an increased risk for developing schizophrenia in adulthood, cardiovascular illnesses, and are at an increased risk of metabolic compromise later in life. Also, some studies have established considerable correlation between maternal age, gestational

diabetes and the infants' likelihood of developing autism spectrum disorders [ASD] (Abel et al., 2013 and Xu, Jing, Bowers, Liu & Bao, 2014).

Research Questions and Hypotheses

1. Is the prevalence of macrosomia higher among women with gestational diabetes mellitus than those without gestational diabetes mellitus?

H_a : There is a difference in the prevalence of macrosomia among women with or without gestational diabetes.

H_o : There is no difference in the prevalence of macrosomia among women with or without gestational diabetes.

2. Is there an association between gestational diabetes mellitus and the risk of developing Type 2 diabetes among mothers?

H_a : There is an association between gestational diabetes mellitus and the risk of developing Type 2 diabetes.

H_o : There is no association between gestational diabetes mellitus and the risk of developing Type 2 diabetes.

Purpose of Study

The purpose of the research was to (a) compare the prevalence of macrosomia among college women diagnosed with and without gestational diabetes mellitus, and (b) to determine the association between gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus among mothers.

Definition of Terms

Gestational Diabetes Mellitus. Carbohydrate intolerance resulting in hyperglycemia, with first onset or detection during pregnancy (Buckley et al., 2012).

Dystocia. Abnormal labor or childbirth (Dorland's Medical Dictionary for Health, 2007).

Quantitative Analysis. The numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect (Babbie, 2013).

Pregnancy Risk Assessment Monitoring Systems (PRAMS). PRAMS uses mail/telephone survey of mothers who have recently given birth to document information on gestational diabetes (CDC, 2014).

Macrosomia. A newborn with an excessive birth weight —typically defined as more than 4.0 kg at birth which, classically occurs in infants of diabetic mothers (Segen's Medical Dictionary, (2012)

Independent Variable. An independent variable is presumed to cause or determine a dependent variable (Babbie, 2013).

Convenience Sampling. Selecting the research participants on the basis of being accessible and convenient to the researcher (Baumgartner & Hensley, 2013).

Assumptions, Limitations, and Delimitations

Assumptions

I assumed participants were able to read, comprehend, and follow the directions on the survey. I also assumed participants answered the questions honestly and to the best of their knowledge.

Limitations

This research consisted of students who attended a private college in New York; therefore data were collected from a convenience sample. According to Baumgartner & Hensley (2013), the results of convenience sample are not generalizable beyond the participants of the study. Also, the survey included only Hispanics/Latino Americans and African Americans/Blacksthereforethe results of the study cannot be a fair representation of all ethnicities. In addition, the mothers were asked to complete a survey based on their last pregnancy; previous pregnancies were not considered. Finally, this study may be impacted by recall bias of the participants, since mothers were asked to recall events of their last pregnancy, which could be months or years before the answering the survey.

Delimitations

The data for this study was obtained through survey done at College XYZ with 113 students. These study population consisted of African Americans and Hispanic/Latino American mothers between ages 21 - 40. Questionnaires were used to obtain data during school hours in the student's classrooms. A more detailed description of the participants and the methodology are discussed in chapter 3.

Significance of the Study

The prevalence of gestational diabetes mellitus in the United States and worldwide has been on the increase (Poth & Carolan, 2013; Oostdam, Poppel, Wouters, & Mechelen, 2011). According to the Centers for Disease Control and Prevention (2014), the incidence of gestational diabetes varies by states and by race/ethnicity. The incidence of gestational diabetes mellitus increased from 8.1% to 9.2% between 2009 and 2010 (CDC, 2014). Accordingly, the impact is felt on the amount of money spent on diagnoses and treatment as well as disability and research. Subsequently, the risk of gestational diabetes mellitus in mothers and the neonate is the increased risk of developing Type 2 diabetes as well as excessive birth weight of the infant (Mitanez, 2010 and Weissmann-Brenner, 2012).

Some studies have established that gestational diabetes mellitus may increase the chance for birth defects (Vinceti et al., 2014). Other studies have linked autism, schizophrenia, depression, and obesity to gestational diabetes mellitus complication in later life (Abel et al., 2013; Heeramun-Aubeeluck, Lu & Luo 2012; Michael, 2005; Van Lieshout, Ryan & Voruganti 2008; Sullivan, Morrato, Ghushchyan, Wyatt, & Hill 2005; Xu, Jing, Bowers, Liu, B., & Bao 2014). According to Cypryk et al., (2008), Xuanping et al., (2012), & Weissmann-Brenner et al., (2012), there is an increased risk for both mother and the neonate to have urinary tract infection, preeclampsia, neonatal hypoglycemia, jaundice and high cesarean sections as a result of these complications.

Mothers with prior knowledge of gestational diabetes mellitus preventive measures are shown to decrease the risk of susceptibility of diagnoses thereby reducing

the possibility of prenatal complications (Crowther et al., 2005). The importance of gestational diabetes mellitus knowledge among women is vital in reducing birth complications and outcomes. This is because mothers are the most vital component to reducing health complications and birth outcomes through gestational diabetes mellitus awareness (Härkönen, Kaymakçalan, Mäki & Taanila (2012), Khan, Khalique, Ali & Khan (2013). These studies showed the significance of women's knowledge in reducing pregnancy and after childbirth risk factors. Through prenatal care, behavioral and mental health issues that can potentially affect the health of the pregnant woman as well as the unborn child are addressed (Khan, Khalique, Ali & Khan, 2013). Also, the health knowledge of the mother can help determine significantly the consequences of future gestational diabetes mellitus complications.

This study will not only bring awareness to expected mothers and clinicians, but also provide information for early intervention to reduce gestational diabetes and its negative impacts among the neonates and their mothers, and subsequently reducing the health care cost associated with the complications of gestational diabetes.

Summary

Gestational diabetes mellitus is a serious public health issue that needs ongoing attention. The association between gestational diabetes and macrosomia has been established (Abel et al., 2013; Crowther et al., 2005; Heeramun-Aubeeluck, Lu, & Luo, 2012; Van Lieshout, Ryan & Voruganti Lakshmi 2008; Xu, Jing, Bowers, Liu, & Bao, 2014). However, more study is needed to ascertain the true prevalence of gestational diabetes mellitus as well as the effects of mothers' health knowledge in reducing birth outcomes. This study compared the prevalence of macrosomia among college students

diagnosed with or without gestational diabetes mellitus; and also determined the prevalence of students who are at risk for developing Type 2 diabetes after being diagnosed with gestational diabetes. It also investigated mothers with gestational diabetes mellitus in their last pregnancy and their delivery outcomes.

In chapter 2, I have presented research on gestational diabetes mellitus, its trend, the risk factors, and maternal and neonate consequences of gestational diabetes. I also examined factors contributing to diabetes and birth outcomes, consequences of gestational diabetes and trends and racial/ethnic disparities in gestational diabetes mellitus. The prevalence of gestational diabetes by age and race are also discussed. Also, the prevention of gestational diabetes mellitus and gaps in knowledge were examined.

Chapter 3 explains the methodology and design used for this study. This include the selection and number of the target population, the material and instrument used to obtain data, the details of why the study design was selected, how the data was evaluated, and the ethical considerations of the study participants.

Chapter 4 presents demographic composition of the study participants, results of each research questions and hypothesis and a summary of the major finds of the study. Chapter 5 discusses the interpretation of findings, limitation of the study, implication for future studies, and recommendation for action.

Chapter 2: Literature Review

Diabetes mellitus is a disease condition whereby the body is unable to effectively metabolized carbohydrates. The body's responsibility is to break down carbohydrates into sugar after eating, and which is subsequently absorbed into the bloodstream. Insulin made in the pancreas helps in getting sugar from the blood into the cells to be used for energy. When diabetes mellitus sets in; the body is unable to make enough insulin thereby leaving the affected person dependent on medication and insulin.

In general, there are 4 different types of diabetes mellitus (American Diabetes Association, 2014). Pre-diabetes mellitus is a condition whereby too much sugar is found in the blood but not high enough to be called diabetes mellitus. Type 2 diabetes mellitus is when the body generates insulin but in deficient quantity. There is also Type 1 diabetes mellitus, which is usually diagnosed in children and young adults. With this type of diabetes, the body does not produce insulin at all. Gestational diabetes mellitus is normally diagnosed during pregnancy but vanishes away after delivery (American Diabetes Association, 2014).

In the United States, diabetes is the 7th leading cause of death. Currently, 25.8 million of the populations have diabetes mellitus (American Diabetes Association, 2014). In addition, 18.8 million are diagnosed with diabetes while 7 million people are undiagnosed. Also, 57 million people have pre-diabetes mellitus and the number is still on the rise (American Diabetes Association, 2014). The organization also mentioned that the major risk factors for diabetes mellitus are overweight, obesity, lack of exercise, high blood pressure, the history of diabetes in a family, when one is 45 years and older, and a woman who has a history of gestational diabetes mellitus.

Gestational Diabetes Mellitus

Gestational diabetes mellitus is diabetes mellitus that happens during pregnancy. Having the condition, gestational diabetes mellitus means that the blood sugar is too high (National Institute of Diabetes and Digestive and Kidney Diseases, 2013). Women with this condition may or may not have diabetes before. This condition goes away after delivery. When a woman is diagnosed with gestational diabetes mellitus, there is a risk of having it in the future pregnancies. Women who had this condition during pregnancy are more likely to develop Type 2 diabetes mellitus (American Diabetes Association, 2014). In 2010, approximately 25.8 million Americans were diagnosed with diabetes mellitus. The rates of heart attacks, stroke, and other micro vascular complications have increased greatly since then. Similarly, in 2008, about 46 million Americans were uninsured and by 2010, the number raised to 49.5 million. The quality of health care services depends on income, which determines the type of coverage a family receives (American Diabetes Association, 2014).

Trends in Gestational Diabetes Mellitus

According to (Ferrara, 2007), there is increasing prevalence of gestational diabetes mellitus especially among different races and ethnicities within the past 20 years. This indicates that Type 2 diabetes among these groups will also be on the increase. In the United States, African Americans, Asians, Native Americans, and Hispanics are among the higher risk groups for gestational diabetes (Ferrara, 2007). Also, studies have shown that older maternal age, the plague of obesity as well as adoption to modern lifestyles in developing countries all add to the growing incidence of gestational diabetes mellitus (Ferrara, 2007). After childbirth, these women are referred to their

primary physicians who may not recognize that women with gestational diabetes mellitus are at higher risk of Type 2 diabetes.

Prevalence of Gestational Diabetes Mellitus by Age and Race

The prevalence of gestational diabetes mellitus increases by age (CDC, 2011; Dabelea et al., 2005; Lawrence et al., 2008). Between ages 18 and 45 years, there has been a significant raise in the number of new cases. In certain population as well as race and ethnicity, the incidence of gestational diabetes mellitus has a direct correlation with the occurrence of Type 2 diabetes mellitus (Lawrence et al., 2008). Furthermore, Dabelea, et al., (2005) established that by the year 2030, the prevalence of gestational diabetes mellitus trends worldwide will rise to a record level as a result of increment in diagnosis. The high-risk groups for gestational diabetes mellitus are women with low socioeconomic status and uneducated. Anna et al. (2008) found that the most significant link of gestational diabetes mellitus by demography is socioeconomic status, maternal age as well as ethnicity. Wang et al., (2013) established that mothers with assisted reproduction technology (ART) treatment had a 28% chance of developing gestational diabetes mellitus compare to women with non-assisted reproduction technology treatment.

Research has shown that the occurrence of both pre-gestational mellitus and gestational diabetes mellitus increases with age (Fong et al., 2014). Their research also confirmed the high rate of incidences of gestational diabetes mellitus in Asian but indicated that the Asians along with the Caucasians have the lowest prevalence of pre gestational diabetes mellitus. The study discussed further that with the increasing incidence of pre gestational diabetes mellitus and gestational diabetes mellitus, health

related diseases like hypertension, renal disease; thyroid dysfunction, fetal CNS malformation, fetal demise, and eclampsia are also on the rise (Fong et al., 2014). The research cautioned that races with the highest predisposition for gestational diabetes mellitus during pregnancy might not necessarily have the highest tendency for pre gestational diabetes (Fong et al., 2014).

Racial/Ethnic Disparities in Gestational Diabetes Mellitus

Xiang et al. (2011) examined the differences in diabetes mellitus risk after gestational diabetes mellitus by race and ethnicity. In a retrospective cohort study of women between 1995 -2009, the study identified gestational diabetes mellitus through plasma glucose level during pregnancy. Their research found out that there are discrepancies in the risk of diabetes mellitus by race and ethnicity. In addition, they discovered that black women diagnosed with gestational diabetes mellitus are more susceptible of developing diabetes mellitus than any other race. Also, effective gestational diabetes mellitus screening as well as prevention within this race is crucial in the control and prevention particularly among the black race.

In order to examine the correlation between gestational diabetes mellitus and the body mass index (BMI) by race/ethnicity, Henderson et al. (2012) in a cohort study discovered that the age-adjusted occurrence of gestational diabetes mellitus varies and rise by increasing body mass index type. They also showed that Hispanics, non-Hispanic whites as well as the African Americans are at a higher prevalence of gestational diabetes mellitus. The research concluded that gestational diabetes mellitus risk might also be high in low body mass index among the Asians and Filipina women. They also concluded that

Asian women stand to profit more from different preventive approach in addition to weight management.

Risk Factors for Gestational Diabetes Mellitus

Recent data have shown that the incidence of gestational diabetes mellitus has increased lately (Fong et al., (2014), Henderson et al., (2012), Reece, Leguizamón, & Wiznitzer, (2009). The increasing maternal age at delivery and the environment women live also contribute significantly. Women who live in urban areas are more likely than women living in rural environment to have gestational diabetes mellitus (Casagrande et al., 2012; Feig et al., 2008; Lawrence et al., 2008; Wang et al., 2013; Wray et al., 2006). Furthermore, the quality and access to health care services before and during first time pregnancy helps to reduce the chances of gestational diabetes mellitus. The lack of continuation of health care services after childbirth may contribute to the chances of gestational diabetes mellitus reoccurrence as well as being diagnosed with Type 2 diabetes in the future (Khambalia, 2013).

Research has shown that women with less hospital visits are more likely to be diagnosed with gestational diabetes mellitus than women who frequently go to the hospital for check-up (Xuanping et al., 2012). In addition, overweight and obesity, the history of macrosomia and prenatal complications, family history for diabetes mellitus, and being pregnant more than once are the common risk factors of gestational diabetes mellitus (Cypryk et. al, 2008). Worldwide, the rate of obesity is on the increase consequently increasing also the rates of gestational diabetes mellitus. Furthermore, maternal ages, obesity, family history of diabetes, glycosuria adverse outcomes in earlier

pregnancy are all risk factors for gestational diabetes mellitus (Araya, 2013, Khan, Khalique, Ali & Khan, 2013).

Kim et al., (2007) surveyed women that have not been diagnosed with gestational diabetes mellitus but were enrolled in a managed care plan. They examined the link between the knowledge of risk and the behavioral practices on gestational diabetes mellitus, the plans to modify behaviors as well as recent behavioral changes. The research measured the knowledge of diabetes mellitus risks factors, perceived personal control, and beliefs in the benefits as well as lifestyle modification barriers among the women (Kim et al., 2007). The study found that 90% of the women were familiar that gestational diabetes mellitus was a risk factor for them in the future. Furthermore, 16% of these women believed that they were at a higher risk of developing Type 2 diabetes mellitus. The study also shows that an increase in fruitconsumption will decrease the diabetes risk. The study concluded that in spite of the women's perception on the link between gestational diabetes mellitus and postpartum diabetes mellitus, they do not perceive themselves to be at a higher risk (Kim et al., 2007).

Diagnosis and Screening for Gestational Diabetes Mellitus

The timely detection of gestational diabetes mellitus will help to improve health outcomes as well as prevent health complications and Type 2 diabetes (Poth & Carolan, 2013). In the United States gestational diabetes mellitus is presently tested with 50-gram glucose load for a 1-hour screening test and after 3 hours, a 100-gram glucose tolerance test is done for those who test positive (Buckley et al., (2012); Vandersten et al., 2013). Also, the 2-hour glucose tolerance tests with a fasting element and glucose load rely on 75 gram of glucose load (Buckley et al., 2012; Vandersten et al., 2013). Currently, there

are approximately 9.2% of the populations that are diagnosed with gestational diabetes mellitus (DeSisto, Kim, and Sharma, 2014). However, several studies established also, that there is no sufficient evidence as to what screening approach is effective regarding gestational diabetes mellitus diagnosis (Benhalima et al., 2012; Hurtling et al., 2012;Vandorsten et al., 2013).

Maternal Consequences of Gestational Diabetes Mellitus

Gestational diabetes mellitus has significantly been linked with complication during pregnancy period such as high cesarean sections, preeclampsia, and urinary tract infection in both neonate and the mother (Cyptryk et al., 2008; Xuanping et al., 2012; Weissmann-Brenner et al., 2012). Women who have had gestational diabetes mellitus during their first pregnancy are at higher risk of developing gestational diabetes in their subsequent pregnancies. Also, evidence suggests that 30 to 50 percent of women diagnosed with gestational diabetes mellitus will go on to develop type 2 diabetes mellitus in future (Poth & Carolan, 2013). The long-term consequences of gestational diabetes mellitus is the risk of developing cardiovascular disease, hypertension and stroke if left untreated (American Diabetes Association, 2014). There is a significant link with macrosomia, neonatal hypoglycemia, and jaundice. In addition, study has shown that hypertension incidence as well as preeclampsia has increased significantly in pregnant women who are diagnosed with pre-gestational diabetes mellitus (Fong et al., 2014).

Neonate Consequences of Gestational Diabetes Mellitus

In infant, the most common birth outcome caused by gestational diabetes mellitus is macrosomia (Campbell, 2014; Dixon, 2009; Evans & Patry, 2004; Olmos, Borzone &

Gómez et al., 2012; Oostdam, Van Poppel, Wouters, & Van Mechelen 2011; & Thorsell, Kaijser, Almström, & Andolf, 2010). This is an excessive weight gain of the fetus due to gestational diabetes mellitus (Mitanechez, 2010). Mitanechez established a recurrent connection of maternal glucose levels with increased birth weight in children born to gestational diabetes mellitus mothers. Also, macrosomic babies are usually born through cesarean section with a complication of dystocia, which is an abnormal labor, neonatal hypoglycemia, and a longer hospitalization period (Weismann-Brenner, 2012). The children of mothers who developed gestational diabetes mellitus during pregnancy are at higher risk of obesity and type 2 diabetes mellitus in the future (Dabelea et al. 2005; Lau 2011; Xiang, 2011; Weismann-Brenner 2012).

Furthermore, the newborns are also at risk of heart disease and malformation due to undiagnosed type 2 diabetes. Vinceti et al., (2014) established that gestational diabetes mellitus might increase the danger for births defects. The consequence of larger gestational age is the risks for shoulder dystocia and caesarian deliveries (Benhalima et al., 2012; Khambalia et al., 2013). Other gestational diabetes mellitus consequences are increased risk for developing schizophrenia in adulthood due to behavioral changes, cardiovascular diseases, and a bigger risk of metabolic compromise (Ma, Chan, Tam, Hanson, & Gluckman 2013; Van, Ryan & Voruganti, 2008). Abel et al., 2013; Xu, Jing, Bowers, Liu & Bao; 2014, found a significant association between maternal age, gestational diabetes mellitus and the risk for developing autism spectrum disorders (ASD) in the offspring.

Cost of Diagnoses and Treatment

The average government expenditure on gestational diabetes mellitus mother to the first year of life of the newborn is about \$212,305 (Chen et al., 2009). Also, the government spent \$230 million on gestational diabetes mellitus related medical costs programs such as Medicaid. Within the private insurance, a total of \$355 million was spent on gestational diabetes mellitus cases. Charity care and self-pay care used up \$51 million (Chen et al., 2009). In Finland, a study to evaluate the cost-effectiveness of primary prevention of gestational diabetes mellitus through counseling on appropriate dieting, physical activity, and weight management for 399 women; Kolu, Raitanen, Rissanen, & Luoto (2013), established that controlling birth weight as a result of gestational diabetes mellitus was not cost-effective.

Prevention of Gestational Diabetes Mellitus

The best methods of prevention is for mothers to practice healthy behaviors such as physical activity and healthy diet to help avoid or impede the onset of diabetes mellitus (Ferrara, 2007). It is also, best for mothers and their newborns to have access to good health care as well as quality care for good counseling and advise so as to prevent the increasing prevalence. Morisset et al. (2010) & Kinnunen et al., (2014) suggested that women can manage their weight through nutritional prevention approach to help reduce the risk of gestational diabetes mellitus. The research correlated higher dietary fat and low carbohydrate intakes during pregnancy period to higher risk for gestational diabetes mellitus. Also, the lack of physical activity due to sedentary lifestyle has been linked to gestational diabetes mellitus development (Evert & Kathy, 2006). The study stated further that prevalence of gestational diabetes mellitus and subsequently Type 2 diabetes

mellitus is on the increase just as obesity and lack of physical activities. Women with gestational diabetes mellitus must to be completely advised about their risk and the need to monitor the risk. The study suggested regular counseling in hospital and clinics during visits could serve as preventive measures for gestational diabetes mellitus.

In conclusion, gestational diabetes mellitus has many consequences for both the mothers and the babies. Primary prevention such as preventing obesity before pregnancy, maintain a healthy diet, and counseling are needed before a woman gets pregnant. Secondary prevention such as screening for gestational diabetes mellitus should be done to expected mothers. This will help to further guide expected mothers to improve their nutrition exercise, and reduce weight among mothers who are at risk. Finally, urgent care is need for those mothers who are diagnosed with gestational diabetes in order to reduce complications for both the mothers and the neonates.

Macrosomia

Macrosomia is defined as excessive weight gain of the fetus due to gestational diabetes (Mitanech, 2010). Macrosomia is defined as a birth weight that is greater than 4.5kg (8lbs. 13 oz.) (Campbell, 2014; Dixon, 2009; Evans & Patry, 2004; Olmos, et al., 2012, & Thorsell, Kaijser, Almström, & Andolf, 2010). In recent studies, the prevalence of macrosomia ranges from 6.3% to 10.9% in mothers without gestational diabetes and is approximately 14% in mothers diagnosed with gestational diabetes (Campbell, 2014; Elnour et al., 2008; Evans & Patry, 2004; Najaafian & Cheraghi, 2012). In a study conducted by Najaafian and Cheraghi (2012), a total of 201,102 mothers gave birth to 1800 (9%) babies with macrosomia.

Gestational Diabetes Mellitus and Macrosomia

Gestational diabetes mellitus is a common well-known risk factor for macrosomia (Campbell, 2014; Dixon, 2009; Evans & Patry, 2004; Levy et al., 2010; Olmos, et al., 2012, & Thorsell, Kaijser, Almström, & Andolf, 2010). This condition happens when the mother develops increased insulin resistance and during fetal circulation there is a higher amount of glucose that crosses the placenta. Resultantly, this glucose becomes stored as body fat in the fetus and cause macrosomia (Kamana, Shakya & Zhang, 2015). According to Campbell (2014), 5-10% of macrosomic babies are born to mothers with gestational diabetes.

According to Lou & Copel (2009), factors such as prior history of macrosomia, pre-gestational/gestational diabetes mellitus, excessive maternal pre-pregnancy weight, and excessive weight gain during pregnancy increase the risk of macrosomia. Also, Levy et al., (2010) associated a significant familial history to gestational diabetes mellitus development in a study that examined familial history of diabetes mellitus and macrosomia as well as the method of delivery. Ogonowski, Miazgowski, Engel, & Celewicz, (2014) established an association between birth weight and the risk for gestational diabetes mellitus in a study that assessed the connection between birth weight and the risk of developing gestational diabetes in the future.

Accordingly, Tsai, Roberson, & Dye (2013), examined the relationship between ethnicity, gestational diabetes mellitus and macrosomia in Hawaiian women. The study found that by race/ethnicity, the prevalence of gestational diabetes mellitus in Hawaii was 10.9%. In Filipina women, the prevalence was 13.1% while 12.1% prevalence was found in Hawaiian/Pacific Islander women. White women had the lowest prevalence at

7.4%. The study established further that Asian/Pacific Islander women have an increased chance of developing gestational diabetes mellitus compared to the white women. Also, the chance of developing macrosomia as a result of the elevated risk of gestational diabetes mellitus among the Asian/Pacific Islander women was low.

Chapter 3: Methodology

This was a quantitative cross-sectional study that was done to compare the prevalence of macrosomia among women diagnosed with and without gestational diabetes mellitus; and to determine the prevalence of women who are at risk for developing Type 2 diabetes mellitus after being diagnosed with gestational diabetes mellitus. This chapter describes the instrument used to collect the data, study population, characteristics of the participants, instrumentation, data analysis, and ethical considerations of the data.

Research Design and Methodology

Design

This study was a quantitative, cross-sectional, and primary as well as secondary data analysis of questionnaires to establish whether knowledge among pregnant women can decrease the risk for gestational diabetes mellitus and macrosomia. A cross sectional design was utilized to verify if there is an association between two or more variables at one particular point in time of the gestational period. The PRAMS data were considered as a secondary data because the current study used questions from PRAM's database as well as analyzed data that were formerly collected by PRAMS to answer different study questions.

Methodology

A quantitative cross-sectional study was carried out to examine if the prevalence of macrosomia is higher among women with gestational diabetes mellitus than those without gestational diabetes mellitus between African American and Hispanic/Latino

students of college XYZ. The study also, determined if there is an association between gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus among mothers. Details of selection of participants, characteristic of the participants, instrumentation, and the target population are discussed separately.

Description of College XYZ

College XYZ is private, four-year institution located in New York City. It consists of approximately 7,000 students and offers undergraduate and graduate degrees. The college offers day, evening and online classes. Majority of the student population represents Blacks and Hispanic/Latinos.

Selection and Characteristics of Study Population

The target population for the thesis was African American/Blacks and Hispanic/Latino American women who attend college XYZ. Permission to conduct the research was granted by an administrator at college XYZ (Appendix I). Students were selected from ten different classes. Participants were both undergraduate and graduate students. The inclusion criteria were women ages 21 through 40 years, and had at least one child. The exclusion criteria included the history of previous pregnancies of mothers with more than one birth. If women had two or more children, they were asked to only give information about their last pregnancy and last baby.

Instrumentation

The instrument used for this study was survey questionnaires obtained from The Pregnancy Risk Assessment Monitoring System (PRAMS) (Appendix II). PRAMS is an

ongoing state- and population-based surveillance system designed to monitor selected self-reported maternal behaviors, conditions, and experiences that occur shortly before, during, and after pregnancy among women who deliver live-born infants. PRAMS select mothers randomly from births records each month to ask questions regarding their pregnancies and the time immediate after the birth of their babies. The questions asked included knowledge of gestational diabetes mellitus, complications during pregnancy, counseling received, method of delivery, and birth outcomes. Using data from PRAMS will help provide adequate information for the thesis direction as well as on the target population.

Data Collection

This study was a quantitative cross-sectional study done to examine if the incidence of macrosomia is higher among women with gestational diabetes mellitus than those without gestational diabetes mellitus between African American and Hispanic/Latino students at College XYZ. Survey questionnaires obtained from The Pregnancy Risk Assessment Monitoring System (PRAMS) were used to collect data from mother's ages 21 to 40 years from 14 different classes.

Dependent Variables

The outcome will measure:

1. *Macrosomia*. This was determined if mothers answered the question "What was the weight of your last child at birth?" A child was considered to have macrosomia if the mother reported a birth weight over 8 lbs. 13 oz.

2. *Women who have Type 2 diabetes.* This will be determined by the responses to the question “since your new baby was born, did a doctor, nurse, or other health care worker tell you that you have diabetes?” The response was dichotomous (Yes/No). If participants answered yes, they were classified as having Type 2 diabetes mellitus.

Independent Variable

Gestational diabetes mellitus is the independent variable. To assess this variable, participants responded “Yes” or “No” to the question “Were you ever told by a doctor, nurse, or other health care provider that you have gestational diabetes mellitus?” A positive response confirms gestational diabetes mellitus.

Covariates

The covariates were maternal age at the time of giving birth, race/ethnicity, income level, and type of insurance used by the participants.

Data Analyses

Data was analyzed using statistical package for social sciences (SPSS), version 20. Descriptive analyses of demographic factors will be calculated using counts and percentages. Chi-square (X^2) was performed to determine the odds ratio. A logistic regression was used to explain the association among variables as needed.

Covariates will be used to determine if there are risk factors for the development of gestational diabetes mellitus and subsequently macrosomia logistic regression.

The analyses were used to answer the following questions:

1. Is the prevalence of macrosomia higher among women with gestational diabetes mellitus than those without gestational diabetes mellitus?

H_0 : There is no difference in the prevalence of macrosomia among women with or without gestational diabetes.

H_a : There is a difference in the prevalence of macrosomia among women with or without gestational diabetes mellitus.

2. Is there an association between gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus among mothers?

H_0 : There is no association between gestational diabetes mellitus and the risk of developing Type 2 diabetes.

H_a : There is an association between gestational diabetes mellitus and the risk of developing Type 2 diabetes.

Ethical Consideration

The Institutional Review Board at Monroe College gave the researcher permission to collect data. To ensure confidentiality of the study participants, the National Institutes of Health (NIH) research guidelines on protecting human research participants were followed. The participants were assigned numbers as an identifier instead of using their names. Also, all electronic data were stored on a password-guarded computer. The survey answered questionnaires were kept in lock filing cabinet to enhance confidentiality.

Chapter 4: Results

Chapter four presents the results of each research question. The demographic variables of age, income, insurance, race, and ethnicity were included in the analyses. The research questions and hypotheses were:

1. Is the prevalence of macrosomia higher among women with gestational diabetes mellitus than those without gestational diabetes mellitus?

H_0 : There is no difference in the prevalence of macrosomia among women with or without gestational diabetes mellitus.

H_a : There is a difference in the prevalence of macrosomia among women with or without gestational diabetes mellitus.

2. Is there an association between gestational diabetes mellitus and the risk of developing Type 2 diabetes among mothers?

H_0 : There is no association between gestational diabetes mellitus and the risk of developing Type 2 diabetes.

H_a : There is an association between gestational diabetes mellitus and the risk of developing Type 2 diabetes.

Descriptive Statistics of Participants

The study population included a subset of mothers, who attended college XYZ between January and March 2015. One hundred and thirteen (113) students answered the survey. The study consisted of 68 African Americans, 38 Hispanic not blacks, and seven other participants who did not indicate their race. Figure 1 describes the race/ethnicity of the participants.

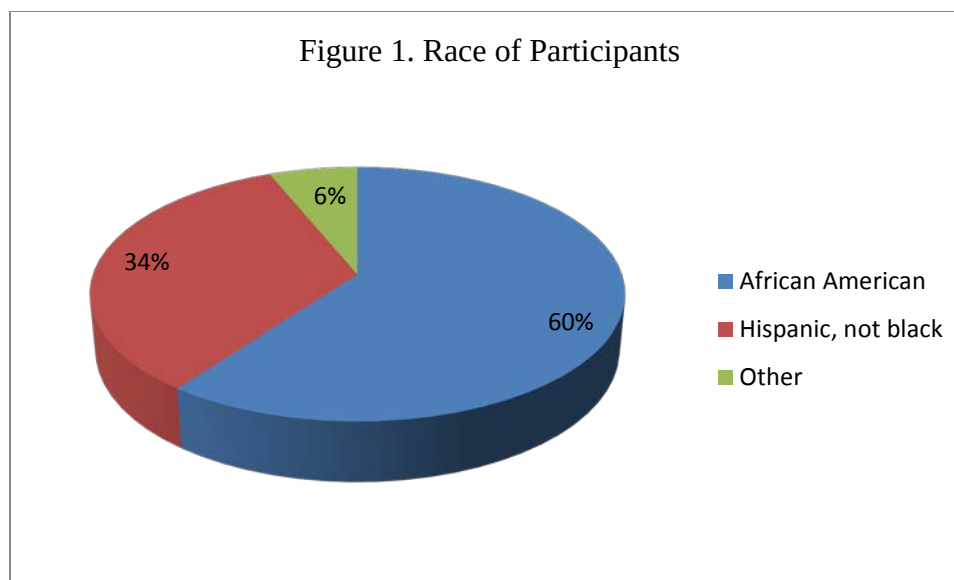


Figure 1. Race/Ethnicity of Participants

Figure 2 shows that most of the study's participants are between ages 21 and 30 years old (75%) and the remainder of the population were between 31 and 40 years old (25%).

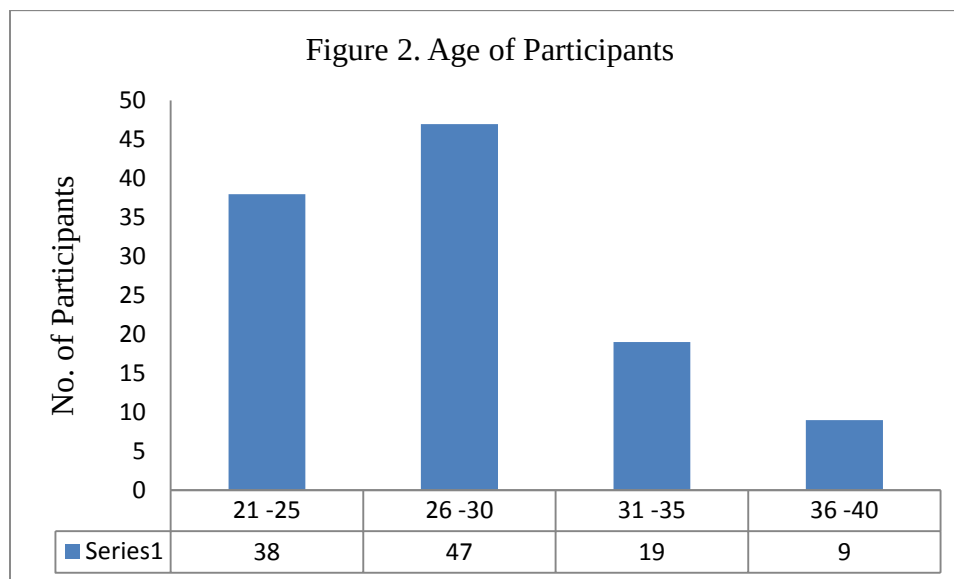


Figure 2. Age of Participants

Most of the participants (49%) had Medicaid insurance while 43% had private insurance. The remaining 8% had Tricare, 1199, or did not have insurance (Figure 3).

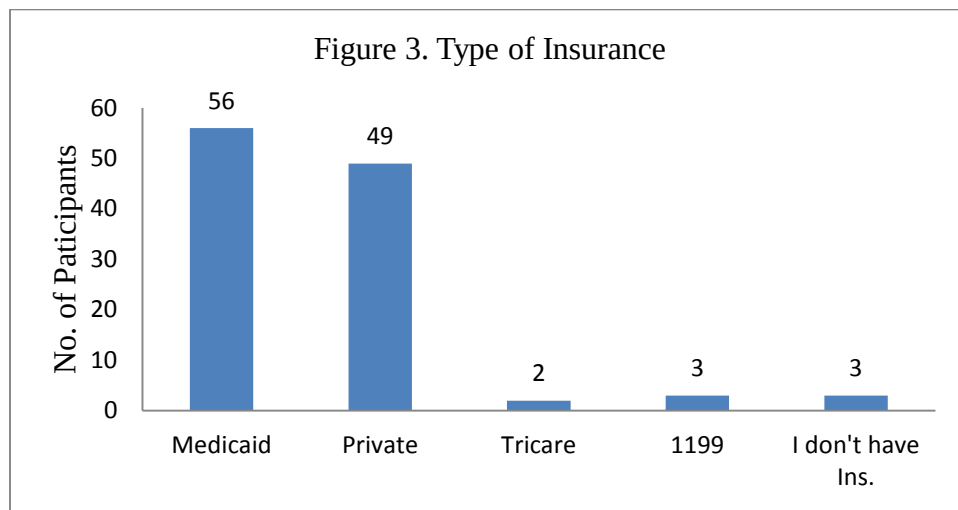


Figure 3. Type of Insurance Coverage of Participants.

Approximately 65% of the participants had an annual income of \$10,000 and \$39,000. Twenty-eight (28%) had an annual income between \$40,000 and \$60,000, and approximately 7% did not state their income (Figure 4).

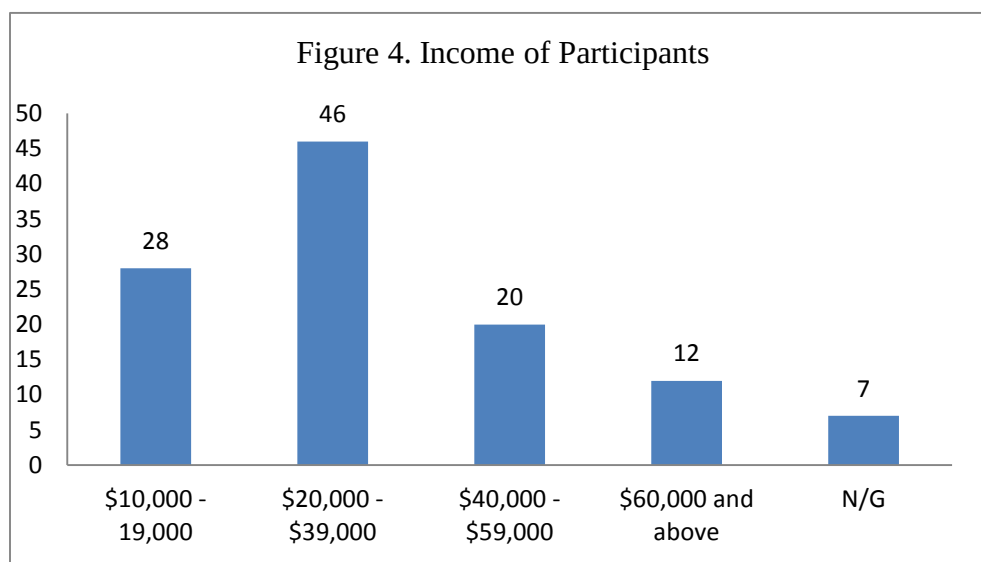


Figure 4. Income Level of Participants

Gestational Diabetes Mellitus Status and Macrosomia

Figure 5 represents the number of participants with and without gestational diabetes mellitus and whether or not those mothers had babies with macrosomia. Of the 113 participants, 14 mothers had gestational diabetes mellitus while 99 did not. Therefore, the prevalence of gestational diabetes among this population was 12.4%.

The overall prevalence of macrosomic babies in the study population was 10.6%. Three (3) mothers with gestational diabetes mellitus had babies with macrosomia (21.4%). There were 9 babies born with macrosomia among the mothers who did not have gestational diabetes mellitus (9%).

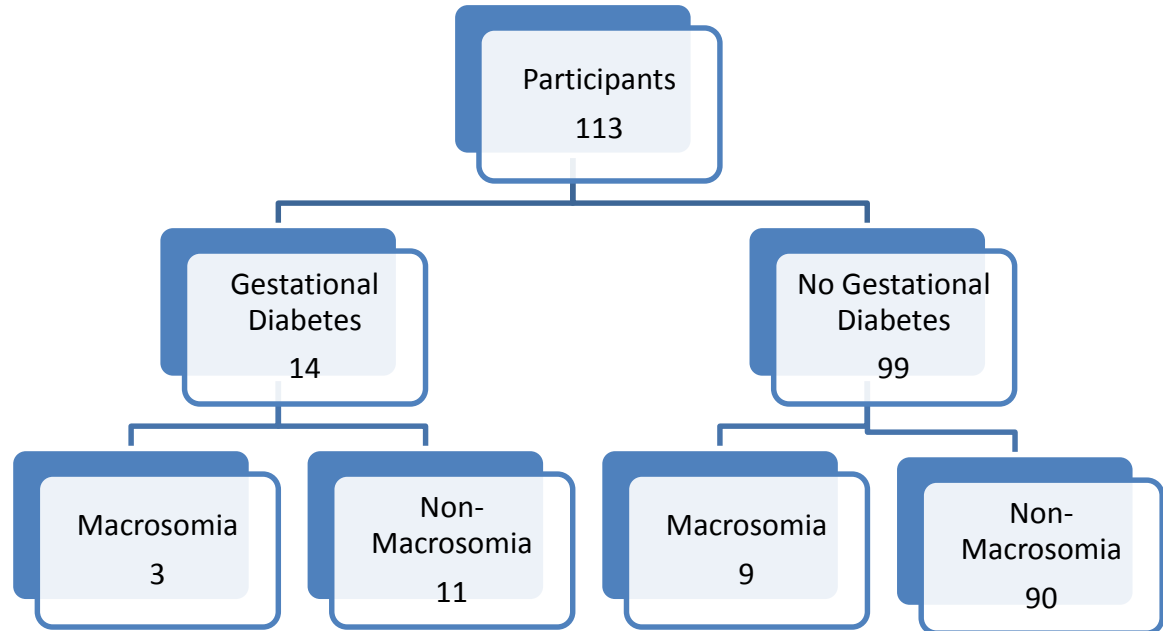


Figure 5 - Participants' Gestational Diabetes Mellitus Status and Macrosomia

Bivariate Analysis

A Chi-square test was performed to calculate the odds ratio for macrosomia and age. The test result indicated that the probability of macrosomia delivery increases with age. At ages 21 - 25, the chance of macrosomia delivery was 5.1%, ages 26 - 30, were 11.1%, and ages 31- 40, 18.5% (Table 1). The results also showed that macrosomia delivery is higher (13%) among mothers who used private insurance for prenatal care then mothers (9.3%) who used public insurance. Also, resultsshowed that the rate of macrosomic delivery is higher (13%) in Hispanic/Latino than African American (7.1%). The study results indicated also that only 20% of women with gestational diabetes mellitus were educated on nutrition during pregnancy. Only 22% were educated about the importance of exercise and 20% were educated on maintaining a healthy weight. Another 20% indicated that they were educated on the risk of developing Type 2 diabetes mellitus.

Table 1

Macrosomic Babies by Mother's Age

Age	%	X ²	p-value
21 - 25	5.1	2.974	0.226
26 – 30	11.1		
31 – 40	18.5		

Note. X² – Chi-square.

Research Questions

1. Is the prevalence of macrosomia higher among women with gestational diabetes mellitus than those without gestational diabetes mellitus?

H_0 : There is no difference in the prevalence of macrosomia among women with or without gestational diabetes mellitus.

H_a : There is a difference in the prevalence of macrosomia among women with or without gestational diabetes mellitus.

Cross-tabulation (Chi-square) test was conducted to determine the relationships between the categorical variables (gestational diabetes mellitus and macrosomia). Results indicated that 9.2% of the women in the group without gestational diabetes mellitus had macrosomic babies, while 21.4% of the women with gestational diabetes mellitus had macrosomic babies. An Odds Ratio (OR) table was constructed for the two variables (Table 2).

Table 2

2X 2 Table for Calculating Odds Ratio (OR)

Gestational Diabetes Mellitus (GDM)	Macrosomia	
	Yes	No
	No	Yes
Yes	A = 3	B = 11
No	C = 9	D = 90

Calculation: Odds Ratio (OR) = $A * D / B * C = 3 * 90 / 9 * 11 = 270 / 99 = 2.73$

An OR of 2.73 suggests that women who had gestational diabetes mellitus were 2.73 times more likely to deliver macrosomic babies than those without gestational diabetes mellitus.

2. Is there an association between gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus among mothers?

H_0 : There is no association between gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus.

H_a : There is an association between gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus.

A Chi-square test was performed to evaluate the association between those who had gestational diabetes mellitus and the chances of developing Type 2 diabetes mellitus. Based on the data collected, approximately eight percent (8%) of those who were diagnosed with gestational diabetes mellitus developed Type 2 diabetes mellitus, while approximately two percent (2%) of the women without gestational diabetes mellitus developed Type 2 diabetes mellitus after giving birth. A table was also constructed to determine the measure of association between having gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus (Table 3).

Table 3

2 X 2 Table for Calculating Relative Risk (RR)

Type 2 Diabetes	Gestational Diabetes Mellitus (GDM)		
		Yes	No
	Yes	A = 5	B = 3
	No	C = 9	D = 96

Calculation: Relative Risk (RR) = $(A/A+B) / (C/C+D) = (5/8) / (9/105) = 525/72 = 7.29$

A RR of 7.29 suggests that women who had gestational diabetes mellitus were approximately 7 times more likely to develop Type 2 mellitus than those without gestational diabetes mellitus. Fisher's Exact Test showed a very strong association between Gestational Diabetes Mellitus and the risk of developing Type 2 Diabetes ($p = 0.001$).

Chapter 5: Discussion, Recommendations and Conclusion

Studies have indicated that the prevalence of gestational diabetes mellitus and its related health complications in the United States and worldwide is increasing (CDC, 2014; Poth & Carolan, 2013, Oostdam, Poppel, Wouters, & Mechelen, 2011).

Macrosomia, a common known health problem associated with gestational diabetes mellitus is also on the rise. Research has established the high-risk groups for gestational diabetes mellitus as people from Hispanic/Latino origin, African Americans, American Indians, women with low-socioeconomic status, and the uneducated, (Dabelea, et al., 2005). Also, the most important demographic links to gestational diabetes mellitus are ethnicity, maternal age, and socioeconomic status (Anna et al., 2008). These studies found that the prevalence of macrosomia among mothers diagnosed with gestational diabetes mellitus ranges from 6.3% to 10% and 14% in mothers without gestational diabetes mellitus (Campbell, 2014; Elnour et al., 2008; Evans & Patry, 2004).

The purpose of this study was to examine whether the prevalence of macrosomia is higher among women with gestational diabetes mellitus than those without gestational diabetes mellitus. Also, the study examined the association between gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus. This study utilized a quantitative cross-sectional design with questions from The Pregnancy Risk Assessment Monitoring System (PRAMS). Gestational diabetes mellitus was the independent variable while the covariates were maternal age at the time of giving birth; race/ethnicity, income level, and type of insurance. Pearson's chi-square test was used to determine the prevalence and association between categorical variables and macrosomia as well as the risk of developing Type 2 diabetes mellitus.

Chi – square test was done to examine the association between independent variable and covariates. Odds ratio with 95% Confidence Interval were used to represent association and p values less than 0.05 were considered statistically significant.

Key Findings

Gestational Diabetes

The prevalence of gestational diabetes mellitus among the participants was 12.4%. The results from this study confirmed that the prevalence of gestational diabetes mellitus is on the increase (13% - Hispanic/Latino and 7.1 – African American) as found in literature. Also, the results of this study confirmed that gestational diabetes mellitus increases with age. Approximately nineteen percent (18.5%) of participants who had GDM were between ages 31 – 40, compared to 11.1% between ages 26 – 30, and 5.1% between ages 21 – 25. Other studies (CDC, 2011; Dabelea et al., 2005; Lawrence et al., 2008) showed similar trend.

Macrosomia

The overall prevalence macrosomia in this study was 10.6%. However, the prevalence of having macrosomic babies among women with gestational diabetes mellitus was higher (21.4%) than those without gestational diabetes mellitus (9%). Olmos et al. (2012) found that the prevalence of macrosomia was 14.9 % among women with gestational diabetes mellitus. Although this present study is much higher than Olmos et al., (2012), this prevalence is even higher in some previous studies. In fact, Kamana, Shakya & Zhang (2015), reported that fetal macrosomia affects 15-45% of newborns of mothers with gestational diabetes.

Another key finding of this study revealed that increase in maternal age is proportional to having macrosomic babies. At ages 21-25, the chance of macrosomia delivery was 5.1%, ages 26-30, 11.1%, and ages 31-40 were 18.5%. This find was also confirmed by previous studies

Finally, a higher percentage (13%) of Hispanic had macrosomic delivery, than Blacks (7.1%). This is a new finding that has never been reported in previous studies.

Development of Type 2 Diabetes

The present study indicates that mothers with gestational diabetes mellitus were seven times more likely to develop Type 2 diabetes mellitus than those without gestational diabetes. Other researchers have found a positive correlation between gestational diabetes and the risk of developing Type 2 diabetes (American Diabetes Association, 2014; Khambalia, 2013; Poth and Carolan, 2013; Wang et al., 2012). Poth and Carolan (2013) indicated that 30-50% of women diagnosed with gestational diabetes had Type 2 diabetes. In the study conducted by Wang et al. (2012), the researchers found out that the hazard ratio (HR) of developing Type 2 Diabetes among the women with gestational diabetes was 6.52. With these results in mind, it is imperative that mothers with this condition get immediate intervention to prevent them from developing Type 2 diabetes.

Limitations of the Study

This study has several limitations. First, the design of the study was a cross-sectional study; therefore it does not provide evidence for causal relationships. On the other hand, the sample size of the study was small (113) so the results cannot be generalized. In addition, the survey was done at a particular location (College XYZ) therefore results cannot be generalized beyond the study population. Furthermore, the

histories of previous pregnancies of mothers with more than one birth were excluded from the study. Women only gave information about their last pregnancy and last baby alone.

Recommendations for Action

Results from this study indicated that the prevalence of macrosomia is increasing. Research reports indicated also that macrosomia is more common among women with gestational diabetes mellitus than those without (Elnour et al., 2008). Studies have also confirmed that a history of prior macrosomia delivery, pre-gestational diabetes mellitus/gestational diabetes mellitus, excessive maternal pre-pregnancy weight and excessive weight gain during pregnancy are factors that increase the risk of macrosomia (Campbell, 2014; Dixon, 2009; Evans & Patry, 2004; Levy et al., 2010; Lou & Copel, 2009; Olmos, et al., 2012, & Thorsell, Kaijser, Almström, & Andolf, 2010). In addition, Elnour et al., (2008) proved that intervention such as education and intensive self-monitoring of mothers with gestational diabetes mellitus decreased macrosomia and neonatal complications, thus improving birth outcomes. Therefore, the awareness and more preventive measures against contributory factors as well as ways to manage gestational diabetes mellitus should be emphasized. Preventive efforts should mainly focus on services such as eating healthy diets, exercising, and maintaining a healthy weight before and after delivery.

Furthermore, one way to effectively prevent the increasing prevalence of gestational diabetes mellitus and macrosomia is through education on ways to prevent it as well as manage it. This research results indicated that only 20% of women with gestational diabetes mellitus were educated on nutrition. Also, only 22% indicated that

they were educated about the importance of exercise and 20% indicated that they were educated on maintaining a healthy weight. Another 20% indicated that they were educated on the risk of developing Type 2 diabetes mellitus. Based on this study, adequate intervention was not in place to help these at-risk women. These preventive measures should be emphasized more among those women who are susceptible to developing gestational diabetes mellitus as well as women with the prior history of macrosomic deliveries due to gestational diabetes.

Implication for Future Studies

This study found a significant association between maternal age and macrosomia. This indicates that the chances of macrosomic deliveries increase as women advance in age. This study confirmed the prevalence of macrosomia among women with gestational diabetes mellitus to be slightly higher than women without gestational diabetes mellitus, however, results from the Chi-Square test indicated that it is not significant because the p-value was greater than 0.05. Explanation could be that the sample size was small to give a significant association. Also, the study confirmed that the prevalence of gestational diabetes mellitus is higher among Hispanic/Latino mothers (13%) than African American mothers (7.1%). Therefore, early intervention is needed, especially for Hispanic/Latino mothers to decrease their prevalence of gestational diabetes.

Conclusion

This study was conducted to explore whether the prevalence of macrosomia is higher among women with gestational diabetes mellitus than those without gestational diabetes mellitus. The study also investigated the possible association between gestational diabetes mellitus and the risk of developing Type 2 diabetes mellitus among mothers. Results from this study suggested that gestational diabetes mellitus is a significant risk factor for macrosomia. Women who had gestational diabetes mellitus had 17% macrosomic delivery than women without gestational diabetes mellitus (9%). In addition, women who were diagnosed with gestational diabetes mellitus are 1.8% at risk of developing Type 2 diabetes mellitus.

The prevalence of gestational diabetes mellitus as found in literature and this study confirmed is on the increase. Literature has confirmed the prevalence of macrosomia in mothers diagnosed with gestational diabetes mellitus ranges from 14% and 6.3% to 10.9% in mothers without gestational diabetes mellitus (Campbell, 2014; Elnour et al., 2008; Evans & Patry, 2004). Studies have also shown that mothers with assisted reproduction technology (ART) have 28% chance of developing gestational diabetes mellitus as compared to mothers with non-assisted reproduction technology treatment (Wang et al., 2013). Explanation to this could be as a result of advance age of those who seek assisted reproduction technology treatment. In addition, this study confirmed that Hispanic/Latino women are at higher (13%) risk of developing gestational diabetes mellitus than African Americans (7.1%).

Preventive measures should focus mainly on education against gestational diabetes mellitus contributory factors. These factors are history of prior macrosomia

delivery, pre-gestational diabetes mellitus/gestational diabetes mellitus, excessive maternal pre-pregnancy weight and excessive weight gain during pregnancy (Campbell, 2014; Dixon, 2009; Evans & Patry, 2004; Levy et al., 2010; Lou & Copel, 2009; Olmos, et al., 2012, & Thorsell, Kaijser, Almström, & Andolf, 2010). Furthermore, preventive efforts that focuses on services such as eating healthy diets, exercising, and maintaining a healthy weight before and after delivery should be encouraged during every prenatal visits. Preventive measures should also be targeted at women who are at high risk of developing Type 2 diabetes mellitus.

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Appendix I - Permission to Conduct Survey at college XYZ

Dec 9, 2014
To
Me
CC

C. Brown
Jan 21

Hi Anita,

You have permission to collect data from College XYZ students.

Xxx Jerome Avenue

West Hall, Room 315

Bronx, NY 10468

xxx.xxx.8301

Appendix II - Survey Questions - Experience during Pregnancy

1. What is your Race/Ethnicity?
 - a. African American/Black

- b. Hispanic or Latino American
 - c. Asian
 - d. Caucasian
 - e. Other
- 2. How old were you when you got pregnant with your **last** baby?
 - a. 21 -25
 - b. 26 -30
 - c. 31 -35
 - d. 36 -40
- 3. Were you ever told by a doctor, nurse, or other health care provider that you have gestational diabetes? Yes No
- 4. Age diagnosed with gestational diabetes
 - a. 21 – 25
 - b. 26 – 30
 - c. 31 – 35
 - d. 36 -- 40
 - e. I never had gestational diabetes **(If you choose the answer, skip question #5)**
- 5. During your most recent pregnancy, when you were told that you had gestational diabetes, did a doctor, nurse, or other health care worker do any of the things listed below? For each item, circle Y (Yes) if it was done or circle N (No) if it was not done.
 - a. Refer you to a nutritionist.....**No Yes**
 - b. Talk to you about the importance of exercise.....**No Yes**

- c. Talk to you about getting to and staying at a healthy weight after delivery.....**No Yes**
- d. Talk to you about your risk for Type 2 diabetes.....**No Yes**
6. How often did your healthcare provider/nurse talk to you about nutrition, physical activities, weight, and consequences of gestational diabetes?
- Very frequently
 - Frequently
 - Occasionally
 - Rarely
 - Never
7. Just before you got pregnant with your new baby, how much did you weigh?
_____lbs.
8. How much weight did your doctor, nurse, or other health care worker tell you to gain during your most recent pregnancy? Please check one answer and fill in the blanks(s) next to the checked box.
- Between [] Pounds and [] Pounds
 - Between [] Kilos and [] Kilos
 - Exactly [] Pounds OR []Kilos
 - None
9. After giving birth with your last baby, were you told by a doctor or nurse that you are at risk of type 2 diabetes? Yes No
10. What was the weight of your last child at birth? _____lbs. _____ oz.

11. Would you consider your child overweight? Yes _____ No _____
12. How tall are you without shoes? _____ft. _____ inches.
13. How much do you currently weigh? _____lbs. _____ oz. **(You may use the scale provided).**
14. Since your new baby was born, did a doctor, nurse, or other health care worker tell you that you have diabetes? **Yes** _____ **No** _____
15. What is your income level?
- a. \$10,000 - \$19,000
 - b. \$20,000 - \$39,000
 - c. \$40,000 - \$59,000
 - d. \$60,000 and above
16. Would you say that, in general, your health is?
- a. Excellent
 - b. Very good
 - c. Good
 - d. Fair
 - e. Poor
17. Are you currently insured? If yes, type of insurance.
- a. Medicaid or Medicare
 - b. TRICARE
 - c. Private insurance
 - d. State option (SCHIP or CHIP program)
 - e. I don't have any insurance

18. Where did you go *most of the time* for your prenatal care visits? **Do not** include visits for WIC. Check one answer.

- a. Hospital clinic
- b. Health department clinic
- c. Private doctor's office or HMO clinic
- d. Other -- Please tell us: _____

THANK YOU