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Childhood Obesity: Intervening In Utero

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Childhood Obesity: Intervening In Utero

by

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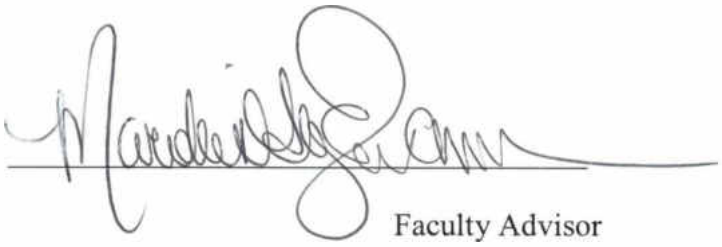
This independent study, submitted by Mary Lee Beck, in fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the faculty advisor under whom the work has been done and is hereby approved.



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Abstract

The prevalence of childhood obesity has risen to epidemic proportions in this country. American Indian youth are disproportionately affected by this epidemic and its comorbidities, like diabetes, when compared to whites, and even other minorities. There is no single determinant of cause. Currently interventions are focused at the individual, family, community and environmental levels. Perhaps the most important component in this epidemic, however, is being overlooked: the health status of the mother during pregnancy. There is strong evidence that obesity and diabetes are perpetually cycled from mother to baby during pregnancy, and maternal obesity and diabetes play a significant role in childhood obesity. The landmark study in 1983 with the Pima Indians in Arizona found a 10-fold higher rate of obesity as a result of exposure to a diabetic intrauterine environment. Today there is renewed interest and supporting evidence that confirms the connection of maternal diabetes and obesity in the offspring. An extensive review of literature was conducted and results were presented to the Leech Lake Tribal Health medical staff during a monthly meeting. Health care practitioners must be aware of the current findings and the 2011 guidelines set forth by the American Diabetes Association so that they can not only provide early interventions to prevent and manage diabetes and obesity throughout pregnancy, but into adulthood as well. American Indian women need to be empowered with this knowledge to improve their own health and that of the generations yet to be born.

Intrauterine Prevention of Childhood Obesity

Introduction

The United States Department of Health and Human Services Healthy People 2020 calls for a reduction in the number of overweight and obese children and adolescents, citing the rising trend of increased body mass index (BMI) and obesity as one of 10 leading health indicators in the United States (Centers for Disease Control [CDC], 2010). A decade after the US Surgeon General published a call of action to the American people to reduce childhood obesity; the United States has made little progress toward these goals. Despite numerous medical and public health efforts over the last 10 years, the prevalence of high BMIs in children has not declined and has remained fixed. Obesity prevalence rates among children and adolescents indicate an alarming forecast for future burden of disease. According to data from the 2007-2008 National Health and Nutrition Examination (2010), 17% of children and adolescents in this country are obese. Approximately 10% of infants and toddlers younger than 2 years are at or above the 95th percentile of the weight-for-recumbent-length growth charts. Almost 12% of children and adolescents ages two-19 years are at or above the 97th percentile of the BMI-for-age growth charts. Almost 17% of children and adolescents ages two-19 are at or above the 95th percentile and almost 32% were at or above the 85th percentile of the weight for height growth charts (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010).

Wang, McPherson, Marsh, Gortmaker and Brown (2011) forecasted that by the year 2020, 3 out of 4 Americans will be overweight or obese if current trends continue, resulting in an additional 6-8.5 million cases of diabetes and similar projections for heart disease, stroke and cancer. The authors also found that the combined medical costs for these preventable diseases are estimated to increase by $48-66 billion per year in the United States.

All obese children face increased risks for developing high cholesterol, hypertension, respiratory problems, depression and social isolation, musculoskeletal problems, and diabetes type 2. There is no single determinant of child and adolescent overweight and obesity; the causes are multifactorial, and have been addressed at the behavioral, psychological, family and societal levels. However, there has been clear evidence showing a link between maternal obesity and diabetes in pregnancy with obesity and diabetes type 2 in the offspring.

American Indian youth are particularly affected by this epidemic and their comorbidities are disproportionate when compared to whites and even when compared to other minority ethnic groups (Crawford, Story, Wang, Ritchie, & Sabry, 2001). Obesity is a devastating personal affliction for these youth, physically, psychologically, and socially. In addition to the high rates of childhood obesity, Native American Children also have the highest prevalence of diabetes type 2. The changes in lifestyle and behaviors and the constructed environments are indeed contributing to this epidemic. It is crucial to recognize that there is still much to accomplish and much ground to be gained in the battle to decrease the number of overweight and obese children and adolescents, especially in the Native American population.

Healthcare providers are missing opportunities to help children and adolescents reduce obesity with interventions during the intrauterine growth period. There is growing interest and significant research in the perpetual cycle of maternal weight gain, maternal type 2 diabetes, and gestational diabetes, with childhood obesity, insulin resistance, and early on-set of diabetes type 2 in the offspring. Fetal life is being examined more closely as a critical period for the development of childhood obesity.

Purpose

The purpose of this project was to explore vital research and evidence that identify the connection between diabetes and obesity during pregnancy, and obesity and diabetes in the offspring. Uncontrolled diabetes and obesity throughout pregnancy may set up a genetic pathway of obesity, diabetes, and metabolic syndrome throughout the lifetime of the child.

Sackett, Rosenberg, Gray, Haynes, and Richardson (1996) define evidence-based medicine as "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients" (p. 71). Evidence showing a relation between obesity in children and diabetes during pregnancy in their mothers first appeared in 1983 in the landmark study with the Pima Indians (Pettitt, Baird, Aleck, Bennett, & Knowler, 1983). The Pima Indian study began in 1965, when Pima Indians at least 5 years old participated in a study of diabetes and its complications. Measurements of obesity and glucose tolerance during pregnancy were examined. This longitudinal study allowed for comparisons of data from children and young adults whose mothers were tested during pregnancy. Follow-up from this research was done by Dabelea, Knowler and Pettitt (2000) confirming that "exposure to diabetes in utero is a strong determinant of diabetes in Pima children" (p. 86). This follow-up study revealed that the diabetic intrauterine environment was responsible for 40% of type 2 diabetes in children and teens ages 5-19 years. Seventy-percent of type 2 diabetes mellitus in adults, ages 25-34 years was also a result of being exposed to the diabetic intrauterine environment. The authors' conclusion: "The effects of diabetic pregnancy can be thought of as a vicious cycle, with consequences for the offspring extending well beyond the well beyond the neonatal period" (p. 87).

In another landmark study, this one concerning the transfer of research evidence from the literature to patient, Balas and Boron (2000) estimated that it takes an average of 17 years to put new scientific evidence into practice. Considering that the first evidence linking maternal diabetes with obesity in the offspring appeared almost 30 years ago, there is now an urgent need to put this scientific evidence into practice.

The goal of educating health care providers with this evidence is to support changes in practice regarding the prevention of excessive weight gain and gestational diabetes during pregnancy, and the promotion of closer management of type 2 diabetes throughout pregnancy. Closer management of type 2 diabetes would include tight glycemic control, therapeutic lifestyle changes and medical nutritional therapy. The chosen deliverable will address these findings with health care providers at Leech Lake Tribal Medical Staff meeting and also at the Leech Lake Diabetes Team meeting in April and May, 2012. A round table discussion will follow summarizing resources within the health division that are available to obese and/or diabetic pregnant women. Referral protocols will be outlined, and copies of the Alaska Native's *Diabetes in Pregnancy-Screening and Management Guidelines, Indian Health Diabetes Best Practices-Diabetes in Pregnancy* (Alaska Native Health Consortium, 2011), and a copy of the American *Diabetes Association's Standards of Medical Care in Diabetes-2011* (ADA, 2011) will be made available to all attendees.

In 2011 the American Diabetes Association (ADA) issued new Standards of Medical Care guidelines recommending changes in the way pregnant women are screened for gestational diabetes and high risk women are screened for type 2 diabetes. The changes were based on the current scientific evidence found in the literature that spans almost 30 years.

Health care providers have a responsibility to screen all high risk pregnant women, including American Indian women, at that very first prenatal visit, and to intercede clinically with prevention of excessive weight gain, tight management of blood sugars and interventions to prevent hyperglycemia, and prevention of gestational diabetes. Post natal childhood obesity interventions may be too late in some cases and for some children.

Significance

Changing the course of maternal weight gain, preventing gestational diabetes during pregnancy, and closely monitoring maternal diabetes type 2 during prenatal care, can have an impact on generations to come and may help to decrease the epidemic of diabetes throughout this country. Nowhere would this be more profound than within the Native American population. Diabetes is a somber threat to many Native American communities.

Obesity and its comorbidities are disproportionately high in American Indian youth, with 40% to 50% of Indian children classified as overweight or obese (Crawford et al., 2001). As stated earlier, the rise of type 2 diabetes prevalence in the American Indian population correlates directly with the increasing rise in prevalence of obesity. Of particular concern are the American Indian children, where the diagnosis of type 2 diabetes is taking place more often and at earlier ages than previous years. The Centers for Disease Control and Prevention reported that the number of American Indian children, adolescents, and adults under 35 years of age diagnosed with diabetes increased 71% from 1990-1998. In those 8 years, the overall prevalence rate increased by 46%. By far the most dramatic increases were seen in children and adolescents, with 60% increase among females and 81% increase among males (CDC, 2011). With almost any tribe in the US today a public health assessment would most likely reveal the prevalence of diabetes type 2 among children to have increased, again, right alongside obesity.

In a study of Northern Plains American Indian children in 2002-2003, it was found that more than 40% of children at 5 years of age were overweight and almost one-quarter of these children were obese (Zephier, Himes, Story, & Zhou, 2006). Anderson and Whitaker (2009) concluded that the highest prevalence of obese and overweight children and adolescents in the US was in the American Indian population, where childhood and adolescent overweight and obesity are twice as common as in non-Hispanic white or Asian children.

American Indian youth who develop type 2 diabetes during their childhood or adolescent years will suffer more years of disease burden and additionally develop more grave complications from type 2 diabetes than other populations (Petitti et al., 2009) This perpetual cycle must be broken if we are to reduce the number of overweight and obese children and adolescents, and consequently the epidemic of diabetes and the resulting comorbidities in young American Indian people. The most important aspect of this project is to encourage preventive health care in the prenatal period to decrease the impact of diabetes on the Native American population.

Overview of the Obesity and Type 2 Diabetes Mellitus Epidemic in American Indians

For young people in American Indian populations, the rise of the epidemic of obesity and the paralleled type 2 diabetes has been particularly swift and severe. This population has experienced rate of diabetes several times higher than that among the white population and even other minority populations (Moore, 2010). From 1990 to 2004 the prevalence of type 2 diabetes among American Indian and Alaska Natives adolescents, aged 15 to 19 years increased by 68% for those who used Indian Health Services (CDC, 2006). Some research has pointed to the influence of rapid environmental and behavioral changes. However, attention has recently been directed at the possible role of diabetic pregnancies, both gestational diabetes and pre-existing

maternal diabetes type 2, in this epidemic. Although compelling human evidence of this first appeared nearly 30 years ago, current research is confirming the intergenerational cycle of obesity and diabetes, providing strong evidence that in addition to genetics, there is an independent effect of the intrauterine environment on the risk for developing childhood obesity.

The current epidemic of childhood obesity among American Indian children is by no means being ignored. Health care professionals are given numerous tools and resources to work with in reducing childhood obesity. There are primary interventions on the family, community, school and environmental level. These include less screen time at home, changing the culture of calorie-laden fast foods diets to eating fresher foods and promoting indigenous foods and gardening. Healthier school lunches and improved physical education programs are being presented within the school systems, and environmental planners are creating more green space, bike paths and walking trails. Secondary interventions include collaborations between health care providers and dieticians for healthy weight goals in children, and prescribed physical fitness programs. There are even tertiary interventions such as bariatric surgery with some morbidly obese adolescents.

All of these efforts, however well planned and executed, are presented in the extra-uterine life, during childhood and adolescence, and we are continuing to see poor results. A crucial component in the primary prevention of childhood obesity is being overlooked and ignored by current protocol – the health status of the mother during pregnancy. Children born with insulin insensitivity and an altered approach to a glucose challenge, as with what happens when there is a diabetic intrauterine environment, are born with the cards stacked against them.

A new approach may be to work to reduce childhood obesity in utero, by altering the intrauterine environment. Preventing excessive maternal weight gain, preventing or controlling

gestational diabetes, screening early and controlling of pre-existing type 2 diabetes should become protocol in perinatal care.

Physiological Framework: Obesity and Diabetes Type 2

Maternal Diet Creating Insulin-Resistance in the Offspring

Knowledge of what happens when fetuses are exposed to diabetes in utero is increasing, but there still is a gap in the understanding of how and why it happens. Some theories suggest that fetal overnutrition, results in fuel excess and increased fat cell neogenesis. Other studies suggest fetal hyperinsulinemia as a result of maternal hyperglycemia creates future insulin resistance and results in malprogramming of the neuroendocrine systems (Franke et al., 2005).

Many studies illustrate the damaging effect of a high-fat diet on insulin and glucose uptake, but very few laboratory studies have investigated the long-term effects of the maternal diet and dietary fat on insulin and glucose uptake in the offspring. Elton, Pennington, Lynch, Carver, and Pennington (2002) published a study on rodents that reported that overweight pregnant females have higher levels of glucose and free fatty acids floating around in the womb than normal weight pregnant rodents do. This study examined the effect of maternal high fat feeding during pregnancy on the glucose/insulin ratio of the offspring upon weaning. The outcome of this study implied that a maternal diet that contained a higher amount of fat had significant negative long-term consequences for the offspring. The data indicate that glucose uptake was profoundly reduced in the muscle fibers of the offspring whose mothers consumed a higher amount of dietary fat. In addition, there was a tendency for a lower fat diet to create higher insulin receptor protein levels in the offspring. This resulted in higher glucose uptake in these offspring. The offspring from the pregnant rats consuming more fat had nearly 50% less receptor-associated, insulin-dependent activity compared with the offspring from the lower fat

diet. Less tyrosine kinase activity resulted in mice that were impaired in their ability to take up glucose and less sensitive to insulin, i.e., insulin resistance (Elton et al., 2002).

Maternal Obesity and Gestational Diabetes

Unhealthy maternal eating and increased weight gain in pregnancy have a negative effect on the offspring: childhood obesity, type 2 diabetes and metabolic syndrome. The 2009 Institute of Medicine's pregnancy weight gain guidelines are based on pre-pregnancy body mass indexes (BMIs). Please see Appendix A.

According to the IOM (2009), women having children today are significantly more overweight and even more obese than at any time in the past. In fact, women are leading the current epidemic obesity rate at a 33% prevalence rate (Ogden et al., 2006). Obesity among pregnant women is becoming one of the most significant health issues in perinatal care. Catalano, Hauguel-de Mouzon, Minium, and Presley (2009) found that maternal blood glucose is increased among obese women, and "fetal development in utero may present a particularly vulnerable time period for the maternal environment to affect long-term growth and energy metabolism" (Catalano, et al., 2009, p. 1079).

Excessive weight gain and gestational diabetes can be prevented in pregnancy with dietary and exercise interventions that are safe and effective. In 2005, evidence appeared establishing physical activity as playing an important role in reducing the incidence of gestational diabetes and improving glycemic control by significantly improving the body's ability to control blood sugar levels (Dempsey, Butler, and Williams, 2005). The authors found that, when compared to pregnant women receiving standard dietary intervention alone, women receiving exercise therapy (e.g., a 1-hour self-paced walk following a meal, or two 30 –minutes sessions on a stationary bike, 3-4 times per week) had better glycemic control, lower fasting and

lower postprandial glucose concentrations. Thus, the risk of childhood obesity could be reduced by the addition of a dietary and exercise program during pregnancy.

Diabetes Type 2 in Pregnancy

Paralleling the epidemic increase of obesity in women of childbearing age is type 2 diabetes in pregnancy. Although most diabetes in pregnancy was previously thought to be gestational diabetes, Hone and Jovanivic (2010), found that approximately 50% of their population of study patients with hyperglycemia were believed to have preexisting type 2 diabetes.

While about 85% of pregnancies complicated with hyperglycemia will not result in major malformations, most experts agree that diabetes and hyperglycemia at the time of conception and in early pregnancy can have the most serious consequences. The effects of hyperglycemia during these stages can result in a lifetime of health challenges for the offspring, including obesity, insulin-resistance/diabetes and metabolic syndrome, as well as the related comorbidities of heart disease, hypertension, and optic, circulatory, liver and renal complications (Boinpally and Jovanivic, 2009; Hone and Jovanovic, 2010).

Definitions

- Type 2 Diabetes Mellitus: Common disorder characterized by insulin resistance and relative insulin deficiency. Obesity, leading to insulin resistance, is the primary cause of type 2 diabetes in children (Mayo Clinic, 2012).
- Insulin Resistance: A condition when cells don't respond normally to insulin, and glucose cannot easily enter the cells. As a result, glucose remains in the blood and levels in the blood rise, despite your body's attempt to control the glucose by churning out more and more insulin. This can lead to abnormally high levels of

insulin in your blood, and eventually diabetes (Mayo Clinic, 2012; (Mantzoros, 2012).

- Metabolic Syndrome: A cluster of conditions that occur together — increased blood pressure, a high blood sugar level, excess body fat around the waist or abnormal cholesterol levels — increasing the risk of heart disease, stroke and diabetes (Mayo Clinic, 2012)
- Gestational Diabetes: When the body is not able to make enough insulin during pregnancy, gestational diabetes mellitus (GDM) is a condition that develops. This lack of insulin causes the blood glucose (also called blood sugar) level to become higher than normal. Gestational diabetes affects between 2 and 10 percent of women during pregnancy (Mayo Clinic, 2012).
- Childhood Obesity: Childhood obesity is a serious medical condition that affects children and adolescents. It occurs when a child is well above the normal weight for his or her age and height. Cutoff points on the growth charts, established by the CDC help identify overweight and obese children: BMI-for-age between 85th and 94th percentiles is overweight and BMI-for-age in the 95th percentile or above is considered obesity. Because the extra pounds often start children on the path to health problems that were once confined to adults, such as diabetes, high blood pressure and high cholesterol, childhood obesity is especially challenging. Childhood obesity can also lead to psycho-social problems, such as depression and self-esteem (Mayo Clinic, 2012).

Process

Literature searches were conducted using the University of North Dakota library website. Google and Google Scholar were used to search for studies and reports from organizations such as the ADA and IOM. A search in PubMed using the MeSH terms "child" and then "obesity" and "prevalence" and "United States" revealed 508 articles. Results were then limited to the last year, and 85 studies were returned, with several pertinent articles. Changing the term "prevalence" to "rates" returned 18 results, with one applicable article. Replacing the term "rates" with "programs" returned 11 results with 3 applicable articles. Data about the prevalence of childhood obesity were also found through a search of the CDC and National Institutes of Health. CINAHL searches used the terms "childhood obesity rates AND " United States" with limits of 2009 to present and noted 19 articles. Four were fully reviewed.

Defining the population and narrowing searches to "American Indian childhood obesity" without limits on PubMed returned 52 articles, seven were applicable. Similar results were found on CINAHL. Searches were also conducted for obesity AND type 2 diabetes in American Indian youth. A simple search in PubMed using "American Indian childhood AND obesity" returned 31 articles, and of these 31, six were pertinent.

A specific search for evidence linking childhood obesity and diabetes to excessive maternal weight gain and maternal diabetes was investigated using PubMed. The search "maternal diabetes and obesity in the offspring" returned 315 articles. Four were found by title matching. With the addition of "American Indian" in the heading, six articles were returned and all six were applicable. The MeSH terms "diabetes, gestational" AND "obesity" AND "child" increased the results to 60 articles, of which 23 were pertinent. This collective search was not

limited by time, as the seminal literature in this area was done in 1983, and the author was also looking for follow-up studies from that research.

Searches for screening and interventions related to type 2 diabetes during pregnancy and gestational diabetes were performed through PubMed, initially using the simple search "preventing gestational diabetes." This returned 88 articles, and included articles on maternal type 2 diabetes as well. The search "screening for type 2 diabetes in early pregnancy" revealed 24 articles, three were pertinent. An internet search for the New Medical Standards of the American Diabetes Association resulted in three scholarly, applicable articles.

Finally, the author searched the reference section of all relevant articles for other pertinent articles, and six articles were included in the project due to these searches.

Information gained from these searches point to needed changes and interventions aimed at prevention of gestational diabetes, early screening and diagnosis of type 2 diabetes, implementing lower thresholds for the diagnosis of gestational diabetes, and prevention of hyperglycemia and excessive maternal weight gain. These changes in clinical practice offer the potential to stop the cycle of diabetes and obesity in children.

Obstetricians, family practitioners, and nurse practitioners, and certified nurse midwives are the intended audience for this information. All are in primary care roles that provide the opportunity to implement the new diabetic screening guidelines and interventions.

Synthesis of the Literature

Multiple articles citing the alarming trend of obesity in children and adolescents were reviewed. Ogden, Carrol, Curtin, Lamb and Flegal (2010), found that despite numerous medical and public health efforts over the last 10 years, the prevalence of high BMIs in children has not declined, and has remained steady. The retrospective studies reflecting this conclusion were

cross-sectional cohort studies based on the National Health and Nutrition Examination Survey that represented a probability study of the US population. A search for childhood and adolescent obesity in the defined population of American Indians returned very few pertinent articles. One review article found that American Indian youth are affected by this epidemic and its comorbidities disproportionately when compared to whites, and even to other minority ethnic groups with 40% to 50% of Indian children classified as overweight or obese (Crawford et al., 2001). Styne (2010) also pointed out the disparity that exists with childhood obesity in American Indian children, confirming similar data that suggests American Indian youth have the highest prevalence of obesity of all ethnic groups in the United States, and the highest prevalence of some complications of obesity, such as a type 2 diabetes. Dabeala, et al., (1998) conducted a cohort study with American Indian children that found an increase in prevalence of type 2 diabetes in this population, related to obesity. Similarly, Zephir et al., (2006) concluded in their analysis of survey data that American Indian children are at an even higher risk for obesity and diabetes type 2 when compared to all US children, including other racial or ethnic groups. Moore (2010) summarized that youth-onset type 2 diabetes is an emerging significant public health problem.

Early on in the literature search it appeared there was a gap in time between the first landmark study linking maternal diabetes to obesity in the offspring and further studies. Pettitt et al., (1983) studied the relations between obesity in children and diabetes during pregnancy in their mothers, within the Pima American Indian population. They concluded that at 15 to 19 years of age, 58% of offspring of diabetic mothers weighed 140% or more of their desirable weight, compared with 17% of the offspring of non-diabetics, and 25% of those with pre-diabetes. The follow-up studies with the Pima Indians, not published until the late 1990's,

continued to provide evidence showing that offspring exposed to maternal diabetes in utero had significantly higher rate of childhood obesity, as well as obesity into adulthood (Dabeala, et al., 2000; Pettitt et al., 1983).

Multiple articles presented findings similar to the landmark study in 1983, and showed evidence of an association between maternal diabetes and obesity in the offspring (Battista, Hivert, Duval, & Baillargeon, 2011; Dabeala, Hanson, Lindsay, Pettitt, Imperatore, Gabir, Roumain, Bennett & Knowler, 1999; Dabelea, Knowler, & Pettitt, 2000; Dabeala, 2007; Damm, 2009; Fetita, Sobngwi, Seradas, Calvo, & Gautier, 2006; Herring & Oken, 2011; Hillier, Pedula, Schmidt, Mullen, Charles & Pettitt, 2007). Two articles specifically addressed fetal exposure to diabetes and/or maternal obesity and subsequent metabolic syndrome in childhood. One, a longitudinal cohort study showed evidence that children who were exposed to an intrauterine environment of either diabetes or maternal obesity were at increased risk of metabolic syndrome (Boney, Verma, Tucker, & Vohr, 2005) The second meta-analysis found strong evidence suggesting a hyperglycemic intrauterine environment, whether from gestational diabetes or overt diabetes present at conception, can impose metabolic changes in the fetus that may predispose a child to a life challenged by obesity, and in some cases, metabolic syndrome (Moore, 2010). An additional study examined the relationship between maternal obesity and insulin resistance in the fetus. They concluded that "maternal obesity creates a significant risk for the next generations with metabolic compromise already apparent before birth. If prevention is the goal to stem the epidemic of obesity and related problems, then the perinatal period of development may be an important focus of additional research" (Catalano et al., 2009, p. 1070).

Studies with other populations have shown mixed results. Perhaps one explanation for the lack of association with other studies is because those mothers achieved optimal glucose control.

Another is that the specific age at which height and weight are measured had most often been under two years of age. A study by Crume, et al., (2011) used the average BMI and the BMI growth trajectory from infancy through childhood with children exposed to diabetes in utero. By investigating growth trajectories rather than data collected from a specific time, the authors focused on developing an understanding of when in post natal life the intrauterine exposure begins to most influence children's BMI. This study revealed that neither the average BMI nor the BMI growth trajectory showed any significant difference between exposed and unexposed offspring from birth through 26 months of age. After 26 months there was a substantially higher average BMI and BMI growth trajectory with the in-utero diabetes exposed children. The effect was most prominent by ages 10 to 13 years (Crume et al., 2011).

The literature also supports measures to screen for and aggressively treat hyperglycemia and keep tight glycemic control during pregnancy. The Hyperglycemia and Adverse Pregnancy Outcomes (HAPO) Study found that there is a continuous linear relationship between maternal glucose and newborn adiposity (Metzger, et al., 2008). Hone and Jovanovic (2010) advocate universal preconception screening for diabetes. Bionpolly and Jovanovic (2010) also recommend early screening and immediate medical nutrition therapy for diabetes in pregnancy. They also concede that when diet and exercise do not succeed in maintaining euglycemia, supplemental pharmacological therapy is necessary.

Gestational diabetes and excessive weight gain can be prevented in pregnancy and dietary interventions and physical activity is supported by the literature. In their article Dempsey, Butler and Williams (2005) cited the newer American Congress of Obstetricians and Gynecologists (ACOG) guidelines that more assertively promote physical activity during pregnancy. They concluded that for most women the risks of exercise during pregnancy do not outweigh the

confirmed health benefits. A meta-analysis by Quinlivan, Juliana and Lam (2011) found that dietary interventions in obese pregnant women can reduce maternal weight gain without a negative effect on newborn weight.

Critical Evaluation of the Literature

According to Larue, Draus, and Klem (2009), one of the final and most important steps in practicing evidence-based care is the critical evaluation of the information used to answer the clinical question. Although there are other methods of evaluating evidence, such as ranking the evidence based on the effectiveness, appropriateness and feasibility of an intervention, (Evans, 2003), the author believes that the ranking system set forth by the American Academy of Family Physicians (AAFP) is most appropriate for this review of the literature.

The AAFP ranking system utilizes an "ABC" rating scale based on the study design. An "A" rating would include studies that are high quality randomized control trials (RCT). Other study designs such as a non-randomized control trial, non-quantitative systematic review, including lower quality RCTs, case-controlled and clinical cohort studies, as well as historical, high quality, uncontrolled studies or well-defined epidemiology studies would be ranked with a ""B" rating. Consensus viewpoint and expert opinion are "C" rated studies.

Crawford, et al., (2001) found that American Indian youth are affected by this epidemic and its comorbidities disproportionately when compared to whites, and even when compared to other minority ethnic groups with 40% to 50% of Indian children classified as overweight or obese. This review article discusses prevalence rates, risk factors, and health consequences of childhood obesity among African Americans, Hispanics, Native Americans, and Asian Americans. Level of evidence: B

An analysis of survey data by Zephier et al., (2006), concluded that rates of overweight and obesity in a sample of American Indian children signify that they are at an even higher risk for overweight and obesity and the resulting comorbidities than the best estimates for all US children. This study was done in the Aberdeen Area Indian Health Service. Participants were 11538 American Indian children attending 55 schools on 12 reservations. The objective of this study was to report prevalence of overweight and obesity in a large sample of American Indian children from a survey in 2002-2003, and to investigate the change in prevalence since the 1995-1996 measurements of children on the same reservations. Level of evidence: B

Two articles discussing the increasing prevalence of type 2 diabetes in American Indian children were referenced in this project. A review article by Dabelea, et al., (1998) found that type 2 diabetes is increasing among children in populations with high rates of type 2 diabetes in adults, such as the American Indian population. This review expanded on the thirty year study with the Pima Indians in Arizona that will be discussed further. Level of evidence: B. In another review article, Moore (2010), discussed the American Indian people experiencing rates of diabetes several times higher than that among the white population and even other minority populations. Level of evidence: B

In 1965 Pima Indians at least 5 years of age began participating in a study of diabetes and its complications. Biennial examinations with measurements of obesity and glucose tolerance were tested during pregnancy in this study. The duration of the study has allowed for comparisons of information collected on children and young adults whose mothers participated in the study and were tested during pregnancy. A landmark retrospective study by Pettitt et al., (1983) came as a result of this longitudinal testing. To date, this cohort study is the most compelling human evidence connecting maternal diabetes and obesity and diabetes in the

offspring. The sample included three categories of offspring in this study: 1326 offspring of 446 non-diabetic mothers, 541 offspring of 134 prediabetic mothers, and 68 offspring of 49 diabetic mothers. Offspring were separated into five age groups. The results indicated that the offspring of the diabetics were generally more obese than the remainder of the offspring, with quite a substantial difference. Offspring exposed to diabetes during pregnancy had a ten-fold higher rate of childhood obesity, independent of maternal obesity and prediabetes, when compared to those not exposed to maternal diabetes. The study concluded that one cause of obesity in children and adolescents may be maternal diabetes during pregnancy, which may consequently lead to diabetes in offspring. Level of evidence: B

Although the Pima Indian study did not make a correlation to obesity in the mothers during pregnancy and obesity in the offspring, more recent articles have made this connection, Catalano and Ehrenberg (2006), reported that children who were born to obese mothers (based on BMI in the first trimester) were twice as likely to be obese by two years of age. It went on to report that in obese women with gestational diabetes, and well-controlled glucose on diet alone there was a significant increase in fetal macrosomia, which many studies connect with childhood obesity when compared to women with gestational diabetes with a normal BMI. The authors concluded that both maternal weight and the presence of maternal diabetes may affect the risk of obesity in the offspring, independently. Level of evidence: B

Herring and Oken, (2009) reported that many epidemiological studies have found that higher maternal gestational weight gain is associated with higher child weight in childhood and adolescence with the resulting risk for diabetes and other comorbidities. Level of evidence: B.

Ci, Goran, Kauer, Nollen, and Ahluwalia, (2007) concluded that predictors early in life may have a substantial influence on the developmental trajectories of overweight children. Level of evidence: C.

Vohr, McGarvey, and Tucker, (1999, p. 1284), found that " large for gestational age offspring of maternal gestational diabetes have evidence of increasing body size and adiposity with increasing age, and that maternal gestational diabetes and maternal pre-pregnant adiposity are significant predictors of their unique growth patterns." Level of evidence: B.

A multicenter, multiethnic cohort study by Wrotniak, Schults, Buttes, and Stettler, (2007), concluded that "helping pregnant women to meet the recommended weight gain during pregnancy may be an important and novel strategy for preventing pediatric obesity" (p. 1818). Level of evidence: B.

A follow-up study of the Pettitt, et al. Pima Indian study was done by Dabelea, Knowler and Pettitt (2000). The objective of this study was to review the data on the long-term effects of fetal exposure to the diabetic intrauterine environment in the Pima Indians. The methods of this study included examining the data from the Pima Indian study that began in 1965. The results of this follow-up revealed that the diabetic intrauterine environment was responsible for 40% of type 2 diabetes in children and teens ages 5-19 yrs. The authors also discovered that 70% of type 2 diabetes in individuals ages 25-34 years was a result of being exposed to the diabetic intrauterine environment. The authors concluded that "The effects of diabetic pregnancy can be thought of as a vicious cycle, with consequences for the offspring extending well beyond the well beyond the neonatal period" (p. 87). Level of evidence: B

In another post-study following the Pima Indian longitudinal study by Dabelea et al., (2000) siblings were observed, comparing those born before their mother had diabetes to those

born after their mother was diagnosed with diabetes. The method for the analysis of diabetes included selecting nineteen nuclear families in which one sibling was born before and at least one sibling was born after the mother was diagnosed with type 2 diabetes. The siblings from the nuclear families each had the same mother and father, so the only major difference was exposure in utero to a diabetic environment. Due to age being a factor in the prevalence of diabetes, siblings at similar ages were used within a three year age interval. For analysis of BMI, fifty-two families were selected in which, again, at least one sibling was born before the mother was diagnosed with diabetes, and at least one sibling was born after the mother was born with diabetes. To determine if the sibling differences were indeed due to differences in exposure to maternal diabetes, rather than to something that correlated with birth order, similar examinations were done in other families selected where siblings were born before and after the father had diabetes. Of the 19 families where one was born before maternal type 2 diabetes and one was born after diabetes, 15 of the siblingships showed that diabetes was more common in the offspring born after the diagnosis of diabetes. Among 84 siblings from 24 families of diabetic fathers, the risk for type 2 diabetes was similar for those born before the fathers were diagnosed with type 2 diabetes and those born after the father was diagnosed with type 2 diabetes. Analyzing for obesity in the offspring, BMI measurements were done in 183 non-diabetic siblings that were born either before or after the mother was diagnosed with type 2 diabetes. In the 62 siblings who were exposed to diabetes in utero, the mean BMI was significantly higher, when compared to the 121 siblings not exposed to diabetes in utero. In the families where the father had type 2 diabetes, those born before the diagnosis and those born after the father had diabetes showed no significant difference in mean BMI. This study concluded that there was

strong evidence supporting a high risk for the development of obesity and diabetes in the offspring when exposed to the intrauterine diabetic environment. Level of evidence: B

In a similar study, Crume et al. (2011) investigated correlations between exposure to diabetes in utero and BMI growth curve from birth through thirteen years of age among a diverse cohort of youth. In the study design, mixed linear effects models were created to investigate differences in BMI and BMI growth velocity for ninety-five subjects, birth through thirteen years of age who were exposed to diabetes in the intrauterine environment. An additional 409 subjects who were not exposed to diabetes in utero enrolled in this retrospective cohort study. The results showed that although the overall BMI growth track – adjusted for sex and race/ethnicity- was not significantly distinctive between exposed and unexposed offspring from birth through 26 months of age. However, the overall growth track from 27 months of age through 13 years did differ by exposure status (also adjusted for age and race/ethnicity). The most substantial difference was in the ages of youth between 10 and 13 years, where there was a much higher BMI growth rate among exposed youth, increasing by 4.56 BMI points, compared with 3.51 BMI points in the unexposed youth. The observations were not altered when there was control for demographic variables, socioeconomic aspects and maternal pre-pregnancy BMI. The authors concluded that BMI growth in late childhood was accelerated due to exposure to diabetes in utero, increasing the long-term obesity risk. Level of evidence: B

Combining evidence from a MEDLINE search that covered that period from 1960-2005 Fetita et al. (2006), found that studies performed with children and adolescents who had been exposed to a diabetic intrauterine environment showed a higher prevalence for impaired glucose tolerance and indicators of insulin resistance. They found that in animal studies as well, exposure to a hyperglycemic environment in utero also led to glucose intolerance in the adult offspring.

The authors concluded that a diabetic intrauterine environment may contribute to the worldwide epidemic of diabetes, and suggested that public health interventions aimed at high risk populations should not only focus on long-term follow-up of these offspring, but also on better glycemic control during pregnancy. Level of evidence: B

Hillier et al. (2007) applied a cohort study to evaluate how the range of quantified glycemia in pregnancy affects the risk of obesity in the offspring. During 1995-2000 universal gestational diabetes screening was performed in two regions of the United States, the Northwest and Hawaii, within a large health maintenance organization. Gestational diabetes was diagnosed using a three- hour oral glucose tolerance test and National Diabetes Data criteria. At five to seven years of age the offspring were weighed for percentiles using U.S. norms and then classified by maternal positive glucose challenge test. The results showed a positive trend for rising childhood obesity across the range for rising maternal glucose values. They concluded that "increasing hyperglycemia in pregnancy is associated with an increased risk of childhood obesity" (p. 2291). Level of evidence: B

Additional literature searches were performed for interventions aimed at screening, supervision and management of type 2 diabetes and screening and prevention or management of gestational diabetes (and hyperglycemia) during pregnancy, in preventing obesity and diabetes in the offspring. An expert review by Boinpally and Jovanovic (2009), discussed type 2 diabetes, stressing that, although gestational diabetes poses threats to the mother and child, undiagnosed type 2 diabetes in pregnancy results in hyperglycemia from conception, with far graver consequences. Therefore, the authors argued, it is imperative that type 2 diabetes be diagnosed early and separated from gestational diabetes. This review reported that many women with diabetes in pregnancy (type 2 and gestational) can, with nutritional and lifestyle management,

reach adequate glucose control. Also in this expert review, the authors discuss the statement from the ADA on nutritional recommendations and interventions for maternal diabetes that states all women with diabetes in pregnancy should receive medical nutritional therapy that consists of a carbohydrate-controlled meal plan with specific individual nutritional evaluations. In addition, blood glucose, urine ketones, appetite and weight gain should be monitored. This review does acknowledge that although the ADA position statement also recommends that women with diabetes in pregnancy receive adequate calorie for appropriate weight gain, caloric restriction and moderate weight loss are thought to be appropriate for some obese women with type 2 diabetes or gestational diabetes. In concluding, the authors put forth that they believe that "the most effective way to improve the fate of the next generation is to employ a more proactive diabetes screening process for women within their childbearing years" (p. 278). Level of evidence: C

Hone and Jovanivic (2010) published a case study focusing on type 2 diabetes during pregnancy and achieving normoglycemia with limited weight gain, to optimize fetal and maternal outcomes. According to the authors, 10 % of pregnancies worldwide are complicated by hyperglycemia. In the population they work with at the Sansum Diabetes Research Institute in Santa Barbara, CA, approximately 50 % of the women diagnosed with hyperglycemia during pregnancy are thought to have type 2 diabetes, meaning hyperglycemia was present from conception. The specific case for this study was a 38 year old Hispanic woman, gravida 3, para 2, who presented in her 9th week of gestation. Preceding this pregnancy her last child, (4 years old at the time of this study), had a birth weight of 9 pounds, 4 oz. Complications in the postnatal period were neonatal jaundice and neonatal hypoglycemia. The random blood glucose testing of the pregnant mother revealed a blood glucose level of 345mg/dl, and her glycosylated

hemoglobin (A1C) was 8.9%. There was no diagnosis of diabetes with her previous pregnancy, and no preconception care. Other assessments included: BMI-29.8, and a dilated retinal examination that showed background diabetic retinopathy. Traditionally this patient would have been classified as having gestational diabetes, but given the high A1C early in pregnancy and the retinopathy, the patient was diagnosed with type 2 diabetes. Upon diagnosis, the patient was educated regarding self-monitoring blood glucose, medical nutritional therapy, journaling and record keeping. In addition, the patient was counseled on insulin, given her extremely high blood glucose and the immediate need for glycemic control. (Insulin dose was calculated using her pregnancy/diagnosis weight, and on first trimester status.) At 12 weeks, the patient's self-monitoring blood glucose levels were at goal, on a regular basis. At sixteen weeks of gestation, the patient's A1C was 6.9%, and by week twenty, the A1C was 5.3%. For the duration of the pregnancy the A1C remained at 5.3%. At the 38th week, the patient gave birth to an infant weighing 8 pounds, 8 ounces. There was no evidence of postpartum neonatal hypoglycemia or hyperbilirubinemia. In conclusion, the authors advocated for universal preconception screening in all women of childbearing age, or screening at the first prenatal visit to prevent hyperglycemia in the early weeks of gestation. Level of evidence: B

In 1998 the International Association of Diabetes and Pregnancy Study Groups (IADPSG) was formed to assist collaboration between regional and national groups that have a focus on diabetes and pregnancy. A report that followed by the International Association of Diabetes and Pregnancy Study Groups Consensus Panel (IADPSG), (2010) gave the opinions of individual members of the IADPSG Consensus Panel after reviewing the Hyperglycemia and Adverse Pregnancy Outcomes (HAPO) study that was presented at an international workshop

sponsored by IADPSG. The objective of this report was to serve as the basis for internationally endorsed criteria for in diagnosing and classifying diabetes in pregnancy.

The HAPO study assessed levels of maternal glucose (less than diagnostic for diabetes) that were associated with perinatal outcomes. This was done by administering a 75-g oral glucose tolerance test on approximately 25,000 women in the third trimester of pregnancy. This cohort of pregnant women was heterogeneous, multinational, multicultural and ethnically diverse. This study led to the lower thresholds for diagnosing gestational diabetes included in the 2011 ADA Standards of Medical Care. This newer criteria for diagnosis will undoubtedly mean an increase in the percentage of women with diabetes in pregnancy, which is appropriate, given the current epidemic of obesity. Level of evidence: B

Regarding the management of obese women during pregnancy and restricting weight gain, a very recent meta-analysis was published by Quinlivan, Juliana, and Lam (2011). The objective of this study was to assess whether dietary interventions that restrict weight gain in pregnancy compromise the weight of the newborn. Although the objective for this study differs from the objective of restricting weight gain in pregnancy to prevent gestational diabetes and obesity in the offspring, the methods are similar, with the intended goal of weight restriction still the target. This review did report that there may be biological effects on the fetus beyond that of birth weight, including the body composition and percentage of fat in the offspring. The authors sought to update a recent systematic review that had concluded that the effect of dietary interventions to overweight and obese pregnant was unclear. The review in question had collected data on trials of a variety of interventions during pregnancy, and in doing so missed the effect of only dietary interventions.

The methods of study selection for this meta-analysis included randomized control trials in which nutritional and dietary interventions were provided to overweight and obese pregnant women. Four randomized control trials were selected involving 537 pregnant women, with 267 in the intervention group and 270 in the control group. The intervention group results were pooled, and with the dietary interventions, the total gestational weight gain was reduced by 6.5 kg (14.3 pounds). Lower gestational weight gain in the mothers was not shown to be associated with the birth weight of the newborn, or have an effect on birth weight. This meta-analysis suggests that it possible to achieve maternal weight restriction during pregnancy with overweight and obese woman, consistent with the 2009 guidelines set forth by the Institute of Medicine, without compromising the birth weight of the offspring. Level of evidence: B. Similarly, in 2005 Dempsey et al., found that women receiving both dietary and exercise interventions in pregnancy had tighter glycemic control with lower fasting and post-prandial glucose concentrations. Level of evidence: B.

Childhood obesity and diabetes type 2 have reached epidemic proportions in the American Indian population and place a heavy burden of disease on the future for the American Indian youth. Although there are numerous efforts aimed at reducing childhood and adolescent obesity, for some, these interventions might be too late. The evidence points out that there exists a relationship between obesity, hyperglycemia and diabetes in the mother during pregnancy, and obesity and diabetes in the offspring. Earlier screening and lower thresholds for diagnosis of diabetes in pregnancy have been set forth by the ADA and evidence of interventions aimed at weight gain restriction and achieving normoglycemia are being shown to be safe for the mother and fetus. More research is needed however, to determine if earlier screening with lower thresholds, weight gain restriction and tight glucose control will result in a reduction in

childhood obesity. It has been established that there is a link between maternal diabetes and childhood obesity, however, additional studies are needed to determine specific results in the offspring when there is closer management of maternal diabetes: medical nutrition therapy and exercise therapy, self-monitoring blood glucose schedules, tightly controlled medications, education and support.

Studies with specific assessment guidelines and interventions are needed to guide practice and facilitate the implementation of newer standards of practice in the prevention of hyperglycemia in pregnancy. More education and guidance for clinical practice is needed from the dietary and nutritional experts related to medical nutritional therapy for diabetes in pregnancy. Exercise therapy guidelines need to be determined. How much is too much and how much is adequate for weight gain restriction and normoglycemia in pregnancy? Public health implications are broad, and collaborations, health teaching, referral and follow-up and additional community, family and individual interventions require evaluation.

Discussion

Interpreting the Evidence

The research connecting the diabetic/hyperglycemic intrauterine environment with childhood obesity has been well documented since 1983. There can be no more delays in education. Clinical practice must reflect the evidence.

The burden of disease from obesity and the paralleling epidemic of type 2 diabetes are crippling the American Indian people. In no other population is this burden of these afflictions quite so severe and widespread. The future well-being of American Indian communities and culture is being threatened by childhood obesity. Obesity is a devastating affliction for these youth, affecting them physically, emotionally and socially.

The path to obesity and diabetes often begins in the womb, and evidence has borne this out. A vicious cycle of the increasing frequencies of diabetic and obese pregnancies is contributing to the increasing number of obese children and adolescents in the American Indian people. The diabetic intrauterine environment has the ability to imprint obesity long before birth. Maternal diabetes can cause childhood obesity.

The ADA medical standards for diabetes in pregnancy changed in 2011, reflecting the current epidemic of obesity and the resulting undiagnosed diabetes during pregnancy. The ADA has recommended that screening for diabetes type 2 be initiated at the very first prenatal visit in all women at risk. The changes also call for lower thresholds with fasting plasma glucose and oral glucose tolerance tests for diagnosing gestational diabetes, and only *one* abnormal value is required for diagnosis. Please see Appendix B.

Interestingly, despite these findings that support newer methods for screening for diabetes, both type 2 and gestational during pregnancy, ACOG has not yet officially changed their recommendations, citing the increasing health care costs of the new screening recommendations. However, the statement by ACOG does not address the long-term risks of obesity in the offspring of diabetic pregnancies, and only mentions adverse pregnancy outcomes such as large for gestational age, fetal hyperinsulinemia, and neonatal hypoglycemia. Perhaps if ACOG were to also consider the evidence of childhood obesity resulting directly from diabetic pregnancies, their recommendations would change. The health care costs of earlier, simpler screening for diabetes in pregnancy pale in comparison to the long-term health care costs of obesity, insulin resistance, metabolic syndrome, diabetes, heart disease, and the other related comorbidities.

With prompt and specific screening, the prevention of excessive weight gain, hyperglycemia, and gestational diabetes in pregnancy, and concentrated management of glycemic control in pregnancy, we may be able to modify and decrease childhood obesity, and reduce the incidence of type 2 diabetes in offspring. In addition future comorbidities, will also be decreased. Therefore the quality of life for American Indian youth will be improved.

Dissemination

The deliverable product for this independent project was an educational presentation presented at the Leech Lake Tribal Health medical staff meeting. The target audience was health care practitioners within Indian Health Services and Tribal Health Divisions. The handout for this independent project guided the lecture and included evidence supporting the link between maternal obesity and diabetes, new standards of care for diagnosing diabetes in pregnancy, and the 2009 Institute of Medicine's pregnancy weight gains guidelines.

Following the presentation a round table discussion took place outlining specific resources that are available within the health division for diabetic and/or obese pregnant women. Protocols for referring to dieticians and certified diabetes educators were also outlined. Copies of the Alaska Native's *Diabetes in Pregnancy-Screening and Management Guidelines, Indian Health Diabetes Best Practices-Diabetes in Pregnancy* (Alaska Native Tribal Health Consortium, 2011), and a copy of the American *Diabetes Association's Standards of Medical Care in Diabetes-2011* (ADA, 2011) was made available to all attendees. Links to the Indian Health Service Diabetes in Pregnancy hand-outs and the Sansum Diabetes Research Institute for their printable educational materials was also provided. The information was well-received and attendees were excited that this issue was being addressed, as this particular community suffers the burden of obesity and diabetes disproportionately when compared to surrounding areas. The

providers saw this presentation very applicable to their recent efforts to increase screening and monitoring of diabetes and obesity in pregnancy.

Implications for Nursing

This evidence implies a complete shift in the paradigm of care for children and adolescents who are overweight or obese. Long before motivational interviewing and behavior/lifestyle modification suggestions, before the trusted and true 5-2-1-0 (five fruits and vegetables five times a day, screen time two hours or less a day, at least one hour of physical activity a day, and zero sugar-sweetened beverages a day), and even before the encouragement to breastfeed is given, care to prevent obesity and diabetes must be given. Nursing science will be influenced by creating a goal of integrating women's health and prenatal care with control over future generations. Intergenerational care will be implemented, and pregnant women can and will learn through nursing care, how to prevent the burden of obesity and diabetes in not only their children but also for their grandchildren, and for generations beyond. Nursing care will have impact on the disease burden of obesity and type 2 diabetes for an entire population of American Indian people. Women who may have previously not felt empowered to change the lives of their offspring will feel empowered, and nursing science will be inspired to create new protocols of care and performance measures.

Nursing should lead the movement to integrate the evidence connecting the intrauterine environment to childhood obesity and work to create systematic approaches to screening and implementation of interventions that can provide American Indian women with the tools and information they need to maintain healthy intrauterine environments while pregnant. Nurses can empower mothers by teaching them that they are in control of the future well-being of their offspring. This strikes the very core of the caring science of nursing.

Practice. Integrating the interventions aimed at reducing childhood obesity by mediating the intrauterine environment will results in changes in practice in all areas of nursing, including public health nursing, clinical and ambulatory care nursing, advanced practice nursing and nursing management and administration. In addition to helping pregnant women adhere to the weight gain limits set forth by the IOM (2009), it is also imperative that health care professionals implement the new screening guidelines for diabetes in pregnancy from the 2011 American Diabetes Association Standards of Medical Care. The changes in screening for type 2 diabetes and gestational diabetes will become standard practice, and nurses will be initiating the changes set forth by the ADA. Because more women are being diagnosed with diabetes in pregnancy, nurses will be called upon more than ever before to implement interventions with these women. Health facilities will need to establish new protocols of care to in pregnancy, such as diet and exercise programs for the prevention of excessive weight gain and gestational diabetes, and algorithms for the management of diabetes in pregnancy. A specific plan of care will be outlined with each high risk pregnancy to include appropriate medical therapy in conjunction with appropriate diet and exercise therapy.

It is anticipated that more referrals will be made to diabetes educators and diabetes clinics during pregnancy. Pregnant women with diabetes are advised to be seen more frequently during their pregnancies, and will be encouraged to report weekly results of their self-monitoring blood glucose levels, by phone or email. Home visiting programs by health care professionals aimed at managing diabetes and obesity during pregnancy could represent a significant improvement in current care. Women could be counseled throughout pregnancy on healthy, low carbohydrate foods, appropriate weight gain and appropriate weight gain.

Education. Education regarding the diabetic intrauterine environment and risk of obesity in the offspring should ideally begin in undergraduate nursing programs, so nurses, in turn, can educate their clients at risk. Although health facilities will have systems and protocols in place and will train nurses, background knowledge is valuable. Health care providers need to be made aware of the evidence so changes can be implemented in practice. Medical staff should be provided with training and education and the evidence should be presented to initiate changes in care. Nearly every employee in a health care setting that provides prenatal care, from lab personnel to coding and billing personnel, will be affected by the changes in practice and should be made aware of the new ADA screening guidelines and evidence based research.

Educating the pregnant woman is truly the key to turning the tide of obesity and diabetes in children. All women should be counseled and educated at the first pre-natal visit on restricting excessive weight gain and preventing gestational diabetes. Pregnant women with diabetes should be advised to modify their diet to prevent large increases in blood sugar. Hand outs and educational take-home materials with specific dietary advice, grocery lists, recipes and appropriate menus will need to be made available and given to each diabetic pregnant woman. Self-monitoring blood glucose (SMBG) is a vital part of the diabetic's daily routine to truly avoid hyperglycemia. It should be taught using a return demonstration method to enhance patient understanding of the technique.

Physical activity is an essential component of every healthy pregnancy. Pregnant women with diabetes should be educated and encouraged to participate in physical fitness routines and daily activity, with appropriate medical clearance. A massive public health educational campaign to inform individuals, families and communities about the risks of childhood obesity associated with diabetes in pregnancy is anticipated in the near future.

Policy. The new screening guidelines from the ADA will upset screening guidelines for high risk women as they are currently known. Organizations, like ACOG, are already challenging the ADA. It is expected that new policies are needed to mandate diabetes screening in high risk pregnancies. The author believes that health care facilities should write policies to include an A1C test along with the additional mandatory prenatal testing at the first visit for all high risk pregnant women. As of April, 2012, this is being practiced by providers with the Leech Lake Tribal Health Division. Evidence-based practice should follow evidence-based research, and in some cases facility policy will be the driving force to implement this.

Research. Additional randomized control studies, well-designed clinical studies and follow-up studies will be needed to address the following questions:

1) Will weight gain restriction in overweight and obese pregnant women reduce the incidence of gestational diabetes?
2) What are the specific benefits of diet and exercise therapy for diabetic pregnant women?
3) How do practitioners systematically and cost-effectively implement the new testing recommendations set forth by the ADA for diabetes in pregnancy.
4) With pregnant diabetics, will normoglycemia from medication alone result in a reduced risk of obesity in offspring, or are diet and exercise also necessary?
5) What role does pre-pregnancy weight play in gestational diabetes?
6) Do offspring of diabetic pregnancies gain weight more quickly and more readily when compared to offspring of non-diabetic pregnancies when they follow the same dietary intake?

7) Do American Indian children of diabetic pregnancies have an increased risk of obesity compared to Caucasian children of diabetic pregnancies?

Summary

With their seminal research nearly 30 years ago, Pettitt, et al., (1983) discovered that exposure to maternal diabetes can contribute to childhood obesity in the offspring, revealing an even 10-fold higher rate of obesity. Current research supports this evidence, and indicates that in addition to diabetes, excessive weight gain in pregnancy may also be directly associated with childhood obesity. American Indians are disproportionately affected by childhood obesity and diabetes, and the burden and shame of obesity that many American Indian youth carry may very well be pre-programmed before birth. There is a crucial link missing in the efforts to thwart childhood obesity, and current practice guidelines need to reflect the evidence. Interventions to prevent excessive weight gain and manage diabetes in pregnancy have reduced the risk of childhood obesity. Given the epidemic of childhood obesity and the paralleling type 2 diabetes in the American Indian population, implementing changes in prenatal care can no longer be delayed.

In 2011 the American Diabetes Association lowered the thresholds for diagnosing gestational diabetes and recommended specific early screening for type 2 diabetes in high risk groups. Undoubtedly this will result in many more pregnant women having diagnoses of diabetes. Proper management after diagnosis means that fewer fetuses at risk. Early screening and subsequent interventions mean more opportunities for reducing the risk of childhood obesity, caused by a less than optimal intrauterine environment. The Institute of Medicine (2009) changed it guidelines for weight gain in pregnancy, demonstrating better fetal and maternal outcomes with the new lower weight gain guidelines. Health care professionals need to be made

aware of the significant link between maternal diabetes and maternal obesity and childhood obesity. It is imperative that the newer guidelines for diagnosing diabetes in pregnancy and more restricted weight gain during pregnancy be implemented to ensure healthier future generations for all women and specifically the American Indian people.

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Appendix A

IOM Weight Gain Guidelines

Pre-pregnancy BMI	BMI (kg/m2)	Total Weight Gain (lbs)	Rates of Weight Gain* 2nd and 3rd Trimester (lbs)
Underweight	<18.5	28-40	1 (1-1.3)
Normal Weight	18.5-24.9	25-35	1 (0.8-1)
Overweight	25-29.9	15-25	0.6 (0.5-0.7)
Obese	>or = 30	11-20	0.5 (0.4-0.6)

***Calculations assume 0.5-2 kg (1.1-4.4 lbs) weight gain in first trimester (Institute of Medicine [IOM], 2009)**

Appendix B

American Diabetes Association 2011 Standards of Medical Care

Diagnostic Criteria for Gestational Diabetes
92 mg/dl fasting blood glucose
180 mg/dl 1 hour post 75 gram oral glucose tolerance test (OGTT)
153 mg/dl 2 hours post 75 gram OGTT
**Only one of these values must be equaled or exceeded for the diagnosis of gestational diabetes, and the test is to be administered 24-28 weeks gestation*
Diagnostic Criteria for Type 2 Diabetes in Pregnancy
Fasting plasma glucose greater or equal to 126mg/dl, or an A1C greater than or equal to 6.5%.
**This test is to be administered at the first prenatal visit with all high risk individuals, including all American Indian pregnant females.*

(ADA, 2011)