DIABETES
Amongst the Métis Nation of Alberta

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MÉTIS NATION of ALBERTA

INJURY PREVENTION CENTRE
KNOWLEDGE. LEADERSHIP. ACTION.

UNIVERSITY OF ALBERTA
SCHOOL OF PUBLIC HEALTH

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Message from the

President

I would like to share with you our latest health report *Diabetes Amongst the Métis Nation of Alberta.*

This report highlights the incidence and prevalence of diabetes amongst Métis Albertans and will be used in the development of future research and health promotion programming. This report found our citizens are far more likely to be living with diabetes than non-Métis Albertans, providing us with a clear message: we must work together to manage diabetes and prevent its complications.

I would like to acknowledge and thank our partner, the University of Alberta School of Public Health, for their continued support during the development of this health report.

Audrey Poitras

President,
Métis Nation of Alberta

Métis sash on a loom

Executive Summary

Diabetes is a significant health burden on Canadians. Research has shown Indigenous peoples (i.e. First Nations, Métis, and Inuit) have higher rates of diabetes compared with non-Indigenous peoples. Much of the research with Indigenous peoples focuses on First Nations peoples in Canada and Native Americans in the United States. The Métis form a distinct group of Indigenous peoples in Canada, and more research is needed for this specific population. This study used data from Alberta's provincially administered health care system linked to a registry of Métis citizens and their dependents to estimate the occurrence, treatment, and complications related to diabetes. The prevalence (total number of diagnoses) and incidence (number of new diagnoses during the examined timeframe) of diabetes was determined for the Métis and the non-Métis population of Alberta. Distribution of diabetes-related medications and the occurrence of complications related to diabetes were also determined and compared between Métis and the non-Métis population of Alberta. The results of the study indicate that the prevalence and incidence of diabetes is higher for the Métis population of Alberta when compared to non-Métis Albertans. Métis Albertans were also more likely to receive medications used in the treatment of diabetes, owing to the higher prevalence of diabetes. However, significant treatment gaps concerning the use of heart/kidney protection drugs in the younger age groups was noted. Finally, Métis individuals with diabetes did not have statistically significant differences in complications, such as macrovascular issues, long-term renal (kidney) dialysis, or lower limb amputation. These results suggest that Métis are a unique population with respect to diabetes prevalence and treatment and require additional prevention and treatment resources to address the health burden they experience.

1. Background

1.1 Background of the Métis

The Métis population in Canada is a distinct Indigenous population with a unique history. The Métis National Council defines Métis as "a person who self-identifies as Métis, is distinct from other Aboriginal peoples, is of historic Métis Nation ancestry, and is accepted by the Métis Nation" (Métis National Council 2010). The Métis population of Canada has been growing rapidly over the last two decades. The Métis population increased by 51.2% between 2006 and 2016, representing the greatest growth of the Indigenous peoples (Statistics Canada 2017). This rise has been largely driven by increased identification by individuals as being Métis (Statistics Canada 2008; Foulds *et al.* 2013). Of the 587,545 individuals who identify as Métis in Canada, Alberta has the second-largest provincial population with 114,370 Métis Albertans identified in the 2016 census (Statistics Canada 2017).

1.2 Diabetes

Diabetes is a common and potentially serious condition. This section will describe the disorder and the main complications associated with it. Diabetes is a metabolic disorder characterized by prolonged periods of high blood sugar. It develops over time when the pancreas fails to produce insulin, a hormone which helps sugar in the blood to be absorbed into the muscles and organs of the body (Type 1 Diabetes), or, when the body no longer responds properly to insulin (Type 2 Diabetes), or a combination of the two. Approximately 8.1% of Canadians had diabetes during 2013/2014 (Public Health Agency of Canada 2017). Males are more likely to have diabetes (8.7% versus 7.6% for females) and diabetes is most common in Ontario, Newfoundland and Labrador, and Manitoba, and less common in Nunavut, Alberta, and Quebec (Public Health Agency of Canada 2018).

Long-term complications associated with diabetes include both micro- and macrovascular complications. Microvascular (small blood vessels, such as capillaries) complications include retinopathy, nephropathy, and neuropathy. Retinopathy is damage to the blood vessels in the eyes that can cause vision problems and blindness. The longer a person has diabetes, the greater the risk of experiencing retinopathy; the majority of people with diabetes will develop some degree of retinopathy eventually (Nathan 1993). Diabetic retinopathy is the leading cause of blindness worldwide, including in Canada (Hooper *et al.* 2012). Retinopathy begins with microaneurysms (swelling) in the small blood vessels of the eye. These vessels can hemorrhage or leak into the eye which may result in loss of vision. As retinopathy progresses, the blood flow in some vessels may become restricted (i.e. retinal ischemia). As a response to this restricted blood flow, new blood vessels develop and grow out of the retina and into the eye. Continued growth of new blood vessels can lead to conditions called retinal traction and detachment, which collectively mean the gel-like vitreous pulls on the retina and eventually the retina separates from the blood vessels which provide oxygen and nourishment. Together, these complications can cause blurry and distorted vision (traction) and/or a loss of vision (detachment). Retinal detachment is serious and can cause a person to permanently lose their sight if not treated very quickly by a doctor.

Nephropathy refers to damage to the kidneys, which is a significant factor in the increased risk of death associated with diabetes. It is less common in diabetes than retinopathy, with between 35% and 45% developing the condition (Nathan 1993). As damage to the kidneys progresses, they begin to lose their effectiveness as filters. Over time the damage may lead to end-stage kidney disease, meaning the kidneys no longer function well enough to meet the body's needs. This kidney failure leads to the necessity for kidney dialysis and transplants. The financial impact to the health system and personal toll of end-stage kidney disease resulting from diabetes is substantial.

Neuropathy refers to damage to the nerves and tends to affect nerves in the feet and hands most severely. Loss of sensation (feeling numb) in the feet is a common complication of diabetes and greatly increases the risk of injury and ulcers. This loss of sensation removes the feeling of pain, which normally helps to prevent additional injuries. Pain also helps wounds heal by deterring people from disturbing these wounds when they walk. These conditions can be worsened due to reduced blood flow in the arms and legs, yet another common symptom of diabetes. Injuries and ulcers may become severe enough that amputation of part, or all the limb, may be required.

Although microvascular issues are common, a clear majority of patients with diabetes will develop complications described as macrovascular (large blood vessels, such as arteries). Common macrovascular complications of diabetes include acute ischemic stroke, ischemic heart disease, atrial fibrillation, congestive heart failure, and transient ischemic attack. In fact, the primary cause of death for people with diabetes is cardiovascular disease (Fowler 2008).

1.3 Treatment of diabetes

Successfully managing diabetes requires many considerations. Research has identified the following priorities for treatment: patient education, dietary advice, blood pressure management, blood sugar management, cholesterol management, and drug treatment (Clement *et al.* 2013; National Institute for Health and Care Excellence 2015; Diabetes Canada Clinical Practice Guidelines Expert Committee *et al.* 2018b). Education, dietary advice, and drug treatment are intended to improve blood pressure, blood sugar, cholesterol, and weight management. Canadian guidelines have highlighted the specific treatment needs of Indigenous groups in Canada, including the Métis, as well as the need to incorporate the social and cultural context of Indigenous individuals into treatment plans (Diabetes Canada Clinical Practice Guidelines Expert Committee *et al.* 2018a).

Ideally, making lifestyle changes informed by patient education and dietary advice would be sufficient to control diabetes, however, this is rarely the case. Prescription medications to help control blood pressure, cholesterol, and blood sugar are often required in addition to lifestyle changes, and the intensity of the medication treatment increases as the disease progresses.

The next few paragraphs outline a suggested treatment path for medications that might be experienced by patients, based on Canadian treatment guidelines mentioned earlier (Diabetes Canada Clinical Practice Guidelines Expert Committee *et al.* 2018a, 2018d, 2018b). Treatment guidelines are regularly updated and therefore shift over time as new information and treatment methods become available.

When medication is needed, Metformin is typically the first drug prescribed for management of blood sugar for Type 2 Diabetes. The dosage is gradually increased while monitoring for side effects. If Metformin alone is not enough to reduce blood sugar, another medication may be added based on patient preference and treatment goals. Examples of other medication options (common brand names italicized in parentheses) include: dipeptidyl peptidase-4 (DPP-4) inhibitors (*Januvia*®), pioglitazone (*Actos*®), sulfonylurea (*Gliclazide*®), glucagon-like peptide-1 (GLP-1) inhibitors (*Victoza*®), and sodium/glucose cotransporter 2 inhibitors (SLGT2i) (*Jardiance*®). These medications may also be used if Metformin is poorly tolerated by the person with diabetes. Although insulin is not always needed in Type 2 Diabetes treatment, it should be started immediately for anyone with metabolic decompensation, especially if experiencing Diabetic Ketoacidosis (DKA) or Hyperosmolar Hyperglycemic State (HHS), which are the extremes in the spectrum of metabolic complications in diabetes (Diabetes Canada Clinical Practice Guidelines Expert Committee *et al.* 2018b). Insulin may also be started at any time based on treatment goals and patient preference.

Canadian guidelines for Type 1 Diabetes focus on various types of insulin treatments and methods for reducing the risk of dangerously low blood sugar (Diabetes Canada Clinical Practice Guidelines Expert Committee *et al.* 2018a).

The suggested treatment for high blood pressure is an angiotensin-converting enzyme (ACE) inhibitor (*Altace*®), or a calcium-channel blocker (*Amlodipine*®) if there is a possibility of pregnancy. If the ACE inhibitor is not effective at reducing blood pressure, or there are undesirable side effects, then it should be replaced with an angiotensin II-receptor blocker (ARB) (*Atacand*®). If blood pressure is still not within the target range, adding a calcium-channel blocker and/or diuretic (water pill) is recommended. If further treatment is needed then adding an alpha-blocker (*Hytrin*®), a beta-blocker (*Lopressor*®), or a potassium-sparing diuretic (*Aldactone*®) is recommended.

Treatment with specific types of GLP-1 and SLGT2i medications may also be used for those with a higher risk of heart disease since these medications have a demonstrated benefit on cardiovascular outcomes. Drugs such as ACE inhibitors, ARBs, and statins (cholesterol-lowering medications) may be prescribed even if blood pressure and cholesterol are at target levels to protect cardiovascular health.

Cholesterol management is important for those diagnosed with diabetes (Diabetes Canada Clinical Practice Guidelines Expert Committee *et al.* 2018c). Canadian guidelines suggest treatment goals should be to reduce low-density lipoprotein (LDL)-cholesterol, known as 'bad cholesterol', until it is consistently less than 2 mmol per litre of blood, or to achieve at least a 50% reduction in LDL-cholesterol from the pre-treatment level.

Several recommendations for treatment of cholesterol issues in individuals with diabetes are suggested (Diabetes Canada Clinical Practice Guidelines Expert Committee *et al.* 2018c). Being physically active and eating a healthy diet is considered a first line therapy to treat and prevent high cholesterol. Statin medications, such as *Lipitor*®, are commonly used to help reduce LDL-cholesterol and are recommended for those with diabetes who have high cholesterol. Regularly measuring cholesterol is highly recommended for individuals with diabetes, since having high cholesterol is a stronger risk factor for serious cardiovascular events, such as heart attack or stroke, in this population. Canadian Guidelines suggest adults with

diabetes have their cholesterol tested yearly, and those taking medications for cholesterol may require more frequent testing.

If diet, exercise, and statin therapy do not reduce LDL-cholesterol to target levels then additional medication can be considered. Ezetimibe (*Ezetrol®*) may be considered, especially in those diagnosed with cardiovascular disease. Evolocumab (*Repatha®*) is another recommended medication for those with cardiovascular disease. While these medications target different areas of the body (small intestine and liver, respectively), their addition to a treatment plan may help individuals who struggle to reach their cholesterol goals, despite efforts to improve lifestyle.

Managing diabetes can involve a complicated combination of medications, and continuous monitoring is needed to adjust treatment. For this reason, taking medications as prescribed and receiving ongoing monitoring by a doctor has been shown to improve the health of people with diabetes, and is therefore a vital aspect of treatment.

1.4 Diabetes in the Métis population

The prevalence of diabetes has been increasing in Canada throughout the last few decades (Ralph-Campbell *et al.* 2009; Public Health Agency of Canada 2011). Prior research has shown that Indigenous peoples have a higher prevalence of diabetes when compared to other Canadians (Public Health Agency of Canada 2011; Randall *et al.* 2012; Foulds *et al.* 2013).

To date, the health of the Métis population has been understudied. However, a small amount of research focusing specifically on diabetes amongst the Métis has been conducted (Bruce 2000; Bruce *et al.* 2003; Statistics Canada 2003; Ralph-Campbell *et al.* 2009; Martens *et al.* 2011; Public Health Agency of Canada 2011; Shah *et al.* 2011; Randall *et al.* 2012; Foulds *et al.* 2013). Research has shown that the Métis population experiences diabetes at a higher rate than non-Indigenous Canadians, but not as high as the rates experienced by First Nations peoples. Furthermore, Métis differ from First Nations with respect to risk factors for poor health (e.g. abnormal waist circumference, being overweight or obese, having pre-diabetes, hypertension, and gestational diabetes; Oster & Toth 2009; Martens et al. 2011; Foulds et al. 2013). The prevalence of diabetes amongst the Métis population in Canada has been estimated at between 5.6% and 11.8% depending on the age of participants studied (Bruce 2000; Bruce *et al.* 2003; Statistics Canada 2003; Ralph-Campbell *et al.* 2009; Martens *et al.* 2011; Public Health Agency of Canada 2011; Shah *et al.* 2011; Randall *et al.* 2012; Foulds *et al.* 2013). Related to the limited research on Métis health, studies specifically examining diabetes epidemiology and treatment in the Métis population is required to understand and improve the health status of Métis people.

As the occurrence of diabetes changes in Canada, the incidence and prevalence of the disease amongst the Métis also needs to be monitored. Other key measures important to understanding the impact of diabetes include the dispensation of medications used to treat the disorder, and major complications such as long-term dialysis and lower leg amputations.

2. Methods

2.1 Data sources

Alberta residents were identified, during the duration of the study, using the *Alberta Health Care Insurance Plan (AHCIP) Population Registry* files. These registry files also provide information on the age and sex of individuals living within the province. Several other administrative health data sources were also linked together using the Personal Health Number and were used in the analysis.

The AHCIP physician claims data contains the records of all fee-for-service claims by physicians in the province. These claims provide information on the diagnosis being treated, which is coded using the International Statistical Classification of Diseases and Related Health Conditions version 9 clinical modification (ICD-9-CM). The Alberta Hospital Discharge Abstract files contain information on all admissions to inpatient units within the province. These abstracts contain information on admission and discharge dates, as well as 25 diagnostic fields coded using the Canadian enhancement of the 10th edition of the International Statistical Classification of Disease and Related Health Conditions (ICD-10-CA). These claims and discharge abstracts also include personal health numbers for patients, as well as dates of treatment.

The Pharmaceutical Information Network (PIN) contains information on prescriptions dispensed from community pharmacies throughout the province. This data contains Drug Information Numbers and Anatomical Therapeutic Chemical (ATC) codes allowing specific types of drugs to be identified. Lastly, The Métis Nation of Alberta (MNA) registry was used to identify Métis citizens living within Alberta. In spring of 2017, supported by an Information Sharing Agreement signed in 2010, the MNA shared a copy of their citizenship registry with the Analytics and Performance Reporting Branch of Alberta Health.

2.2 Identification of Métis Albertans

Registered citizens of the MNA formed the Métis cohort in this study. All individuals who self-identify as Métis but were not registered citizens of the MNA during the study period were not included in the MNA cohort. Therefore, any mention of "Métis" in subsequent sections of this report are solely referring to the MNA cohort. Of the 34,235 citizens listed within the MNA registry (September 2016), 33,796 (98.7%) were successfully matched to personal health numbers within the population data available at Alberta Health. Non-spousal first-level dependents (e.g., children) of MNA citizens were also identified. This result was accomplished by using household accounts within the Alberta Health Care Insurance Plan registry. Dependents were defined as: (i) persons under 21; (ii) students; or (iii) permanent dependents due to mental/physical disabilities. If a person was identified as a dependent of an MNA citizen but was not yet included in the original MNA registry, they were added to the population file identifying Métis Albertans. There were 27,175 dependents identified

through these methods, however, 834 individuals were missing date of birth information and were removed from the cohort. With the addition of these dependents, there were a total of 60,137 people classified as part of the MNA population for the purposes of compiling MNA-specific diabetes information.

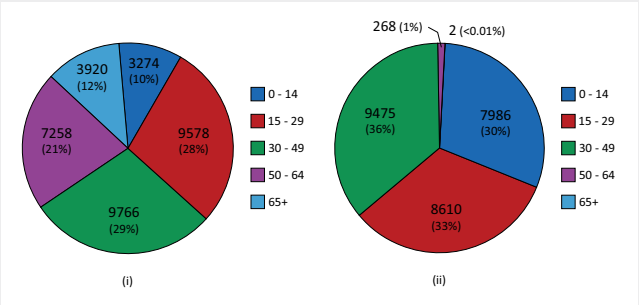

Figure 1.
Age distribution of (i) initial MNA citizens (left) and (ii) dependents (right)

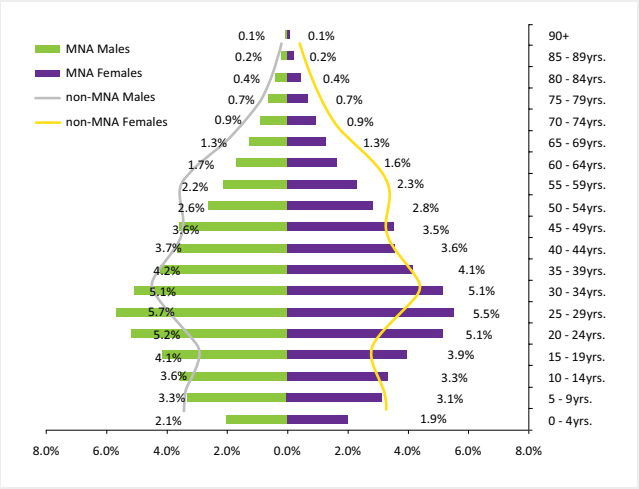

Figure 2.
Percent of Alberta population by 5-year age group, sex, and MNA citizenship, 2017.

Note: Based on a total MNA population of 60,137 (includes dependents as determined by Alberta Health Care Insurance Plan base number; 1.4% did not have age or sex data and were excluded here) and a non-MNA population of 4,098,842 (based on mid-year Alberta population in 2017 minus the MNA population).

Figure 1 provides the age distribution amongst the initial MNA citizens listed in the MNA registry provided to Alberta Health (left) and the additional dependents that were then identified (right). Figure 2 compares the age and sex distribution of the Métis population with other Albertans.

2.3 Identification of diabetes

Individuals were classified as having diagnosed diabetes if they met the following criteria:

- Two physician visits with a diagnosis of diabetes (ICD-9: 250) within a two-year period

OR

- One hospital discharge with a diagnosis of diabetes (ICD-10: E10-E14) in any diagnosis field

Gestational diabetes is excluded from this definition. Visits occurring 120 days prior or 180 days after a pregnancy-related visit are not included.

2.4 Diabetes medications

The use of diabetes medications was determined using the PIN data based on ATC codes. ATC code A10 and all drug subtypes categorized within this code were included in the definition of a diabetes medication. This includes several unique diabetes dispensations based on drug category (Insulins and analogues, Biguanides (Metformin), Sulfonylureas, DPP-4 inhibitors, or SLGT2 inhibitors) that were also individually identified. Blood pressure, lipid lowering, and cardio/kidney protection medications were also identified.

2.5 Identification of long-term dialysis

Long-term dialysis was determined using the following procedure codes: 13.99C, 13.99D, 13.99A, 13.99B, and 13.99O, but excluded kidney transplantations (67.59A). The definition of long-term dialysis required two dialysis procedure codes in the same year, at least 90 days apart from the earliest dialysis claim within that same year.

2.6 Identification of amputation

Table 1 outlines the physician claims procedure codes used to determine the occurrence of amputation. Amputations related to trauma (ICD9: 895-897) and tumors (ICD-9: 107.7, 107.8) were excluded.

Table 1.
Definition of Lower Limb Amputation using Alberta Physician Claims Data Procedure Codes

Procedure	Procedure Codes
Amputation and disarticulation of one toe	96.11A, 96.11AA, 96.11PA
Amputation and disarticulation of foot: Metatarsal	96.12A, 96.12AA, 96.12AB, 96.12AC
Amputation and disarticulation of foot: Transmetatarsal	96.12B, 96.12PB
Amputation and disarticulation of mid-tarsal	96.12C, 96.12PC
Amputation and disarticulation of foot: Metatarsal – whole ray	96.12PA
Amputation and disarticulation of ankle: Symes, Pirogoff	96.13
Amputation of lower leg below knee	96.14
Amputation of thigh or disarticulation of knee: Supracondylar Thigh through femur	96.15

Note: Adapted from *Ch. 7: Diabetes, Foot Disease and Lower Limb Amputations in Alberta, Alberta Diabetes Atlas 2011*, by Haverstock et al., retrieved from https://www.ihe.ca/publications/alberta-diabetes-atlas-2011.

2.7 Macrovascular complications

Frequencies for the following macrovascular complications were determined for individuals diagnosed with diabetes and living in the province as of June 30, 2016: acute ischemic stroke, ischemic heart disease, atrial fibrillation, congestive heart failure, and transient ischemic attack.

The methods used to identify these conditions are as follows:

Acute Ischemic Stroke

A case of acute ischemic stroke was defined as follows: one emergency or inpatient record identified by:

ICD09: 362.3, 433*1, 434*1, 436

ICD10: H34.1, H34.2, I63*, I64*

Atrial Fibrillation

A case of atrial fibrillation was defined as follows: two physician visits, inpatient, or ambulatory care records separated by at least 30 days within the first year of the first record.

Records for Inclusion

ICD09 Diagnosis: 427.3*

ICD10 Diagnosis: I48*

Records for Exclusion

ICD09 Diagnosis: 394-396, 424.0, 424.1

ICD10 Diagnosis: I05, I06, I34, I35, I08.0, I08.1, I08.2, I08.3

ICD09 CM: 35.0x, 35.2x, 35.96, 35.97, 35.99

ICD10 CCI: 1.HT.89, 1.HV.80, 1.HU.80, 1.HT.80, 1.HS.80, 1.HV.90, 1.HU.90, 1.HT.90, 1.HS.90

Congestive Heart Failure

A case of congestive heart failure was defined as follows: one inpatient or ambulatory care record.

Records for Inclusion

ICD09 Diagnosis: 428*

ICD10 Diagnosis: I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5, I42.9, I43*, I50*, P290

Ischemic Heart Disease

A case of Ischemic Heart Disease (IHD) was defined as follows: Two physician visits with a diagnosis of IHD in any diagnosis field within a one-year period OR one separation from hospital with either a diagnosis of IHD in any diagnosis field or one IHD intervention code in any intervention field.

Records for Inclusion

IHD diagnosis codes: ICD-9 410-414 or ICD-10 I20-I25

IHD intervention codes: PCI or CAPG 36.01, 36.02, 36.05, 36.10-36.19 or CCI 1IJ50, 1IJ57QG, 1IJ54, 1IJ76

Notes: i) At least one of the two physician visits must be from a general practitioner (GP) or specialist in a hospital or emergency department setting. ii) The two physician visits must be on different days. iii) The incidence date is based on the last record used for case ascertainment. iv) Physician Claim records back to 1983, and hospitalization records back to 1994 were used for case definition ascertainment.

Transient Ischemic Attack

A case of transient ischemic attack was defined as follows: one emergency or inpatient record.

Records for Inclusion

ICD09: 435*

ICD10: G45* (not G45.4), H34.0

2.8 Analysis

This study estimated the incidence of new cases and prevalence of diabetes, use of diabetes medications, and complications of diabetes such as long-term dialysis, macrovascular conditions, and lower limb amputation. Age standardization was used to better compare the Métis population's outcomes to non-Métis Albertans'. Standardization was done using the direct method with five-year age groups using the 2011 Canadian population as the population standard. Estimates were calculated for the years 2006 to 2016. Rates were also examined by sex group. The results were graphed to show the rates over time and by sex. Differences between Métis and non-Métis were assessed as ratios, or percentages calculated using the following formula:

$$\left(\frac{\text{standardized rate}_{MNA}}{\text{standardized rate}_{non\text{-}MNA}} - 1\right) \times 100\%$$

Frequencies were determined for macrovascular complications and the use of diabetes-related medications. Macrovascular complications were compared between the two groups. Risk ratios were calculated for specific medication subtypes comparing the Métis and non-Métis populations during 2016 and were adjusted for age. Age-specific risk ratios are shown where there was a statistically significant difference between the two groups. For this analysis, individuals were grouped based on broader, clinically-relevant age groups (e.g. 0 to 29, 30 to 49, 50 to 64, and 65 and older).

3. Diabetes prevalence and incidence

3.1 Diabetes prevalence

3.1.1 Age-standardized prevalence by MNA identity

The age-standardized prevalence of diabetes amongst the MNA population ranged between 82 per 1,000 population (in 2006) and 107 per 1,000 population (in 2016). This increase represented approximately 1,500 to 3,300 MNA individuals, respectively, living with diabetes between 2006 and 2016. MNA individuals had a rate of diabetes approximately 1.5 times higher when compared to non-MNA across all age groups. Furthermore, the prevalence increased over time similarly for both populations (Figure 3). After standardizing for age, the prevalence of diabetes was 1.46 (95% CI: 1.38 to 1.54) times

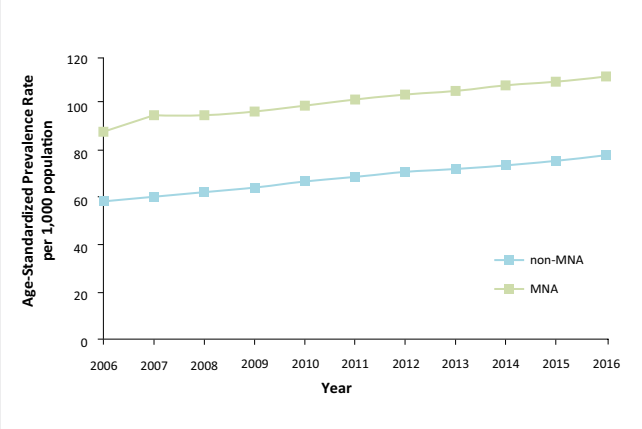

Figure 3.
Age-standardized diabetes prevalence per 1,000 population by MNA identity, 2006 to 2016

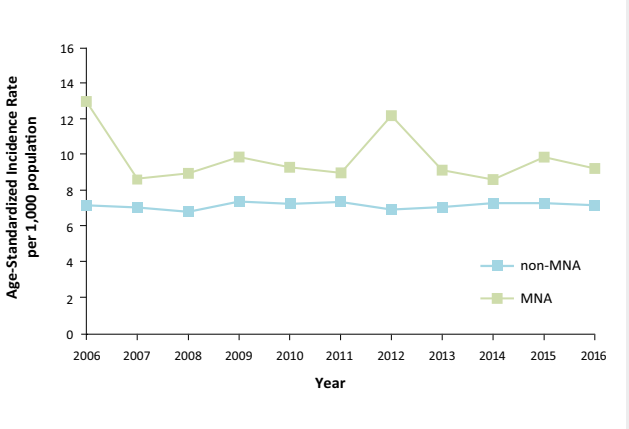

Figure 5.
Age-standardized incidence rates for diabetes per 1,000 population by MNA identity; 2006 to 2016

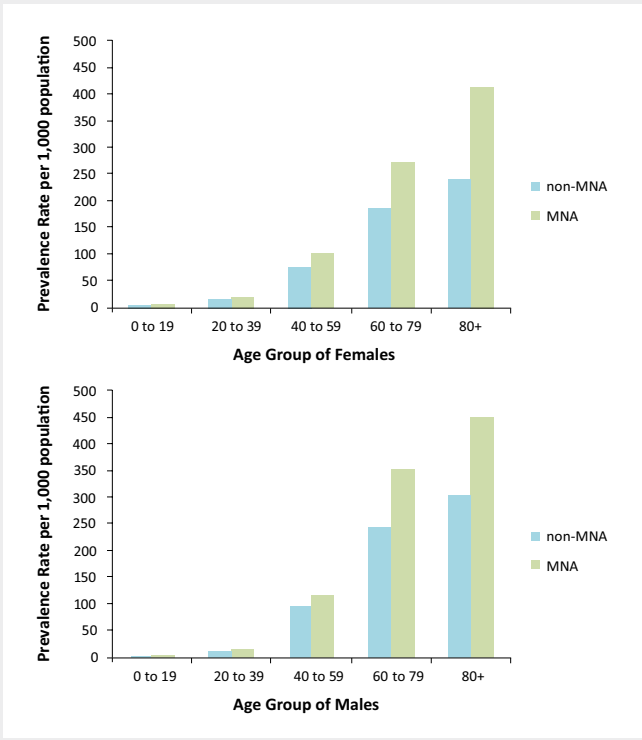

Figure 4.
Age-specific prevalence per 1,000 population by sex and MNA identity in 2016: Females (top) and Males (bottom)

higher amongst female Métis, and 1.37 (95% CI: 1.30 to 1.44) times higher amongst male Métis compared to non-Métis Albertans.

3.1.2 Age-specific prevalence by MNA identity in 2016

Age-specific prevalence increased by age for both males and females amongst MNA and non-MNA populations (Figure 4). For both sexes, diabetes prevalence was approximately 1.5 times higher amongst Métis Albertans over the age of 60 compared to their non-MNA counterparts.

3.2 Diabetes incidence

3.2.1 Age-standardized incidence rates by MNA identity

The age-standardized incidence rates for diabetes between 2006 and 2016 were generally higher amongst Métis Albertans when compared to non-Métis Albertans, with an average rate of 9.8 cases per 1,000 population and 7.1 cases per 1,000 population, respectively. Between 2006 and 2016, the annual average number of new cases of diabetes diagnosed amongst the MNA cohort was 210 (20,100 amongst non-MNA).

After adjusting for age, female Métis experienced an incidence rate that was 1.4 (95% CI: 1.10 to 1.80) times higher than female non-Métis Albertans, a significant difference. Male Métis experienced an incidence rate that was 1.2 (95% CI: 0.98 to 1.4) times higher than non-Métis Albertan males, but this difference was not statistically significant.

3.2.2 Age-specific incidence rates by MNA identity in 2016

Age-specific incidence rates between Métis Albertans and non-Métis Albertans showed similar patterns by age. Amongst females, incidence rates increased with age. Amongst males, incidence rates increased with age until peaking for those 60 to 79 years old. For both sexes, incidence rates were generally comparable or higher amongst Métis when compared to non-Métis Albertans (Figure 6) with one exception: the incidence rate amongst Métis males 80 years and older (9 cases per 1,000 population) was lower than the rate amongst non-Métis males (17 cases per 1,000 population). The lower rate of diabetes in Métis males 80 years and older may have been related to the competing risk of death (e.g., increased risk of death from any cause in this group relative to the non-Métis population; thus, there were fewer Métis males 80 years and older susceptible to diabetes). However, as death data was not available, the true meaning of the incidence rate of diabetes in this group should be interpreted with caution. Amongst females, the rate of diabetes in Métis Albertans over the age of 80 was 1.8 times higher than the rate amongst their non-Métis counterparts.

4. Pharmaceutical

4.1 Blood sugar lowering medications dispensed from community pharmacies

4.1.1 Age-standardized dispensation rates by MNA identity

The age-standardized rate for at least one dispensation of blood sugar lowering drugs increased from 72 per 1,000 population (in 2010) to 82 per 1,000 population (in 2016) for Métis Albertans and 43 per 1,000 population (in 2010) to 54 per 1,000 population (in 2016) for non-Métis Albertans. The overall percentage increase between 2010 and 2016 was comparable for both MNA and non-MNA populations (Figure 7). Between 2010 and 2016, Métis Albertans received blood sugar lowering medications at a rate 1.6 times higher when compared to the non-Métis population, aligning with the higher prevalence of diabetes amongst the Métis.

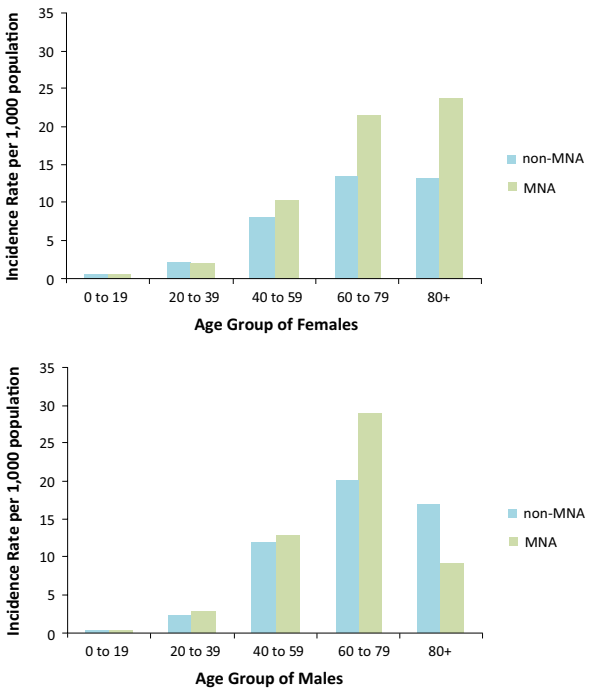

Figure 6.
Age-specific incidence rates per 1,000 population by sex and MNA identity in 2016: Females (top) and Males (bottom)

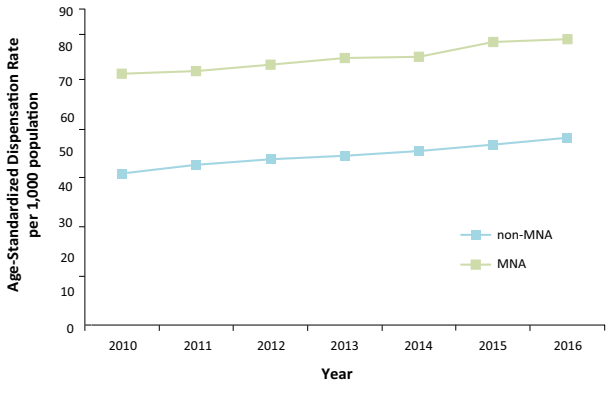

Figure 7.
Age-standardized rates for at least one dispensation of blood sugar lowering drugs per 1,000 population by MNA identity, 2010 to 2016

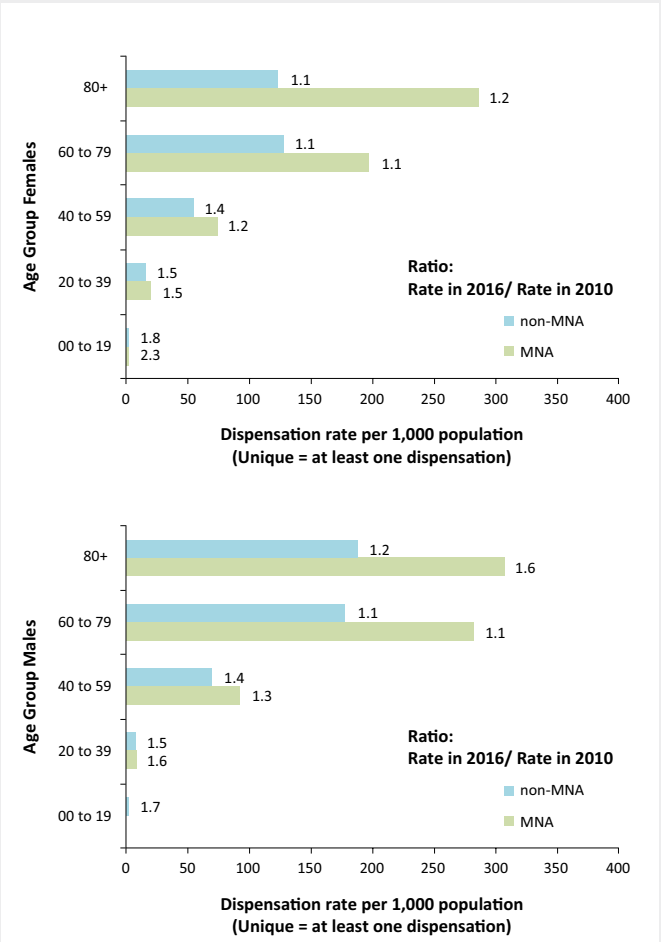

Figure 8.
Age-specific rate per 1,000 population for at least one dispensation of blood sugar lowering drugs by sex and MNA identity in 2016: females (top) and males (bottom). The ratios provide a comparison of dispensation rates between MNA and non-MNA populations in 2010.

Note: Males less than 20 years old with MNA citizenship did not have any dispensations in 2010, 2013, and 2016 and ratios were not reported.

4.1.2 Age-specific dispensation rates by MNA identity in 2016

Dispensation rates for blood sugar lowering drugs were 1.9 times higher amongst Métis females (at least 60 years old) when compared to non-Métis females in 2016. Similarly, Métis males (at least 60 years old) had dispensation rates 1.6 times higher than non-Métis males (Figure 8). Dispensation rates were higher amongst males compared to females 40 to 79 years. Dispensation rates were higher amongst females when compared to males 20 to 39 years. The change in dispensation rates between 2010 and 2016 increased with age for both sexes, for both Métis and non-Métis Albertans.

4.2 Medication use amongst individuals with a recorded diagnosis of diabetes

After examining individuals identified as having diabetes in 2016 and their medication use, several significant findings were identified. Figure 9 shows the number of unique diabetes drug categories received by individuals. Although the differences were small, Métis people were more likely to receive two or more diabetes medications and non-Métis people were more likely to receive zero or one medications.

Looking at the trends by broad age groups (i.e. 0-29, 30-49, 50-64, and 65+), the only age group with a significant difference was 65+, although the 50-64 age group was nearly significant. Figure 10 shows the medication use amongst those aged 65 and older. This figure illustrates how this age group drives the overall trend in the population due to the high number of people with diabetes at this age.

Table 2 highlights the relative use of specific medications

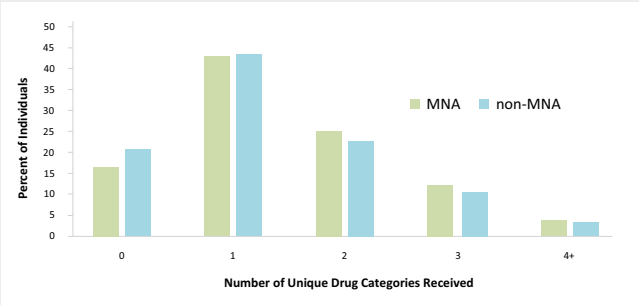

Figure 9.
Number of Unique Diabetes Drug Categories Received by Individuals Diagnosed with Diabetes in 2016

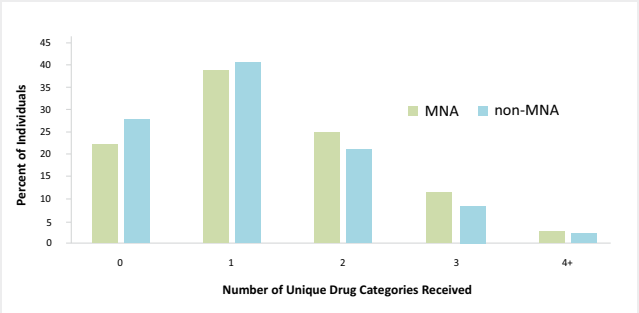

Figure 10.
Number of Unique Diabetes Drug Categories Received by Individuals 65 Years and Older Diagnosed with Diabetes in 2016

Table 2.
Relative use of specific medications amongst Métis Albertans in 2016

	Overall Risk Ratio		Age Specific Risk Ratio			
	Risk Ratio	95% CI	0 to 29	30 to 49	50 to 64	65+
Any blood pressure drug	1.04	1.02 to 1.06	--	--	1.06	1.03
Biguanides (including Metformin)	1.08	1.05 to 1.11	--	--	1.05	1.14
Cardio/kidney protection drugs	1.03	1.00 to 1.05	--	0.73	1.06	1.06
Dipeptidyl peptidase 2 (DPP-4) inhibitors	1.07	0.99 to 1.17	--	--	--	--
Insulin and analogues	1.12	1.06 to 1.18	--	--	1.25	1.26
Lipid-lowering drugs	1.04	1.01 to 1.07	--	--	1.07	1.04
SLGT2	1.13	1.02 to 1.27	--	--	--	1.42
Sulfonylurea	1.14	1.06 to 1.22	--	--	--	1.22

Notes: Risk ratio adjusted for age. Only significant age-specific risk ratios listed

amongst Métis Albertans diagnosed with diabetes in relation to non-Métis Albertans diagnosed with diabetes in 2016. Métis Albertans were more likely to receive a prescription for every medication except for DPP-4 inhibitors. Age-specific analysis showed that the significant differences occurred amongst the oldest two population groups for most medications. One interesting finding was cardio/kidney protection drugs were 27% less likely to be prescribed to Métis between the ages of 30 and 49. This result was the only instance where Métis people were less likely to receive a medication and the difference was one of the largest found. The differences between Métis and non-Métis were smallest for medications generally prescribed for complications of diabetes (e.g. blood pressure, heart/kidney, and lipid-lowering medications).

5. Diabetes complications

5.1 Long-term dialysis amongst individuals with diabetes (≥20 years of age)

Age-standardized rates for long-term dialysis amongst people with diabetes were comparable between Métis and non-Métis Albertans except for 2006 and 2010, where rates were lower amongst Métis Albertans. The total number of Métis Albertans

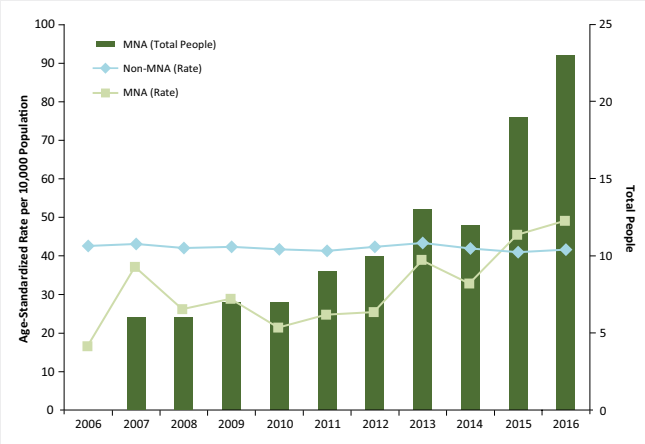

Figure 11.
Number of identified Métis Albertans undergoing long-term dialysis (bars) and age-standardized long-term dialysis rate (lines) for people who were at least 20 years old with diabetes between 2006 and 2016 by MNA identity

Note: Long-term dialysis is defined as two dialysis events at least 90 days apart; there were fewer than 5 people undergoing long-term dialysis in 2006 (number suppressed to maintain confidentiality)

that underwent long-term dialysis ranged from fewer than five (in 2006) to 23 (in 2016). In comparison, 938 (in 2006) and 1509 (in 2016) non-Métis Albertans underwent long-term dialysis (Figure 11). Overall, males had higher rates of long-term dialysis than females between 2006 and 2016:

- In 2016 amongst Métis Albertans, the rate of long-term dialysis was 1.8 times higher for males (64 per 1,000 population; n=15 people) than females (35 per 1,000 population; n=8 people).
- Amongst non-MNA Albertans, the long-term dialysis rate was 1.4 times higher for males (49 per 1,000 population; n=942 people) compared to females (35 per 1,000 population; n=567 people).

Notes: Trends by sex in other years were not made due to very small numbers of identified Métis Albertans with long-term dialysis, which could result in large fluctuations in rates.

5.2 Lower leg amputations amongst individuals with diabetes (≥20 years of age)

Figure 12.
Age-standardized lower leg amputation rates for people who were at least 20 years old with diabetes by MNA identity, 2006 to 2016

Notes: Trends by sex were not made by MNA citizenship due to very small numbers, which could result in large fluctuations in rates.

Over the past 11 years, a total of 71 and 5,572 lower leg amputations occurred amongst the MNA and non-MNA populations, respectively (Figure 12). The lower leg amputation rate was comparable between the MNA and non-MNA populations – though this comparison was limited by a lack of statistical power for the MNA estimates (i.e., the MNA population who underwent lower leg amputation was too small to detect a difference). The average age-standardized lower leg amputation rate between 2006 and 2016 amongst people with diabetes was 17 per 10,000 population and 12 per 10,000 population amongst Métis Albertans and non-Métis Albertans, respectively. Note that annual fluctuations in rates amongst the Métis cohort were due to a relatively small number of events.

5.3 Macrovascular health

Those living with diabetes as of June 30, 2016 were examined for their experience of macrovascular health issues. Table 3 shows the occurrence of these conditions amongst those with diabetes. It includes individuals in which these conditions were diagnosed prior to their diabetes diagnosis, but with no occurrence after their diabetes diagnosis.

Macrovascular complications occurred at similar rates amongst the identified individuals. The most commonly identified macrovascular condition was ischemic heart disease which was identified in 18.6% of Métis. The least common of the conditions was transient ischemic attack, which occurred for 0.8% of the Métis population with diabetes. The other three conditions occurred between 4% and 7% of the Métis population with diabetes. Except for transient ischemic attacks, these conditions

Table 3.
The number and proportion (%) of MNA and non-MNA citizens living with diabetes as of June 30, 2016 who had ever experienced a macrovascular event by sex*

	MNA						non-MNA					
	Males		Females		Total		Males		Females		Total	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Acute ischemic stroke	85	4.2	65	3.7	150	4.0	7,950	4.4	5,874	4.1	13,824	4.3
Ischemic heart disease	443	21.8	257	14.8	700	18.6	37,330	20.7	19,637	13.6	56,967	17.6
Atrial fibrillation	102	5.0	62	3.6	164	4.3	9,645	5.4	6,682	4.6	16,327	5.0
Congestive heart failure	142	7.0	121	6.9	263	7.0	13,927	7.7	10,732	7.4	24,659	7.6
Transient ischemic attack	13	0.6	16	0.9	29	0.8	1,443	0.8	1,239	0.9	2,682	0.8

*prior to June 30, 2016

Table 4.
The number and proportion (%) of MNA and non-MNA citizens living with diabetes as of June 30, 2016 who experienced at least one macrovascular event following diabetes diagnosis by sex*

	MNA						non-MNA					
	Males		Females		Total		Males		Females		Total	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Acute ischemic stroke	49	2.4	43	2.5	92	2.4	5,280	2.9	3,857	2.7	9,137	2.8
Ischemic heart disease	204	10.0	160	9.2	364	9.6	19,135	10.6	11,203	7.8	30,338	9.4
Atrial fibrillation	54	2.7	36	2.1	90	2.4	5,574	3.1	3,631	2.5	9,205	2.8
Congestive heart failure	92	4.5	94	5.4	186	4.9	9,580	5.3	7,549	5.2	17,129	5.3
Transient ischemic attack	5	0.2	13	0.7	18	0.5	1,002	0.6	820	0.6	1,822	0.6

*prior to June 30, 2016 and based on the definition of diabetes used to identify a case in administrative databases (see documentation on case definitions)

were more common amongst Métis males. This pattern was shared with other Albertans.

Instances of these conditions were also identified if they occurred after the diagnosis of diabetes, specifically. Table 4 shows the results of this analysis. Ischemic heart disease remained the most common diagnosis with 9.6% of Métis being diagnosed with macrovascular conditions after being diagnosed with diabetes.

Congestive heart failure was second most common at 4.9%, and acute ischemic stroke and atrial fibrillation identified at 2.4%. Transient ischemic attack was the least common, occurring in 0.5% of the Métis.

6. Discussion

This study examined the occurrence of diabetes, its treatments, and the complications resulting from it amongst the Métis population of Alberta. These measures were then compared to the non-Métis population of the province. Overall, the incidence and prevalence of diabetes between 2006 and 2016 was generally higher amongst Métis Albertans compared to their non-Métis counterparts. Prior research estimated the prevalence of diabetes as being between 5.6% and 11.8% (Bruce 2000; Bruce *et al*. 2003; Statistics Canada 2003; Ralph-Campbell *et al.* 2009; Martens et al. 2011; Public Health Agency of Canada 2011; Shah *et al.* 2011; Randall *et al.* 2012; Foulds *et al.* 2013), while this study found an age-standardized prevalence increasing from 8.2% to 10.7%. Not only was this rate 1.5 times higher than the non-MNA population, but the rate of increase was high. Both the MNA and non-MNA populations experienced increased prevalence during the study period, however. The incidence of new cases of diabetes appears to be stable over time despite the noticeable increase in prevalence. This may indicate improved survival, and/or earlier detection of cases.

Dispensation rates of blood sugar lowering medications were also higher amongst the MNA cohort when compared to the non-MNA population between 2010 and 2016. The difference between the Métis and non-Métis populations in dispensation of blood sugar lowering medications aligned with the difference in prevalence of diabetes; Métis Albertans had 1.6 times the rate of non-Métis Albertans. The overall rate of dispensation also increased over time. Amongst older Métis with a diabetes diagnosis, similar use of drugs to control blood sugar, as well as medications prescribed for the treatment of complications of diabetes such as blood pressure medications, cardio/kidney protection drugs, and lipid-lowering drugs was observed compared to the non-Métis population. Amongst those aged 30 to 49, however, lower medication use for cardio/kidney protection drugs in the Métis was noted – a 27% lower rate, despite similar dispensation of blood sugar lowering medications. Given that the primary cause of death in diabetes is cardiovascular disease (Fowler, 2018), and that ischemic

heart disease is the most common complication of diabetes amongst Métis Albertans, there appears to be a significant gap in this area of disease management. Moreover, symptoms of cardiovascular disease may take decades to develop. It would be reasonable to assume proper diagnosis and medical management of complications related to diabetes during this age range could be a window of opportunity to prevent negative consequences later in life.

Complications of diabetes including long-term dialysis and lower leg amputations were comparable between the MNA and non-MNA populations (at least 20 years old).
This finding suggests that those diagnosed with diabetes have similar prognoses in both groups. However, the rarity of these events in the Métis population limited the statistical power, and this lack of power may have caused a failure to find a difference, although one may exist. Despite the small sample size, the overall occurrence of these major complications is higher amongst the Métis population related to the higher prevalence of diabetes when compared to the non-Métis population.

Policy implications

These results suggest that preventative programs and services involving the Métis population of Alberta are warranted. Medication use amongst Métis people after diagnosis appeared to be mostly higher than non-Métis Albertans. Whether this is because Métis populations experience more severe diabetes or a higher uptake of medication is unclear. However, a significant care gap may exist for cardio/kidney protection drugs amongst younger Métis. Therefore, it may be more beneficial to direct resources into health promotion amongst Métis people to increase awareness of the risk factors for diabetes and to increase blood sugar screening to identify individuals with pre-diabetes. Moreover, increased prioritization of preventative programs and the need for cardio/kidney protection drugs amongst younger Métis may also be warranted.

Research on the effect of changes to primary health care systems meant to improve Indigenous peoples' health is limited and has not found a consistent improvement in health outcomes (Gibson & Segal 2015). Diabetes is a complex condition requiring strategies addressing multiple angles of prevention and treatment. In line with this, there is evidence that improving multiple aspects of primary health care is more effective than single-focus changes (Gibson & Segal 2015). Promoting reduced consumption of sugary snacks and beverages and investing in youth-oriented fitness programs has been found to decrease insulin resistance in Indigenous youth (Ritenbaugh *et al.* 2003). Identifying those at higher risk of developing diabetes and focusing prevention programs towards them may also be effective for Métis Albertans. Research on lifestyle based prevention programs has suggested they may have a noticeable impact over the short term and maintain some preventative effectiveness 10 years after the program (Diabetes Prevention Program Research Group *et al.* 2009). The increasing prevalence of diabetes in the province is also a concern. Rising costs associated with treating diabetes and its complications mean that additional funding may be necessary in the future to maintain the current level of treatment for those with diabetes.

Strengths and limitations

The strengths of this study are its ability to link individuals of confirmed Métis citizenship to the publicly administered health care system of Alberta. Since this health system collects data from all fee-for-service physician treatments and hospitalizations, it provides an exhaustive collection of records for individuals that seek medical care in Alberta.

There are, however, also several limitations to this study. This study could not identify individuals with diabetes, nor the complications of diabetes, if they have not sought treatment by physicians. It was estimated that 1.13% and 3.09% of Canadian adults were living with undiagnosed Type 2 Diabetes in 2015, based on fasting blood sugar and hemoglobin A1C measurements, respectively (Rosella *et al.* 2015). As access to screening programs in Métis communities was not addressed in this study, a potentially large group of individuals with undiagnosed diabetes could not be identified. Secondly, not all individuals of the Métis population of Alberta are currently registered as citizens of the MNA and available for linkage to the administrative data. It is possible that the registered Métis citizens of the MNA and their dependents are different than the non-registered Métis in the province. These differences were not explored in this study but could include socio-economic differences and potentially stronger feelings of connection to their heritage when compared with unregistered Métis in Alberta. The population of Métis in the sample was also not large enough to reliably identify small differences in rare outcomes such as the yearly trend in lower leg amputations. Estimating yearly rates is also limited by using a static population estimate when the real underlying population is continuously changing.

7. Conclusion

Métis Albertans experienced higher rates of diabetes between 2006 and 2016. Métis Albertans were also more likely to receive medications used in the treatment of diabetes, owing to the higher prevalence of the disorder. However, significant treatment gaps concerning the use of cardio/kidney protection drugs in the younger age groups was noted. Métis individuals with diabetes experienced similar complications related to diabetes and did not have statistically significant differences in long-term dialysis or lower limb amputations when compared to the non-Métis population. The Métis are a unique population regarding their experiences with diabetes and require additional prevention and treatment resources to address the health burden they face.

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