Maternal and neonatal outcomes in pregnancies with type 2 diabetes in First Nation and other Manitoban women: a population-based study

Jennifer M. Yamamoto MD MSc [1,2], Christy Pylypjuk MD MSc[2,3], Elizabeth Sellers MD MSc[2,4], Lorraine McLeod BN[5], Brandy Wicklow MD MSc[2,4], Monica Sirski PhD[6], Heather Prior MSc[6], Chelsea Ruth MD MSc[4,6]

[1]Department of Internal Medicine, University of Manitoba, Winnipeg, Canada
[2]Children's Hospital Research Institute of Manitoba, Winnipeg, Canada
[3]Department of Obstetrics, Gynecology and Reproductive Sciences, University of Manitoba, Canada
[4]Department of Paediatrics and Child Health, University of Manitoba, Canada
[5]First Nations Health and Social Secretariat of Manitoba
[6]Manitoba Centre for Health Policy, University of Manitoba, Winnipeg, Canada

Document Data: Abstract: 246 words; Text: 2490 words; Figures: 1; Tables: 3

Corresponding author: Chelsea Ruth
Address: 408-727 McDermot Ave, Winnipeg MB, Canada, R3E 3P5
Tel: 204-787-4998 Email: Chelsea.ruth@umanitoba.ca

Funding: This project was undertaken at the request of Manitoba Health, Seniors and Active Living (MHSAL), a department within the Government of Manitoba, as part of the contract between the University of Manitoba and MHSAL. It was supported through funding provided by MHSAL to the University of Manitoba (HIPC 2017/2018–24). The results and conclusions are those of the authors and no official endorsement by MHSAL was intended or should be inferred.

Competing interests by authors: None

Abstract

Background: First Nation women living in Canada experience a high prevalence of type 2 diabetes in pregnancy. Contemporary studies are needed to determine how First Nation heritage affects the risk of adverse pregnancy outcomes for women with type 2 diabetes. This study aims to describe pregnancy outcomes in First Nations and all other women with type 2 diabetes living in Manitoba, Canada.

Methods: This was a population-level retrospective cohort study using linked administrative data from Manitoba (2012-2017). First Nation women with type 2 diabetes were compared to all other Manitoban women with type 2 diabetes using relative risks (RR) and 95% confidence intervals (CI).

Results: A total of 2181 women with type 2 diabetes were included. First Nation women with type 2 diabetes were significantly more likely to experience stillbirth (RR 2.17 [95% CI 1.13, 4.18]) and perinatal death (RR 2.40 [95% CI 1.37, 4.19]) than all other Manitoban women with type 2 diabetes. Offspring of First Nation women with type 2 diabetes had a higher risk of most neonatal complications compared to all other Manitoban women with type 2 diabetes, including a higher risk of congenital anomalies (RR 1.97 [95% CI 1.30, 2.99]).

Interpretation: First Nations women living with type 2 diabetes experienced a higher risk for adverse pregnancy outcomes compared to all other Manitoban women with type 2 diabetes. Additional studies are needed to identify both high-risk and protective factors for pregnancy complications in First Nation people living with type 2 diabetes in pregnancy.

Introduction

The prevalence of type 2 diabetes in pregnancy has seen a substantial increase. With an estimated 90% increase in the number of pregnancies complicated by type 2 diabetes over the last 15 years, in many centres it has become the most common type of pre-existing diabetes in the pregnant population (1-3). Pregnancies complicated by type 2 diabetes are associated with a higher risk of maternal and neonatal complications. For the neonate, these include large-for-gestational-age, hypoglycemia, intensive care unit admission, congenital anomalies and stillbirth, with little improvement in outcomes over the last 15 years (1, 2, 4).

Globally, hyperglycemia disproportionally affects Indigenous peoples (5). Indigenous women experience a high prevalence of gestational diabetes and type 2 diabetes in pregnancy (6, 7). Previous cohorts examining diabetes in pregnancy in Indigenous populations have demonstrated a higher risk of adverse pregnancy outcomes (8, 9). For First Nation women living in Canada with diabetes these include an increased risk of macrosomia, preterm delivery, and neonatal hypoglycemia compared to other individuals with diabetes (7, 10).

Given the increasing prevalence of obesity and type 2 diabetes, the younger age at type 2 diabetes diagnosis, as well as increasing maternal age, contemporary population-level studies are required to evaluate whether disparities in pregnancy outcomes complicated by type 2 diabetes continue to exist between First Nation women and other women living in Canada (11, 12). Additionally, given the different risk profiles in type 2 vs gestational diabetes, there is a paucity of data examining pregnancy outcomes in First Nation women with type 2 diabetes and their

offspring. Therefore, this study reports on pregnancy outcomes in First Nation and all other Manitoban women with type 2 diabetes living in Manitoba, Canada from 2012-2017.

Methods

We performed a population-level retrospective cohort study using administrative data from fiscal years 2011/12 to 2016/17 in Manitoba, Canada. Manitoba is an ethnically diverse province with a population of ~1.3 million (13). Registered First Nation people represent approximately 10% of the province's adult population (14). Since Manitoba has a provincially funded healthcare system, health records are inclusive of the vast majority of the population. To ensure that this study included the perspective of First Nation people and communities, all study aspects were conducted in partnership between researchers at the Manitoba Centre for Health Policy (MCHP) and the First Nation Health and Social Secretariat of Manitoba.

Data Sources

The Population Health Research Repository at MCHP contains de-identified data from multiple administrative and clinical sources, linked on a per project basis by a scrambled personal health identification number. Multiple databases were used in the study and included both administrative and clinically-based data encompassing physician billing data, hospital discharge abstracts, drug dispensation data and a clinical paediatric diabetes database, the Diabetes Education Resource for Children & Adolescents. The First Nations Research File was used to identify registered First Nation individuals. These databases have been extensively used for research studies and are well-validated (15, 16). This current study is part of a larger report examining the impact of type 2 diabetes on all populations in Manitoba (14).

Identification of the cohorts

Individuals with pre-existing type 2 diabetes or type 2 diabetes diagnosed in early pregnancy were identified using an administrative data definition which built upon a previously validated definition of all types of diabetes in order to isolate type 2 diabetes (14, 17-20). To avoid misclassification of gestational diabetes as type 2 diabetes, individuals with billing codes within 120 days of delivery and 180 days after delivery were excluded (21). For the analysis of stillbirth and perinatal death, events were captured for all pregnancies for individuals between 14-40 years. Age limits were placed as there were no births to women less than 14 years of age, and women over age 40 were excluded from the matched analyses as the number of births to women in this age group was very low and the health-related characteristics of these women differed from younger women. For the remainder of the outcomes, analyses were restricted to individuals aged 14-40 with type 2 diabetes who had at least one live birth during the study period after their diagnosis of diabetes. These individuals with type 2 diabetes were then matched 1:3 on maternal age (± 2 years), ethnicity (First Nation versus all other Manitobans), primiparity, multiple gestation, and region of residence (using regional health authority zone) to mother-baby pairs without evidence of any diabetes in pregnancy. For individuals with more than one birth during the study period, one birth was randomly chosen for matching. Mother-baby dyads were limited to single liveborn infants only; if women had multiple births during the study period those birth events were excluded.

Key definitions and outcome measures

Maternal outcomes included mode of delivery (operative vaginal delivery, and caesarean section), induction of labour, and maternal morbidity and mortality. Neonatal outcomes included gestational age at delivery, birthweight, neonatal intensive care unit admission, neonatal readmission, congenital anomalies, and birth trauma (14). Preterm delivery and early preterm delivery were defined as deliver prior to 37- and 34-weeks gestation, respectively. Large-for-gestational-age was defined as >90th centile and small-for-gestational-age was defined as <10th centile of their sex- and gestational-age specific birthweight (6). Stillbirth was defined as a birth after 28-weeks gestation without signs of life and perinatal death was defined as having either a stillbirth or an infant that died within six days of birth. Details of all outcome definitions have been previously published (14).

Statistical Analysis

Data extraction and analysis was performed at MCHP. Analyses were stratified by type 2 diabetes and by First Nation status and relative risks were calculated based on epidemiologic tables. Poisson regression was utilized to evaluate the association between exposure to type 2 diabetes in pregnancy and our primary outcomes. The association of type 2 diabetes with each of the maternal and neonatal outcomes was analyzed and reported as relative risks (RR) and 95% confidence intervals (CI). A p-value of <0.05 was considered significant. The data analyses were generated using SAS software, Version 9.4 or Stata, Version 16.1.

Results

A flow diagram of included mother-baby pairs is detailed in Figure 1. A total of 2283 livebirths occurred in individuals with type 2 diabetes during the study period. Of these births, 2181 were

in women aged 14-40 years of age, with no births recorded under age 14 years. After choosing one random birth per woman and matching with controls, a total of 1506 live births born to women with type 2 diabetes where included (816 First Nation and 690 other Manitoban women).

Stillbirth and perinatal death during the study period

First Nation women with type 2 diabetes were more likely to experience a stillbirth than all other Manitoban women with type 2 diabetes (2.6% [n=33] vs 1.2% [n=12], respectively; RR 2.17 [95% CI 1.13,4.18]; p=0.017). First Nation women with type 2 diabetes were also more likely to experience a perinatal death than all other Manitoba women with type 2 diabetes (3.9% [n=49] vs 1.6% [n=16], respectively; RR 2.40 [95% CI 1.37,4.19]; p=0.0015).

Maternal and neonatal outcomes in type 2 diabetes pregnancies compared to matched mother-baby pairs without type 2 diabetes

Maternal baseline characteristics of the matched cohorts are reported by First Nation versus all other Manitobans with and without diabetes in Table 1. Maternal and neonatal outcomes stratified by First Nation status compared to matched controls are summarized in Supplementary Table 1 and the RRs of these outcomes are reported in Table 2. In both First Nation and all other Manitoban women, type 2 diabetes was associated with an increased risk of caesarean section and induction of labour but no difference in vaginal delivery or maternal mortality/morbidity (Table 2).

In both First Nation and all other Manitoban offspring, risk of preterm delivery, early preterm delivery, large-for-gestational-age infant, birth trauma, admission to neonatal intensive care unit,

and congenital anomalies was higher with type 2 diabetes compared to diabetes free matches. There was a lower risk of small-for-gestational-age in First Nations women with type 2 diabetes compared to matched controls (RR 0.41 [95% CI 0.28,0.60]). Conversely, in all other Manitobans compared to matched controls, there was no association between type 2 diabetes and small-for-gestational-age neonates (Table 2).

Maternal and neonatal outcomes in First Nation women and all other Manitobans with type 2 diabetes

In women with type 2 diabetes, the relative risk of caesarean section, operative vaginal delivery, and maternal mortality morbidity did not differ between First Nation women and all other Manitoban women (Table 3). However, First Nation women with type 2 diabetes were more likely to have induction of labour compared with other Manitobans with type 2 diabetes in pregnancy (Table 3).

Offspring of First Nation women with type 2 diabetes had an increased risk of preterm and early preterm delivery, neonatal intensive care unit admission, and neonatal readmission to hospital compared to offspring of all other Manitoban women with type 2 diabetes (Table 3). In addition, offspring of First Nation women with type 2 diabetes were more likely to be large-for-gestational-age neonate and less likely to be small-for-gestational-age neonate compared to offspring of all other Manitoban women with type 2 diabetes (Table 3). There was an almost 2-fold increased risk of congenital anomalies in pregnancies in First Nation women with type 2 diabetes compared with all other Manitoban women with type 2 diabetes (RR 1.97 [95% CI 1.30,2.99]).

Interpretation

While type 2 diabetes is known to increase the risk of congenital anomaly, stillbirth, and perinatal mortality, these risks were two-fold greater for First Nation women compared to other Manitoba women with type 2 diabetes. Additionally, most adverse neonatal outcomes were more common in First Nation women compared to other Manitobans. Both First Nation and other Manitoban women with type 2 diabetes continue to have a higher risk of adverse pregnancy outcomes, although the magnitude of risk seems disproportionate by ethnicity.

Prior to our study, there were limited data are available examining these severe adverse outcomes specifically among First Nation women with type 2 diabetes compared to other populations. Our study is consistent with another large Canadian cohort study in Quebec that found pre-existing diabetes was more strongly associated with an increased risk of stillbirth in First Nations women compared to non-Indigenous populations (22). Our study also found a two-fold increased risk of perinatal death in the offspring of First Nation compared to all other Manitoban women with type 2 diabetes in pregnancy which was not found in the Quebec cohort. Our cohort included only women with type 2 diabetes, while the Quebec cohort did not differentiate type of pre-existing diabetes which may account for this difference (22, 23). More recent data from the United Kingdom have demonstrated that while women with type 2 diabetes are more likely to reach glycemic control targets throughout pregnancy than women with type 1 diabetes, severe adverse neonatal outcomes are as common or more common (24, 25). We postulate that the higher risk of stillbirth and perinatal death in First Nation women is likely multifactorial and may include factors such as access to care, socioeconomic factor index differences, higher rates of obesity or above target glycemic control, and systemic racism within

our healthcare system. Additional research is required to identify modifiable risk factors in this population.

In our cohort, type 2 diabetes was associated with a higher risk of large-for-gestational-age neonates in both First Nation and other Manitoban women (47.4% and 26.5% respectively). The proportion of other Manitobans with a large-for-gestational-age neonate is consistent with other studies of women with type 2 diabetes (3, 24). First Nation women in our study were more likely to have a large-for-gestational-age neonate and less likely to have a small-for-gestational-age neonate compared to other Manitobans. Our findings are consistent with an earlier Alberta-based cohort which compared birthweight in First Nation and non-First Nation women regardless of diabetes status (26). In this study, infants of First Nation women were significantly more likely to have a high birthweight and very high birthweight. This study also found a significant association between First Nation status and birthweight <1500g but was no association with birthweight <2500g. Unlike the Alberta cohort, our cohort used size for gestational age parameters and was restricted to women with type 2 diabetes which is a well-recognized risk factor for fetal overgrowth. Additionally, definitions of macrosomia using an absolute birthweight instead of a percentile corrected for gestational age tend to underestimate the identification of large-for-gestational-age infants (9, 27, 28). Large-for-gestational-age size has been associated with an increased risk of other adverse pregnancy outcomes such as neonatal hypoglycemia and stillbirth (3, 25, 29). Both diabetes in pregnancy and fetal macrosomia are also independent predictors of need for caesarean delivery, which was consistent with our study findings that type 2 diabetes was associated with an increased risk of caesarean section in First Nations and all other Manitoban women. To mitigate the risk of stillbirth, pregnancies

complicated by diabetes with suboptimal glycemic control and fetal macrosomia are often delivered earlier in the late preterm/early term period; while this practice pattern attempts to prevent stillbirth, it can translate into later postnatal sequelae for the newborn. Additional research is needed to identify potential modifiable risk factors for large-for-gestational-age neonates such as above target glycemic control, maternal weight and excess gestational weight gain in First Nation and all other women with type 2 diabetes, and to improve optimal timing and mode of delivery.

Our study benefits from several important strengths. It is a large population-based cohort allowing for examination of less frequent outcomes such as stillbirth and perinatal death. It also benefits from its specific definition for type 2 diabetes allowing us to make robust conclusions regarding the risk of adverse pregnancy outcomes in pregnancies with type 2 diabetes. The use of the more robust definitions of fetal growth abnormalities using percentile cut-offs is also a study strength. We also acknowledge a number of limitations. We had incomplete data for hemoglobin A1c data, so were unable to examine the role of glycemic control in these adverse outcomes. While we matched our type 2 diabetes and non-type 2 diabetes cohorts for important factors such as maternal age, we were unable to adjust for potential confounders not captured by our administrative data such as maternal obesity. Lastly, our study did not examine for or address the complex causes for the differences in pregnancy outcomes in First Nations and all other Manitobans with type 2 diabetes.

First Nation lives continue to be affected by the legacy of colonization which has had and is continuing to have a profound and intergenerational effect on First Nation health. Our large

population-based cohort study demonstrated that First Nations women living with type 2 diabetes experienced a higher risk for adverse pregnancy outcomes compared to all other Manitoban women with type 2 diabetes. Additional studies are need to identify both high-risk and protective factors for adverse outcomes in First Nation people with type 2 diabetes in pregnancy as well as to understand the way systemic racism in healthcare delivery and access contributes to these outcomes.

Acknowledgements

Data: The authors acknowledge MCHP for use of data contained in the Manitoba Population Research Data Repository under HIPC#2017/18-24. We also acknowledge the Diabetes Education Resource for Children and Adolescents, Winnipeg Manitoba for use of the pediatric clinical diabetes database. The results and conclusions are those of the authors and no official endorsement by the Manitoba Centre for Health Policy, Manitoba Health, or other data providers is intended or should be inferred. Data used in this study are from the Manitoba Population Research Data Repository housed at the Manitoba Centre for Health Policy, University of Manitoba and were derived from data provided by Manitoba Health, Winnipeg Regional Health Authority, Diagnostic Services Manitoba, and Statistics Canada.

Contribution statement

CR, LM, ES, MS, and HP contributed to study conception and design. CR, MS, and HP were involved with data acquisition and analysis. JMY, CP, CR, ES, LM, and BW were involved in data interpretation. JMP wrote the first draft of the manuscript with input from CR and CP. All

authors contributed to critical review and all authors approve of the final manuscript. CR is the guarantor of this work and is accountable for all aspects of the work.

References

1. Mackin ST, Nelson SM, Kerssens JJ, Wood R, Wild S, Colhoun HM, et al. Diabetes and pregnancy: national trends over a 15 year period. Diabetologia. 2018;61(5):1081-8.
2. Murphy HR, Bell R, Cartwright C, Curnow P, Maresh M, Morgan M, et al. Improved pregnancy outcomes in women with type 1 and type 2 diabetes but substantial clinic-to-clinic variations: a prospective nationwide study. Diabetologia. 2017;60(9):1668-77.
3. Yamamoto JM, Donovan LE, Mohammad K, Wood SL. Severe neonatal hypoglycaemia and intrapartum glycaemic control in pregnancies complicated by type 1, type 2 and gestational diabetes. Diabet Med. 2020;37(1):138-46.
4. Beyerlein A, Lack N, von Kries R. No further improvement in pregnancy-related outcomes in the offspring of mothers with pre-gestational diabetes in Bavaria, Germany, between 2001 and 2016. Diabet Med. 2018;35(10):1420-4.
5. Gracey M, King M. Indigenous health part 1: determinants and disease patterns. Lancet. 2009;374(9683):65-75.
6. Sellers EA, Dean HJ, Shafer LA, Martens PJ, Phillips-Beck W, Heaman M, et al. Exposure to Gestational Diabetes Mellitus: Impact on the Development of Early-Onset Type 2 Diabetes in Canadian First Nations and Non-First Nations Offspring. Diabetes Care. 2016;39(12):2240-6.
7. Liu SL, Shah BR, Naqshbandi M, Tran V, Harris SB. Increased rates of adverse outcomes for gestational diabetes and pre-pregnancy diabetes in on-reserve First Nations Women in Ontario, Canada. Diabet Med. 2012;29(8):e180-3.
8. Duong V, Davis B, Falhammar H. Pregnancy and neonatal outcomes in Indigenous Australians with diabetes in pregnancy. World J Diabetes. 2015;6(6):880-8.
9. Pylypjuk C, Sellers E, Wicklow B. Perinatal Outcomes in a Longitudinal Birth Cohort of First Nations Mothers With Pregestational Type 2 Diabetes and Their Offspring: The Next Generation Study. Can J Diabetes. 2021;45(1):27-32.
10. Oster RT, King M, Morrish DW, Mayan MJ, Toth EL. Diabetes in pregnancy among First Nations women in Alberta, Canada: a retrospective analysis. BMC Pregnancy Childbirth. 2014;14:136.
11. Feig DS, Hwee J, Shah BR, Booth GL, Bierman AS, Lipscombe LL. Trends in incidence of diabetes in pregnancy and serious perinatal outcomes: a large, population-based study in Ontario, Canada, 1996-2010. Diabetes Care. 2014;37(6):1590-6.
12. Guariguata L, Linnenkamp U, Beagley J, Whiting DR, Cho NH. Global estimates of the prevalence of hyperglycaemia in pregnancy. Diabetes Res Clin Pract. 2014;103(2):176-85.
13. Statistics Canada. Census Profile, 2016 Census. Ottawa, Canada 2019 [Available from: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E] [Accessed 27Sept2021].
14. Ruth C, Sellers E, Chartrand C, McLeod L, Prior H, Sirski M, et al. Type 2 Diabetes in Manitoba. Autum. Winnipeg, Manitoba Manitoba Centre for Health Policy 2020.
15. Smith M, Lix LM, Azimaee M, Enns JE, Orr J, Hong S, et al. Assessing the quality of administrative data for research: a framework from the Manitoba Centre for Health Policy. J Am Med Inform Assoc. 2018;25(3):224-9.
16. Jutte DP, Roos LL, Brownell MD. Administrative record linkage as a tool for public health research. Annu Rev Public Health. 2011;32:91-108.

17. Lix L, Yogendran M, Burchill C, Metge C, McKeen N, Moore D, et al. Defining and Validating Chronic Diseases: An Administrative Data Approach Winnipeg, Manitoba, Canada: Manitoba Centre for Health Policy; 2006 01/01.
18. Health Canada. Responding to the Challenge of Diabetes in Canada: First Report of the National Diabetes Surveillance System. Ottawa, Ontario; 2003.
19. Khokhar B, Quan H, Kaplan GG, Butalia S, Rabi D. Exploring novel diabetes surveillance methods: a comparison of administrative, laboratory and pharmacy data case definitions using THIN. J Public Health (Oxf). 2018;40(3):652-8.
20. Allen VM, Dodds L, Spencer A, Cummings EA, MacDonald N, Kephart G. Application of a national administrative case definition for the identification of pre-existing diabetes mellitus in pregnancy. Chronic Dis Inj Can. 2012;32(3):113-20.
21. Shah BR, Retnakaran R, Booth GL. Increased risk of cardiovascular disease in young women following gestational diabetes mellitus. Diabetes Care. 2008;31(8):1668-9.
22. Chen L, Wang WJ, Auger N, Xiao L, Torrie J, McHugh NG, et al. Diabetes in pregnancy in associations with perinatal and postneonatal mortality in First Nations and non-Indigenous populations in Quebec, Canada: population-based linked birth cohort study. BMJ Open. 2019;9(4):e025084.
23. Lemieux P, Benham JL, Donovan LE, Moledina N, Pylypjuk C, Yamamoto JM. The association between gestational diabetes and stillbirth: a systematic review and meta-analysis. Diabetologia. 2021.
24. Murphy HR, Howgate C, O'Keefe J, Myers J, Morgan M, Coleman MA, et al. Characteristics and outcomes of pregnant women with type 1 or type 2 diabetes: a 5-year national population-based cohort study. Lancet Diabetes Endocrinol. 2021.
25. Mackin ST, Nelson SM, Wild SH, Colhoun HM, Wood R, Lindsay RS, et al. Factors associated with stillbirth in women with diabetes. Diabetologia. 2019;62(10):1938-47.
26. Oster RT, Toth EL. Longitudinal Rates and Risk Factors for Adverse Birth Weight Among First Nations Pregnancies in Alberta. J Obstet Gynaecol Can. 2016;38(1):29-34.
27. Isabey EP, Pylypjuk CL. The Relationship between Fetal Abdominal Wall Thickness and Intrapartum Complications amongst Mothers with Pregestational Type 2 Diabetes. J Diabetes Res. 2021;2021:5544599.
28. American College of Obstetricians and Gynecologists. Macrosomia: ACOG Practice Bulletin, Number 216. Obstet Gynecol. 2020;135(1):e18-e35.
29. Yamamoto JM, Corcoy R, Donovan LE, Stewart ZA, Tomlinson G, Beardsall K, et al. Maternal glycaemic control and risk of neonatal hypoglycaemia in Type 1 diabetes pregnancy: a secondary analysis of the CONCEPTT trial. Diabet Med. 2019;36(8):1046-53.

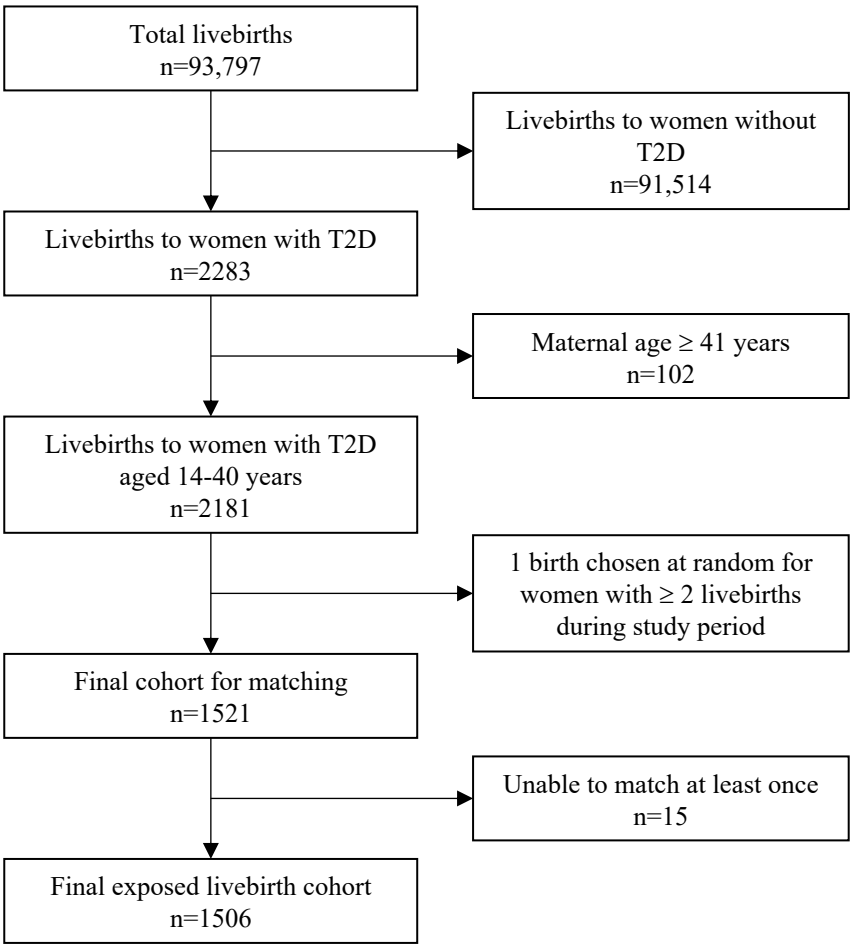

Figure 1: Study flow diagram of included mother-baby pairs
T2D, type 2 diabetes

Table 1: Maternal characteristics of matched cohort of individuals with and without type 2 diabetes in First Nation women and all other women

	First Nation with type 2 diabetes	First Nation without type 2 diabetes	All others with type 2 diabetes	All others without type 2 diabetes
Baseline	n=816	n=2233	n=690	n=2068
Age (median)	29 (25,34)	28 (24,33)	32 (29,36)	32 (29,35)
Urban	60-65 (7.3-7.9)	339 (15.18)	513 (74.35)	1544 (74.66)
Parity				
0	151 (18.50)	416 (18.63)	225 (32.61)	673 (32.54)
1	153 (18.75)	390 (17.47)	242 (35.07)	801 (38.73)
2	147 (18.01)	359 (16.08)	125 (18.12)	372 (17.99)
3+	365 (44.73)	1068 (47.83)	98 (14.2)	222 (10.74)
Socioeconomic factor index group*				
High (less than -1)	**	17 (0.76)	29 (4.20)	269 (13.03)
Middle (-1 to 0)	59-64** (7.23-7.84)	158 (17.09)	322 (46.67)	1044 (50.56)
Low (0 to +1)	135 (16.54)	396 (17.76)	224 (32.46)	620 (30.02)
Very low (+1 plus)	618 (75.74)	1659 (74.39)	112 (16.23)	132 (6.39)

Data are presented as n (%); *n=10 missing; **data suppressed due to too few numbers in group

Table 2: Relative risk of maternal and neonatal outcomes in First Nation and all other pregnancies in women with diabetes compared to those without diabetes

	First Nation with type 2 diabetes vs diabetes free matches Relative Risk (95% CI)	**All others with type 2 diabetes vs diabetes free matches** Relative Risk (95% CI)
Maternal Outcomes		
Caesarean section	**2.34 (2.07, 2.65)**	**1.77 (1.58, 1.97)**
Operative vaginal delivery	1.40 (1.00, 1.95)	0.90 (0.66, 1.23)
Induction	**1.97 (1.80, 2.16)**	**2.09 (1.86, 2.35)**
Mortality/Morbidity	0.83 (0.36, 1.93)	1.18 (0.59, 2.35)
Neonatal Outcomes		
Preterm delivery	**3.99 (3.37, 4.73)**	**4.19 (3.38, 5.20)**
Early preterm delivery	**2.68 (1.85, 3.90)**	**1.94 (1.14, 3.29)**
Large-for-gestational-age	**2.90 (2.58, 3.27)**	**2.42 (2.03, 2.88)**
Small-for-gestational-age	**0.41 (0.28, 0.60)**	0.85 (0.63, 1.15)
Birth trauma	**6.25 (2.58, 15.15)**	**5.24 (2.21, 12.45)**
NICU admission	**3.93 (3.32, 4.65)**	**3.42 (2.82, 4.15)**
Neonatal readmission	**1.60 (1.12, 2.29)**	0.88 (0.53, 1.49)
Congenital anomaly	**3.61 (2.55, 5.12)**	**2.72 (1.67, 4.43)**

Boldface font indicates statistical significance; NICU, neonatal intensive care unit

Table 3: Relative risks of maternal and neonatal outcomes in First Nation women with type 2 diabetes compared to all others with type 2 diabetes.

	First Nations with type 2 diabetes vs all others with type 2 diabetes Relative Risk (95% CI)
Maternal Outcomes	
Caesarean section	0.89 (0.79, 1.00)
Operative vaginal delivery	0.86 (0.59, 1.27)
Induction	**1.22 (1.10, 1.35)**
Mortality/Morbidity	0.54 (0.21, 1.38)
Neonatal Outcomes	
Preterm delivery	**1.31 (1.11, 1.54)**
Early preterm delivery	**1.99 (1.23, 3.26)**
Large-for-gestational-age	**1.79 (1.55, 2.07)**
Small-for-gestational-age	**0.46 (0.30, 0.73)**
Birth trauma	0.97 (0.48, 1.97)
NICU admission	**1.23 (1.05, 1.44)**
Neonatal readmission	**2.11 (1.24, 3.62)**
Congenital anomaly	**1.97 (1.30, 2.99)**

Boldface font indicates statistical significance; NICU, neonatal intensive care unit

Appendix

Appendix Table 1: Pregnancy and neonatal outcomes in matched cohort of mother-baby pairs

	First Nation with type 2 diabetes	First Nation without type 2 diabetes	All others with type 2 diabetes	All others without type 2 diabetes
	n=816	n=2233	n=690	n=2068
Maternal Outcomes				
Caesarean section	326 (40.0)	381 (17.1)	311 (45.1)	528 (25.5)
Operative vaginal delivery	49 (6.0)	96 (4.3)	48 (7.0)	160 (7.7%)
Induction	452 (55.4)	628 (28.1)	313 (45.4)	449 (21.7)
Mortality/Morbidity	7 (0.9)	23 (1.0)	11 (1.6)	28 (1.4)
Neonatal Outcomes				
Preterm delivery (<37 weeks)	267 (32.7)	183 (8.2)	172 (24.9)	123 (5.9)
Early preterm delivery (<34 weeks)	52 (6.4)	53 (2.4)	22 (3.2)	34 (1.6)
Large-for-gestational-age	387 (47.4)	365 (16.3)	183 (26.5)	227 (11.0)
Small-for-gestational-age	28 (3.4)	188 (8.4)	51 (7.4)	179 (8.7)
Birth trauma	16 (2.0)	7 (0.3)	14 (2.0)	8 (0.4)
Neonatal intensive care unit admission	270 (33.1)	188 (8.4)	185 (26.8)	162 (7.8)
Neonatal readmission	45 (5.5)	77 (3.4)	18 (2.6)	61 (2.9)
Congenital anomaly	70 (8.6)	53 (2.4)	30 (4.3)	33 (1.6)

Data are presented as n (%)