Gestational Diabetes and Barriers to Care that May be Addressed by Physician Assistants

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ABSTRACT

Background – Gestational diabetes mellitus (GDM) is an increasingly common pregnancy complication. It occurs when women not previously diagnosed with diabetes mellitus develop high blood sugar during their pregnancy, typically between 24 to 28 weeks' gestation. (1) Appropriate management is required to minimize maternal and neonatal adverse outcomes, therefore attending prenatal appointments is crucial. This reality can cause stress and anxiety for mothers who are faced with barriers that do not allow them access to resources to attend their prenatal appointments. (2)
Objective – The aim of this paper is an in-depth literature review on the overall topic of GDM and to determine the barriers women face with receiving appropriate management. Furthermore, to determine if there is a justifiable role for physician assistants (PAs) to assist in overcoming these barriers.
Methods – An in-depth narrative literature review was undertaken using PubMed and Scopus databases. Keywords used include "gestational diabetes" "barriers or obstacles" and "physician assistants." The search was limited to the last 15 years and limited to studies completed in North America.
Literature Review – GDM women living in a Canadian rural community expressed the barriers they faced when attempting to receive prenatal care. This includes a lack of resources: transportation, child care options, and communication with health care providers. Studies compared a PA and nurse practitioner (NP) role to that of a physician when managing diabetes mellitus and found similar outcomes in control of glycated hemoglobin level (HBA1c), systolic blood pressure (SBP), and low-density lipoprotein cholesterol (LDL-C). Similar outcomes were also found in more complex patients requiring a specialists' involvement. PAs saw an increased proportion of patients presenting with new complaints, and PAs/NPs combined saw more patients in rural settings than physicians.
Conclusion – PAs are caring for patients with similar characteristics and complexity levels as those seen by physicians with no significant clinical difference in patient outcomes. Furthermore, PAs are caring for a higher percentage of patients in rural settings which is where resources are frequently limited. Based on this data, rural Manitoba communities may benefit by integrating a PA that is dedicated to caring for women with GDM.

PURPOSE OF THE STUDY

The purpose of the study is to investigate the topic of Gestational Diabetes Mellitus (GDM) as a whole: including prevalence, etiology, risk factors, recommended screening, diagnosing methods, treatment options, and maternal and neonatal adverse effects associated with the condition. Furthermore, to determine the major barriers that women diagnosed with GDM must overcome in the process of receiving adequate prenatal care. Also to investigate the impact, or lack thereof, that physician assistants have had when caring for patients with similar conditions to GDM. Overall, I would like to determine the major barriers that are preventing women (specifically Manitoba women) from receiving recommended prenatal GDM care and determine if there is a role for physician assistants in helping to overcome these barriers.

INTRODUCTION

Background

GDM is defined as a transient glucose intolerance disorder with first recognition during pregnancy. (3) It is one of the most prevalent pregnancy complications today. (4) According to the International Diabetes Federation, approximately 21.4 million births are affected by hyperglycemia annually, 84% of which are also affected by GDM. (5) It most often is recognized between 24 to 28 weeks gestation and is commonly associated with both maternal and perinatal complications, especially if left untreated. The risk of developing GDM depends on the individuals' personal risk factors: older age (>35 years), higher risk race (African, Arab,

Asian, Hispanic, Indigenous, South Asian), corticosteroid medication use, obesity (BMI greater than 30kg/m^2), prediabetes, gestational diabetes in a previous pregnancy, having a macrosomia child in a previous pregnancy, first degree relatives with type 2 diabetes, polycystic ovarian syndrome, and acanthosis nigricans. (6) Rates of GDM have jumped a surprising 122% between 1989 and 2004, and World Health Organization predicts that the deaths related to diabetes is expected to increase by more than 50% within the next decade, therefore action must be taken to improve GDM care. (4)

Pathophysiology of GDM

In a normal pregnancy, insulin resistance is expected to increase and insulin sensitivity is expected to decrease by up to 60%. Insulin resistance is highest during the second and third trimester of pregnancy. The anti-insulin effect that occurs during pregnancy is due to the presence of diabetogenic placental hormones: corticotrophin-releasing hormone, prolactin, placental growth hormone as well as progesterone. The result is a glucose-sparing state and postprandial hyperglycemia which allows the fetus to uptake a greater percentage of nutrients necessary for growth and development. In normal pregnancies a woman's pancreatic function is able to secrete sufficient levels of insulin to compensate for the expected increased insulin resistance. In the case of gestational diabetes, however, the pancreas is unable to compensate for the insulin resistance due to deficits in beta cells. The pathophysiology for GDM is therefore similar to that of type 2 diabetes. (7) Maternal glucose is able to cross the placenta while maternal insulin is unable to cross and for this reason maternal hyperglycemia can directly cause fetal hyperglycemia. A hyperglycemic state of the fetus triggers an insulin response; when this

anabolic hormone is increased it acts as a growth hormone and will cause excessive growth of the fetus leading to fetal macrosomia. (6)

Screening and Diagnosing GDM

Despite potentially devastating outcomes associated with GDM, it is common for the condition to present without any noticeable symptoms. If symptoms do present they are often mild and vague; they include fatigue, blurry vision, polyuria, polydipsia and snoring. (1) For this reason routine prenatal screening has been put into action with the goal of recognizing and treating this condition in order to mitigate complications.

The standard of care is to screen for GDM between 24-28 weeks gestation. (6) Diagnosing this condition can be achieved by a one-step approach or a two-step approach; this remains a controversial topic as there are many varying opinions amongst the two methods. The two-step method identifies 5% to 6% of women as having GDM, while the one-step test has been shown to be associated with improved pregnancy outcomes and is a more cost effective method. (7)

A National Institutes of Health consensus conference determined there is insufficient evidence for pursing a one-step approach, and thus recommends the two-step approach be utilized in clinical practice. The preferred two-step screening process consists of a 50g oral glucose tolerance test at 24-28 weeks gestation. A normal glucose value is less than 7.8mmol/L. If the initial non-fasting 50g oral glucose tolerance test produces a value that is greater or equal to 11.1mmol/L, GDM is immediately diagnosed. A value exceeding 7.8mmol/L indicates the need for a 75g oral glucose tolerance test with glucose measurements taken at 1, 2 and 3 hours.

Following the 75g load, if one plasma glucose value is abnormal (fasting blood glucose greater or equal to 5.3mmol/L, 1 hour post-prandial value greater or equal to 10.6mmol/L, or 2 hour post-prandial value greater or equal to 9.0mmol/L) then a diagnosis of GDM will be given.

It is recommended that women with significant clinical risk factors who are at a higher likelihood of having undiagnosed type 2 diabetes be screened for GDM earlier in their pregnancy; the recommendation is to screen these women using an A1C value prior to 20 weeks gestation and as early as the first prenatal visit. This allows for early maternal interventions and fetal surveillance with an emphasis on promoting healthy behaviors. Some major risk factors that may indicate the need for this earlier screening include an advanced maternal age (>35 years old), obesity, higher risk ethnicity (African, Indigenous, South Asian, Hispanic), family history of diabetes mellitus, a history of GDM in a previous pregnancy, delivery of a macrosomia child in the past, prediabetes, and polycystic ovarian syndrome. (9)

GDM Treatment

If GDM is left untreated or treated inadequately, the risk of maternal and perinatal morbidity is significantly increased. Tight control of blood glucose will reduce the risk of hyperglycemic-related complications. First line treatment for women diagnosed with GDM is lifestyle modifications including appropriate diet and exercise. The combination of appropriate diet and exercise has been shown to improve insulin resistance. Ideally, a registered dietician should provide nutritional counseling to help achieve normoglycemia, prevent ketosis, and obtain appropriate gestational weight gain based on maternal BMI. (8) The recommended caloric intake for women with GDM is approximately 30-35 kg-cal/kg of ideal body weight per day. This typically amounts to a total of 1,800 to 2,400kg-cal/day. For obese women with GDM,

caloric restriction of up to 70% has been shown to minimize weight gain without negative maternal or fetal effects. (6) Women with GDM will be asked to monitor their own blood sugars on a daily basis and frequent checkups with a clinician should be initiated. It is suggested that women with GDM initially measure and record their glucose levels a minimum of four times per day (when they wake up in the morning and following meals) in order to identify which women will also require the use of an antihyperglycemic agent. Once blood sugars are well-controlled, the frequency of glucose monitoring may be reduced.

Exercise is a critical component of managing GDM – an increase in muscle mass has been shown to increase insulin sensitivity of tissues thus reducing fasting and postprandial glucose concentrations. (8) A randomized trial measured glycemic control to investigate the benefits of an exercise program, and it was found that 17 out of 21 patients using the exercise program not only maintained normoglycemia but also removed the need for insulin therapy throughout their pregnancy. Furthermore, the study showed that the exercise-trained subjects and insulin-treated subjects both ended up with similar mean glucose values during their pregnancy, similar infant birth weights, and similar macrosomia rates. (13)

If appropriate blood sugar levels are not achieved with diet and exercise alone, pharmaceutical strategies will be initiated. Pharmaceutical therapy is initiated when fasting blood glucose concentration is >5.3 mmol/L, one-hour postprandial blood glucose concentration is >7.8mmol/L, or two-hour postprandial glucose concentration is >6.7mmol/L. Although the majority of women are able to manage GDM with exercise and nutritional therapy alone, it has been found that up to 30% to 40% of women will require drug therapy. (8) Insulin and oral antihyperglycemic agents are the two pharmacological options for GDM. Insulin remains the gold standard, however, with 10-20% of women utilizing this agent to control their blood sugars.

(10) Women are typically prescribed NPH which is to be taken at bedtime, dosed at 0.5units/kg/day in the first trimester, 0.6units/kg/day in the second trimester and 0.7units/kg/day in the third trimester. If post prandial hyperglycemia remains apparent, regular insulin can be added to the regime at meals. (6)

Other health care providers may choose to initiate the use of oral antihyperglycemic agents. Metformin and glyburide can be utilized in select patients however one should be aware the fetal drug level is high in pregnancy. There is no evidence that links these agents to an increased risk of birth defects but the long-term effects of transplacental passages is unknown; therefore theoretical teratogenic risks have not been completely ruled out. Recent studies found these oral agents to be safe in lowering blood sugars during pregnancy and are a reasonable alternative for women who fail nutritional therapy and are non-compliant with insulin therapy. (11) Metformin has the additional benefit of reducing the frequency of pregnancy induced hypertension because its mechanism of action involves reducing hepatic glucose output and increasing insulin sensitivity, whereas glyburide simply stimulates insulin secretion as its mechanism of action. (12)

Postpartum Care for GDM

As women with GDM are at an increased risk of developing type 2 diabetes postpartum, guidelines recommend a 75g oral glucose tolerance test between six weeks to six months following delivery. The high reoccurrence of GDM in sequential pregnancies must be considered for future pregnancy planning. Screening should occur before planning a pregnancy and additionally every three years or more if significant risk factors are present. (9)

If possible, women diagnosed with GDM are encouraged to breastfeed immediately following delivery for a minimum of four months to help prevent neonatal hypoglycemia, childhood obesity, and postpartum diabetes for both mother and child. A study published by the American Diabetes Association looked at 324 children who have mothers diagnosed with GDM and concluded childhood obesity was reduced by up to 50% if the women chose to breastfeed for over three months. Breastfeeding for more than six months is effective in helping women control their weight following birth as it improves glucose tolerance and causes the body to burn extra calories. (14) One should also strive to reduce their body weight postpartum in order to prevent GDM in subsequent pregnancies.

Consequences Associated with GDM

Lack of glycemic control can lead to maternal adverse outcomes that include, but are not limited to, pelvic inflammatory disease, pre-eclampsia, as well as the need for a caesarean section. (15) A study shows that both GDM and obesity are independently associated with an increased risk of adverse pregnancy outcomes, and these adverse outcomes become additive when a woman has both GDM and obesity in combination. (16) It has been determined that up to an alarming 50% of patients diagnosed with GDM will develop type 2 diabetes within a five year time period postpartum. (17)

Neonatal adverse outcomes may include macrosomia (an infant weighing more than nine pounds), shoulder dystocia or other birth trauma, premature birth with respiratory distress syndrome, and metabolic effects including hypoglycemia, hypocalcaemia, hyperbilirubinemia, as well as the development of childhood obesity and type 2 diabetes later in life. Further complications include an increased risk of spontaneous abortion, intrauterine deaths, and

congenital anomalies. (4) Medical doctor Robert O. Atlas claims “children born to mothers with gestational diabetes…have about a 50 percent chance of being overweight by the age of eight.” (14) As previously mentioned GDM is often asymptomatic, therefore routine screening is crucial to achieve effective diagnoses and management. Women are encouraged to aim for a HBA1c level of less than or equal to 6.5% during their pregnancy. (18)

METHODS

A narrative literature review was done for the purpose of this paper. Various papers and articles surrounding GDM as a whole were examined and the relevant and in-depth information is presented in this literature review. The methodology included researching recommended screening, diagnosing and treatment protocols as well as the barriers that are preventing these recommendations from being carried out. Also, how advanced practice providers, PAs and NPs, are currently contributing to managing patients diagnosed with GDM and other conditions in both rural and urban communities and the impact that they have been able to have. Key words such as “gestational diabetes,” “physician assistant,” and “barriers,” were searched within the scholar one search system from the Neil-John Maclean Library. The advanced search option in PubMed was also utilized to focus the research. Relevant author names were searched in the Scopus database. The literature review also took advantage of the reference section in key papers in order to find additional papers. The search was limited to papers that have been published within the last fifteen years and initially limited to those done in Manitoba, followed by Canada.

There was found to be an apparent limitation of Canadian studies relevant to this paper, thus the scope was widened to include any studies completed across North America.

LITERATURE REVIEW

In a 2016 study completed by Whitty-Rogers et al conversational interviews were conducted with nine Mi'kmaq women, a First Nations group located in Nova Scotia. The study focuses on two rural Mi'kmaq First Nations communities and aims to understand the overall experiences these Mi'kmaq women endured when diagnosed with GDM and how their experiences were affected by the social determinants of health. The women in this study claimed they felt "frustrated and powerless, as well with a feeling of being discriminated" following their diagnosis of GDM. (4)

Many were surprised by the diagnosis and felt hopeless; they admitted to having little to no knowledge about the topic and did not understand the physiology behind the condition.

> *They had to learn quickly to self-administer insulin, eat healthy foods, and change their lifestyle. This was a major change for them as there was very little time to learn.*

Five out of the nine women were unemployed at the time of the study making it difficult to afford healthy foods; an attempt to improve their eating habits following the diagnosis was described by the women as overwhelming and expensive.

> *The women knew that when they received a diagnosis of GDM, they had to follow a healthy diet, but for some, it presented a challenge because they did not have easy access to grocery stores and/or*

because they did not have the financial resources to buy food, let alone healthy food.

The study found that these women received unequal access to health care; limited transportation to urban clinics took away opportunities to attend their appointments. The lack of transportation posed as a major barrier for these women. Even if transportation was offered, timing for this transportation presented further complications as the scheduling often did not align with the women's personal availability. Most women in the study were already caring for one to four children at home – with one of the women having eight children – that they were unable to leave unsupervised while attending their appointments. They expressed that finding childcare services was extremely challenging with limited options available. Even if they were able to find a daycare service for their children, the cost was often unrealistic and unaffordable as most women were unemployed. If the women were able to attend their prenatal appointments despite these challenges their other children would need to be brought along with them in most cases which inevitably made the process much more challenging.

Because the women could not afford to pay for childcare, they took their children with them wherever they went. This made attending medical appointments at times more challenging.

Communication and language barriers presented another complication as it was challenging to adequately communicate questions during appointments with English speaking health care providers. Furthermore, the women expressed frustration at times when they felt their concerns were dismissed.

They were unhappy when the doctors or nurses disregarded their concerns or did not give them an opportunity to ask questions or express their opinion.

Following the study, two women went on to develop diabetes mellitus shortly after their delivery. (4)

A 2013 cohort study was conducted by G.L. Jackson et al that investigated the clinical outcomes for 368,481 pharmacologically treated adult diabetic patients who were provided care by either a physician, physician assistant (PA) or nurse practitioner (NP). The study examined any differences in quality of care amongst the different health care providers. A total of 3487 physicians, 1445 NPs and 443 PAs were used in this study, and outcomes were analyzed over a one-year time period. In order to compare patient outcomes between the various primary care providers, the control of outpatient HBA1c, SBP, and LDL-C for each profession was measured and compared to the other professions. Based on current guidelines, the definition of "adequate control" for diabetic patients includes HbA1c concentrations less than 7.0%, mean SBP less than 130mmHg, and mean LDL-C levels less than 2.59mmol/L (100mg/dL). Primary care was given to a patient by the same provider for two years in order to allow a timeframe long enough to have a genuine impact on the measured values. To interpret the results, a threshold for determining clinical significance of observed difference was set in this study to be 0.3% for HbA1c concentration, 3.0mmHg for SBP, and 0.12mmol/L for LDL-C.

The patients seen by all three of the different primary care providers were well balanced, with no major differences in either patient quantity or key patient characteristics such as sex, age, race, ethnicity, and BMI. The results from this study determined the difference in HbA1c values compared to a physician was -0.01% for PAs and 0.05% for NPs. The difference for SBP was 0.02mmHg for PAs and -0.08mmHg for NPs. Finally, the difference in LDL-C was 0.03mmol/L for PAs and 0.01mmol/L for NPs. Although some of these values are statistically significant,

none met the studies' criteria for being clinically significant. Additionally, there was no clinically significant difference when comparing outcomes between PAs versus NPs, as the results were 0.06% for HbA1c values, 0.06mmHg for SBP, and 0.01mmol/L for LDL-C levels. Furthermore, there was found to be no clinically significant difference in patient outcomes when the patient also required services from either a diabetes specialist or endocrinologist in addition to a physician, PA, or NP. (19)

Community health centers (CHC) are designed to provide primary health resources to underserved individuals, families and communities. (20) A large percentage of the population cared for by CHCs earn less than the poverty level income, are members of an ethnic minority, and 5% are homeless. (21) The presence of PAs and NPs is significant in CHCs, accounting for 30% of total CHC visits between 2006-2007. (22) A cross sectional observational study was done in the United States by Perri Morgan et al to examine characteristic differences associated with patient visits to CHCs when the patients were seen by PAs, NPs or physicians. The study analyzed annual survey data from 2006-2010 taken from the National Ambulatory Medical Care Survey CHC sample. For this study, providers were asked to complete a survey following a patients' appointment for up to 30 randomly selected patients per week. A total of 24,528 CHC patients were studied in this timeframe with 670 physicians, 103 PAs, and 245 NPs as the healthcare providers. Throughout the five-year course of this study, it was found that the number of patient visits to PAs and NPs in CHCs increased – accounting for over one third of patient visits – likely a result of an increasing proportion of PAs and NPs working in the healthcare field.

When comparing the characteristics of patients, the study shows that NPs saw a greater proportion of young adult and female patients, while PAs and physicians saw a greater proportion of middle aged and older adult patients. When comparing the reason for patient visit as well as specific diagnosis and care management, the study found these factors to be more similar between a physician and a PA as compared to an NP. While the majority of NP visits were focused on preventative care (42%), PAs and physicians had higher percentages of chronic care visits (25% and 26% respectively, $p<0.05$). Additionally, PAs were shown to have the greatest proportion of patients presenting with new problems (45% as compared to 38% for physicians and 36% for NPs).

The study found, when comparing regional differences, that there were more patient visits to PAs and NPs in rural CHCs (21%) than there were to physicians in rural CHCs (9%) and this was statistically significant with a p value of less than 0.05. Furthermore, all three of the healthcare provider types equally identified as being the primary care provider for patients they saw in rural settings, amounting to approximately 80% of all patients visits. In urban settings, however, physicians saw 18% more patients than PAs and NPs whom they identified as being the primary care provider for. (23)

DISCUSSION

Barriers for Receiving Adequate Prenatal Care in Manitoba

In Canada, it has been shown that Indigenous women are up to five times more likely to develop gestational diabetes than non-Indigenous women. The rates for GDM in the Indigenous population is 8-18%, whereas the rate is only 3.5-3.8% in non-Indigenous populations. (4) In Manitoba, studies have shown that inadequate prenatal care is also significantly higher amongst Aboriginal women than non-Aboriginal women, with values of 15.7% and 3.6% respectively. Various steps must be taken in order to adequately care for women diagnosed with GDM, and naturally there are several barriers (both within and outside the health care system) that tend to arise and make the process difficult for many women. Within the Indigenous population the social determinants of health (SDOH) have found to be a major barrier in the quest for proper GDM care; specifically lower socioeconomic status, lower level of education, lack of employment, poor living conditions, low self-esteem, as well as being surrounded by a challenging physical environment. (15, 24) Other barriers that pose a threat include an internally decreased motivation to be screened with subsequent pregnancies, age, obesity, and lack of encouragement from health care providers. (15)

The study conducted by the Mi'kmaq First Nations group truly brings to light the reality and struggles that rural women must overcome to receive necessary GDM care. Although the women in the study are located in Nova Scotia, the population is comparable to several First Nations populations living in rural Manitoba communities. A major barrier expressed in the conversational interviews is the travel distance to screening sites; pregnant women living in rural and remote areas often do not have access to immediate transportation and are therefore unable

to attend their prenatal visits. Limited access to childcare services further takes away the opportunity to attend appointments if they have other children to care for. (25) In order to begin overcoming these barriers, focus needs to be directed in these rural communities.

PAs and NPs together saw a larger proportion of patients in rural settings than physicians in the Perri Morgan et al study (PAs and NPs saw a combined proportion of 21% as compared to a 9% proportion seen by physicians) and identified as being the primary care provider for more rural than urban patients. On the contrary, physicians identified as being the primary care provider to 18% more patients in urbans CHCs compared to PAs and NPs. (23) These findings suggest it may be easier to attract advanced practice practitioners (PAs and NPs) to work in rural settings as compared to physicians. Based on various backgrounds and socioeconomic statuses, it is unrealistic to expect all rural mothers diagnosed with GDM to travel to urban centers for their prenatal appointments. Perhaps a more effective strategy would be increasing resources in rural communities to provide these women with a more convenient way of accessing proper prenatal GDM care, thus removing the barrier of transportation and removing the burden of putting their personal life and responsibilities on hold to attend appointments. As a result, one can predict that appointment attendance will increase, adequate prenatal and postnatal care will be given, and the risk of complications resulting from GDM will decrease.

Outcomes Following Physician Assistant Care

Nearly half of the patients diagnosed with diabetes mellitus in the United States see a PA or an NP as part of their diabetic care. (27) This high percentage suggests high capabilities are possessed by PAs and NPs. Although the literature review did not find articles that directly measured outcomes for patients with GDM when cared for by a PA, the study completed by G.L.

Jackson supports the notion that PAs and NPs are able to provide adequate care and achieve outcomes that are comparable to a physician in the management of diabetes mellitus. The study measured control of hemoglobin A1c, systolic blood pressure, and low-density lipoprotein cholesterol for patients who were cared for by either a physician, PA or NP and found there to be no significant clinical difference in patient outcome between the various primary care providers. Furthermore, there was no significant difference in patient outcomes between physician, PA or NP inpatients who were also seeing an endocrinologist or specialty diabetic service; this suggests that PAs and NPs are sufficiently able to handle complex and atypical cases that require speciality services thus including GDM patients.

The cross-sectional observational study by Perri Morgan et al found PAs are more commonly treating patients presenting with new problems, which can include newly diagnosed GDM patients. There was also considerable overlap in the patient characteristics seen by PAs, NPs and physicians, suggesting that all three providers share similar clinical responsibilities and share similar demand for their services. There was a greater similarity in visit characteristics for physicians and PAs as compared to NPs. This finding may imply that PAs possess a wide skill set that mirrors the skill set of a physician and therefore PAs should be capable of managing GDM patients as competently as a family physician. It should be noted that this finding may also be a reflection of the universal requirement for physician supervision of PAs.

Emphasizing Patient-Centered Care

A diagnosis of GDM cannot be ignored or brushed off because of potential maternal and neonatal morbidities associated with the condition, and for many women this new responsibility is an unfamiliar reality that must be acknowledged for the remainder of their pregnancy and years afterwards. Lack of knowledge surrounding the condition as well as limited communication from health care professionals makes the already daunting diagnosis even scarier. The Mi'kmaq women claimed they experienced feeling overwhelmed, clueless and frightened following their diagnosis. Lusine Poghosyan et al completed a qualitative study in 2017 by interviewing 26 physicians and NPs in New York State. The purpose of the study was to address the errors of omission that occur regularly in primary care practices. Four main themes of omission were found: patient teaching, patient follow up, emotional support, and mental health needs. The interviewees recognized that patient teaching carries great value but is often limited. They admitted that although patients will frequently turn to them for emotional support, this type of support is often perceived as being a "low priority patient need… physical health needs were prioritized at the expense of their emotional needs, which were left unattended." (26) A main cause contributing to these omissions is time constraints: the primary care providers expressed a difficulty in addressing patients' psychosocial and mental health concerns when limited to short visit times. One primary care provider said he chooses to focus on "what might be important," with physical concerns and urgent care needs taking precedence over anything else. (26) This mindset, combined with the pressure of time restrictions, inevitably leads to major gaps in patient centered care. The discussion section of the study suggests maximizing other care team members as a way to reduce gaps in care. In the process of training to work as a PA, the theme of "patient centered care" is consistently emphasized and engrained as being a priority

while practicing. PAs are capable of providing in-depth education and psychosocial support that many women require following their diagnosis of GDM. If there is an opportunity for a PA to care for patients with GDM specifically, from time of initial screening and diagnosis all the way to postpartum follow up appointments, the burden of time constraints associated with each appointment will be reduced and the opportunity to provide adequate patient education and emotional support will be readily available on a more regular basis.

LIMITATIONS

A limitation from the cohort study completed by G.L Jackson is the primary health care provider – whether it was a PA, NP, or physician – was involved in their patients care for a minimum of two years. This may not be translatable to GDM patients as the time spent between primary care provider and a patient with GDM may be shorter. It has been shown, however, that 50% of women with GDM will develop type 2 diabetes postpartum; the high-risk of developing this chronic condition suggests the need for long term management and a long-lasting relationship between patient and health care provider. Another limitation of this study is a difficulty in comparing the study's population to a GDM population. The patients chosen were predominantly male with a mean age of 65.2 years (19) and had more comorbidities compared to the general population. The average age of women diagnosed with GDM is 28 years old. (27)

A limitation from this literature review is lack of research available that focuses specifically on GDM patient outcomes – including appointment attendance, glycemic control, pregnancy complications, and postpartum complications – when a physician assistant is

functioning as the primary care provider throughout an entire GDM pregnancy and thereafter. Although the literature review supports the notion that the PA profession carries the knowledge, skill set, and willingness required to make a positive difference in all aspects of this condition, studies should be done in the future to confirm this.

CONCLUSION

In Manitoba, GDM is most prevalent amongst Indigenous women and uncontrolled GDM is most prevalent amongst vulnerable rural populations with limited resources. A lack of transportation into urban clinics is one of the most significant barriers preventing adequate prenatal care. Another barrier is a lack of guidance and support offered to women by health care professionals following the overwhelming diagnosis which results in a feeling of hopelessness and a lack of motivation to ameliorate the condition. Removing these barriers requires increasing resources in rural, underserved areas. Studies found that PAs and NPs are generating comparable patient outcomes to that of a physician in the management of diabetes mellitus, with treatment difference being near zero between any two provider. This holds true in more complex patients who also require a specialists' involvement. PAs are currently identifying as being the primary care provider for a greater proportion of patients in rural than urban community health centers, suggesting their willingness to work in rural communities. Based on evidence gathered, this literature review proposes utilizing PAs to care for GDM women in rural Manitoba clinics (with readily available access to a physician via telephone if necessary) with an emphasis on achieving adequate glycemic targets and providing ongoing patient education, support, and encouragement,

will improve prenatal appointment attendance and reduce morbidities associated with poorly controlled GDM. For this to be warranted, however, further studies and trials should be done that investigate patient outcomes in rural communities when women are cared for by a physician assistant throughout their entire GDM journey.

TABLES AND FIGURES

Table 1. *Summary of G.L. Jackson et al study.* Mean values of controlled HBA1c, SBP, and LDL-C measurements for patients being cared for by either a PA, NP or physician.

G.L. Jackson et al Study										
Primary Care Provider Type (PCP)	**Number of PCPs**	**A1C (%)**			**SBP (mmHg)**			**LDL-C (mg/dL)**		
		# of patients (n)	Estimated mean level (95% CI) [%]	Patients with control (95% CI) [%]	# of patients (n)	Estimated mean level (95% CI) [mmHg]	Patients with control (95% CI) [%]	# of patients (n)	Estimated mean level (95% CI) [mg/dL]	Patients with control (95% CI) [%]
PA	443	23,789	7.59	38.43	25,147	133.09	36.29	22,151	85.97	73.23
NP	1445	63,246	7.53	40.04	66,442	133.03	36.07	59,037	85.47	74.13
Physician	3487	263,209	7.58	38.67	274,873	133.11	35.81	245,046	84.89	75.15

Table 2. *G.L. Jackson et al Study:* Comparing differences in mean values of A1c, SBP, and LDL-C outcomes between the various primary care providers, none of which are clinically significant.

Outcome	PA versus physician	NP versus physician	PA versus NP
A1c (%)	-0.01	0.05	0.06
SBP (mmHg)	0.02	-0.08	0.06
LDL-C (mg/dL)	0.03	0.01	0.01

Table 3. *Peri Morgan et al Study*: Comparison of patient characteristics between the various primary care providers.

Characteristic	**Primary Care Provider Type**		
AGE of Patient	**PA patients (%)**	**NP patients (%)**	**Physician patients (%)**
0-18 years old	23	24	27
19-45 years old	39	48	33
46-64 years old	28	22	18
>65 years old	10	6	12
SEX of patient			
Female	60	74	62
Male	40	26	38

Table 4. *Peri Morgan et al Study:* Comparison of patients' reason for visit between the various primary care providers.

Primary Care Provider Type				
Reason for Visit	**PA (%)**	**NP (%)**	**Physician (%)**	**p-value**
New issue	45.5	35.9	38.1	<0.05
Preventative Care	22.8	41.5	28.7	
Chronic issue (flare up)	25.1	16.9	26.0	
Chronic issue (follow-up)	7.2	5.8	6.6	

Figure 1.

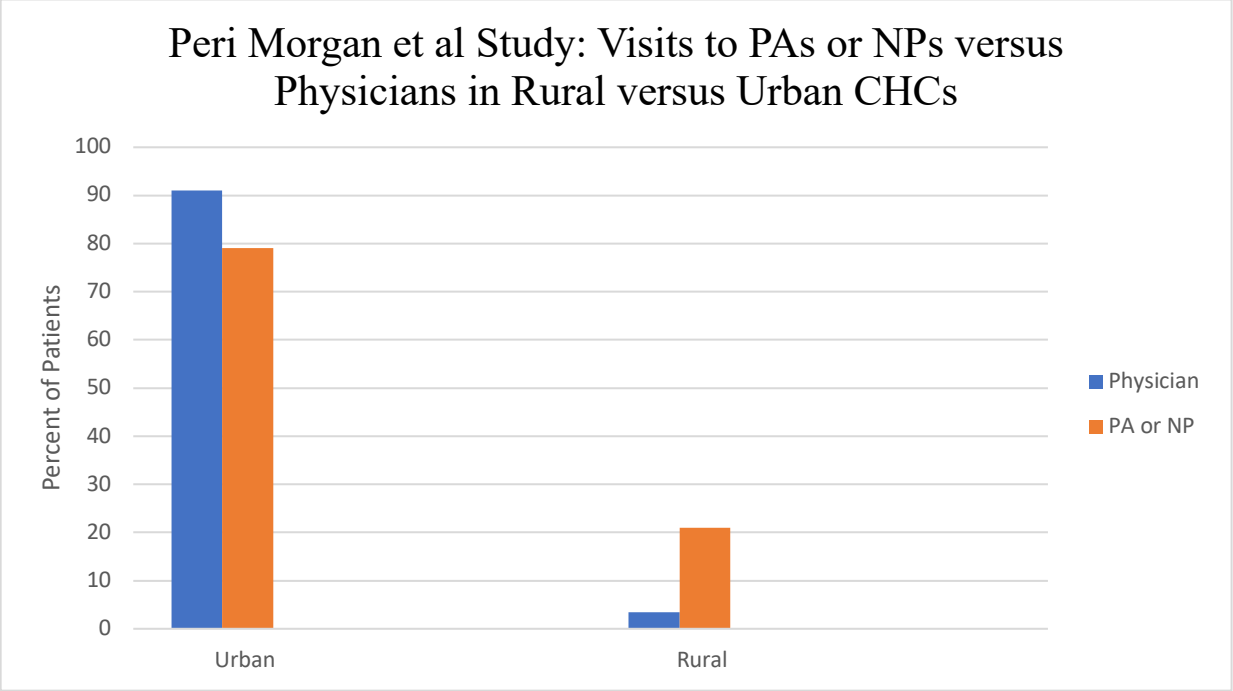
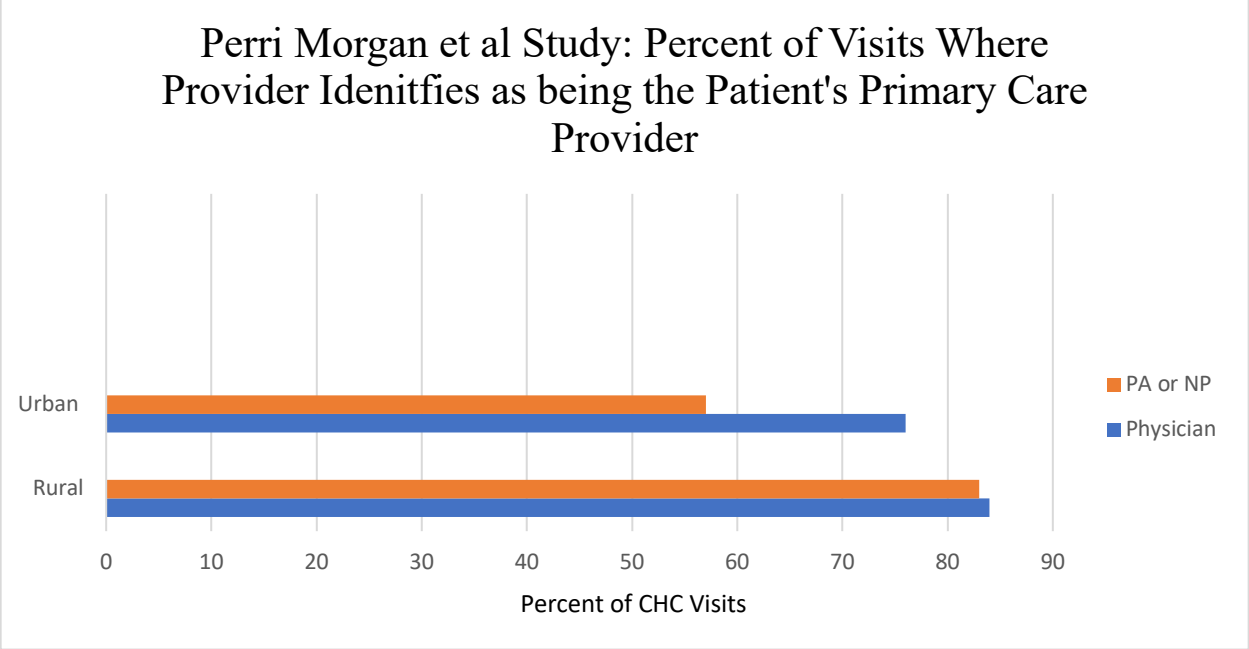


Figure 2.



REFERENCES

1. Everything You Need to Know About Gestational Diabetes [Internet]. Healthline. [cited 2019 Nov 15]. Available from: https://www.healthline.com/health/gestational-diabetes

2. Nielsen KK, Kapur A, Damm P, de Courten M, Bygbjerg IC. From screening to postpartum follow-up – the determinants and barriers for gestational diabetes mellitus (GDM) services, a systematic review. BMC Pregnancy Childbirth. 2014 Jan 22;14:41.

3. Canada PHA of. Maternal diabetes in Canada [Internet]. aem. 2016 [cited 2019 Aug 19]. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/maternal-diabetes-canada.html

4. Whitty-Rogers J, Caine V, Cameron B. Aboriginal Women's Experiences With Gestational Diabetes Mellitus: A Participatory Study With Mi'kmaq Women in Canada. Advances in Nursing Science. 2016 Jun;39(2):181–98.

5. Nielsen KK, Rheinländer T, Kapur A, Damm P, Seshiah V, Bygbjerg IC. Factors influencing timely initiation and completion of gestational diabetes mellitus screening and diagnosis - a qualitative study from Tamil Nadu, India. BMC Pregnancy Childbirth [Internet]. 2017 Aug 1 [cited 2019 Aug 19];17. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5539632/

6. Ribowsky J. Gestational Diabetes - Current managment strategies for a "growing" problem. 2010 Nov;31–49.

7. Dugan JA, Ma-Crawford J. Managing gestational diabetes. Journal of the American Academy of PAs. 2019 Sep;32(9):21.

8. Gestational diabetes mellitus: Glycemic control and maternal prognosis - UpToDate [Internet]. [cited 2019 Oct 2]. Available from: https://www.uptodate.com/contents/gestational-

diabetes-mellitus-glycemic-control-and-maternal-prognosis?search=GDM&source=search_result&selectedTitle=1~89&usage_type=default&display_rank=1#H1

9. Feig DS, Berger H, Donovan L, Godbout A, Kader T, Keely E, et al. Diabetes and Pregnancy. Canadian Journal of Diabetes. 2018 Apr;42:S255–82.

10. Gestational diabetes - Diagnosis and treatment - Mayo Clinic [Internet]. [cited 2019 Aug 21]. Available from: https://www.mayoclinic.org/diseases-conditions/gestational-diabetes/diagnosis-treatment/drc-20355345

11. Kalra B, Gupta Y, Singla R, Kalra S. Use of Oral Anti-Diabetic Agents in Pregnancy: A Pragmatic Approach. N Am J Med Sci. 2015 Jan;7(1):6–12.

12. Romero R, Erez O, Hüttemann M, Maymon E, Panaitescu B, Conde-Agudelo A, et al. Metformin, the aspirin of the 21st century: its role in gestational diabetes mellitus, prevention of preeclampsia and cancer, and the promotion of longevity. Am J Obstet Gynecol. 2017;217(3):282–302.

13. Breastfeeding After Gestational Diabetes Benefits Both Mother and Baby - Gestational Diabetes Center - EverydayHealth.com [Internet]. [cited 2019 Nov 14]. Available from: https://www.everydayhealth.com/gestational-diabetes/benefits-of-breastfeeding.aspx

14. Cullinan J, Gillespie P, Owens L, Dunne F. Accessibility and screening uptake rates for gestational diabetes mellitus in Ireland. Health & Place. 2012 Mar 1;18(2):339–48.

15. Medline ® Abstract for Reference 4 of "Gestational diabetes mellitus: Glycemic control and maternal prognosis" - UpToDate [Internet]. [cited 2019 Oct 2]. Available from: https://www.uptodate.com/contents/gestational-diabetes-mellitus-glycemic-control-and-maternal-prognosis/abstract/4

16. Sterne VL, Logan T, Palmer MA. Factors affecting attendance at postpartum diabetes screening in women with gestational diabetes mellitus. Practical Diabetes International. 2011;28(2):64–68a.

17. Gestational diabetes - Symptoms and causes - Mayo Clinic [Internet]. [cited 2019 Jun 29]. Available from: https://www.mayoclinic.org/diseases-conditions/gestational-diabetes/symptoms-causes/syc-20355339

18. Jackson GL, Smith VA, Edelman D, Woolson SL, Hendrix CC, Everett CM, et al. Intermediate diabetes outcomes in patients managed by physicians, nurse practitioners, or physician assistants a cohort study. Annals of Internal Medicine. 2018;169(12):825–35.

19. Government of Ontario M of H and L-TC. Community Health Centres - Health Services in Your Community - MOHLTC [Internet]. [cited 2019 Oct 19]. Available from: http://www.health.gov.on.ca/en/common/system/services/chc/

20. 2010 National Health Center Data [Internet]. [cited 2019 Oct 19]. Available from: https://bphc.hrsa.gov/uds/view.aspx?year=2010

21. Hing E, Hooker RS, Ashman JJ. Primary health care in community health centers and comparison with office-based practice. J Community Health. 2011 Jun;36(3):406–13.

22. Morgan P, Everett C, Hing E. Nurse practitioners, physician assistants, and physicians in community health centers, 2006–2010. Healthcare. 2015 Jun 1;3(2):102–7.

23. Heaman MI, Gupton AL, Moffatt ME. Prevalence and predictors of inadequate prenatal care: a comparison of aboriginal and non-aboriginal women in Manitoba. J Obstet Gynaecol Can. 2005 Mar;27(3):237–46.

24. Glucose testing – screening for gestational Diabetes – Pregnancy Info [Internet]. [cited 2019 Jun 29]. Available from: https://www.pregnancyinfo.ca/your-pregnancy/routine-tests/glucose-testing/

25. Everett CM, Schumacher JR, Wright A, Smith MA. Physician Assistants and Nurse Practitioners as a Usual Source of Care. J Rural Health. 2009;25(4):407–14.

26. Poghosyan L, Norful AA, Fleck E, Bruzzese J-M, Talsma A, Nannini A. Primary Care Providers' Perspectives on Errors of Omission. J Am Board Fam Med. 2017 Nov 1;30(6):733–42.

27. Prakash GT, Das AK, Habeebullah S, Bhat V, Shamanna SB. Maternal and Neonatal Outcome in Mothers with Gestational Diabetes Mellitus. Indian J Endocrinol Metab. 2017;21(6):854–8.