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CARDIOMETABOLIC HEALTH

QANUILIRPITAA? 2017

Nunavik Inuit Health Survey

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RÉGIE RÉGIONALE DE LA SANTÉ ET DES SERVICES SOCIAUX DU NUNAVIK
NUNAVIK REGIONAL BOARD OF HEALTH AND SOCIAL SERVICES

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QANUILIRPITAA? 2017 HEALTH SURVEY

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In memory of Audrey Flemming and Linda Shipaluk.

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ACR	Ratio of urinary albumin to creatinine
ALT	Alanine aminotransferase
Apo	Apolipoprotein
AST	Aspartate aminotransferase
BIESP	Bureau d'information et d'études en santé des populations
BMI	Body mass index
CKD	Chronic kidney disease
CMD	Cardiometabolic diseases
CI	Confidence interval
CV	Coefficient of variation
CV risk index	Cardiovascular risk assessment index
FLI	Fatty Liver Index
GFR	Glomerular filtration rate
GGT	Gamma-glutamyl transferase
HbA1c	Glycated haemoglobin
HDL-C	High density lipoprotein cholesterol
HFSSM	Household Food Security Survey Module
ICD	International Classification of Diseases
IHS 2007-2008	Inuit Health Survey 2007-2008
KDIGO	Kidney Disease: Improving Global Outcomes
LDL-C	Low-density lipoprotein cholesterol
NAFL	Non-alcoholic fatty liver
NAFLD	Non-alcoholic fatty liver disease
NASH	Non-alcoholic steatohepatitis
PPR	People per room
PR	Prevalence ratio
QICDSS	Quebec Integrated Chronic Disease Surveillance System

1 BACKGROUND OF THE *QANUILIRPITAA?* 2017 HEALTH SURVEY

The *Qanuilirpitaa?* 2017 Health Survey is a major population health survey conducted in Nunavik that involved the collection, analysis and dissemination of information on the health status of Nunavimmiut. The last health survey conducted prior to it in Nunavik dated from 2004. Since then, no other surveys providing updated information on the health of this population had been carried out. Thus, in February 2014, the Board of Directors of the Nunavik Regional Board of Health and Social Services (NRBHSS) unanimously adopted a resolution to conduct a new health survey in all 14 Nunavik communities, in support of the Strategic Regional Plan.

The general objective of the 2017 health survey was to provide an up-to-date portrait of the health status of Nunavimmiut. It was also aimed at assessing trends and following up on the health and health determinants of adult participants since 2004, as well as evaluating the health status of Nunavik youth. This health survey has strived to move beyond traditional survey approaches so as to nurture the research capabilities and skills of Inuit and support the development and empowerment of communities.

Qanuilirpitaa? 2017 included four different components: 1) an adult component to document the mental and physical health status of adults in 2017 and to follow up on the adult cohort of 2004; 2) a youth component to establish a new cohort of Nunavimmiut aged 16 to 30 years old and to document their mental and physical health status; 3) a community component to establish the health profiles and assets of communities in a participatory research approach; and 4) a community mobilization project aimed at mobilizing communities and fostering their development.

This health survey relied on a high degree of partnership within Nunavik (Nunavik Regional Board of Health and Social Services (NRBHSS), Makivik Corporation, Kativik Regional Government (KRG), Kativik Ilisarniliriniq (KI), Avataq Cultural Institute, Qarjuit Youth Council, Inuulitsivik Health Centre, Ungava Tulattavik Health Centre), as well as between Nunavik, the Institut national de santé publique du Québec and academic researchers from three Canadian universities: Université Laval, McGill University and Trent University. This approach followed the OCAP principles of Ownership, Control, Access and Possession (First Nations Center, 2007) (First Nations Information Governance Centre, 2007).[1] It also emphasized the following values and principles: empowerment and self-determination, respect, value, relevance and usefulness, trust, transparency, engagement, scientific rigour and a realistic approach.

TARGET POPULATION

The survey target population was all permanent Nunavik residents aged 16 years and over. Persons living full time in public institutions were not included in the survey. The most up-to-date beneficiaries register of all Inuit living in Nunavik, provided by the Makivik Corporation in spring 2017, was used to construct the main survey frame. According to this register, the population of Nunavik was 12 488 inhabitants spread out in 14 communities. The register allowed respondents to be selected on the basis of age, sex and coast of residence (Hudson coast and Ungava coast).

SURVEY FRAME

The survey used a stratified proportional model to select respondents. Stratification was conducted based on communities and age groups, given that one of the main objectives of the survey was to provide estimates for two subpopulations aged, respectively, 16 to 30 years and 31 years and over. In order to obtain precise estimates, the targeted sample size was 1 000 respondents in each age group. Assuming a 50% response rate, nearly 4 000 people were required to obtain the necessary sample size. From this pool, the number of individuals recruited from each

1. OCAP® is a registered trademark of the First Nations Information Governance Centre (FNIGC).

community was proportionate to population size and took into account the number of days that the survey team would remain in each community – a situation that imposed constraints on the number of participants that could be seen. Within each stratum, participants were randomly selected from the beneficiaries register. However, the individuals from the 2004 cohort, all 31 years old and over (representing approximately 700 individuals), were automatically included in the initial sample.

DATA COLLECTION

Data were collected from August 19, 2017 to October 5, 2017 in the 14 villages. The villages were reached by the *Amundsen*, a Canadian Coast Guard Icebreaker, and participants were invited on board the ship for data collection purposes.

Two recruitment teams travelled from one community to another before the ship's arrival. An Inuk assistant in each community helped: identify, contact and transport (if necessary) each participant; inform participants about the sampling and study procedures; obtain informed consent from participants (video) and fill in the identification sheet and sociodemographic questionnaire.

Data collection procedures for the survey included questionnaires, as well as clinical measurements. The survey duration was about four hours for each wave of participants, including their transportation to and from the ship. Unfortunately, this time frame was sometimes insufficient to complete the data collection process. This survey received ethical approval by the Comité d'éthique de la recherche du Centre Hospitalier Universitaire de Québec - Université Laval.

Aboard the ship, the survey questionnaires were administered by interviewers, many of whom were Inuit. Face-to-face interviews were conducted using a computer-assisted interviewing tool. If there were problems with the laptop connections, paper-form questionnaires were filled out. The questionnaires were administered in Inuktitut, English or French, according to the preference of the participants. Interviewers received training in administering the questionnaires prior to the start of the survey. The questionnaires were divided into five blocks: psychosocial interview (blocks 1 and 3), physical health and food security interview (block 2), food frequency questionnaire (block 4), and sociodemographic interview (block 5).

The survey also included a clinical component, with tests to document aspects of physical health, sampling of biological specimens (blood, oropharyngeal swabs, urine, stool, and vaginal swabs), spirometry, and an oral clinical exam. These sessions were supervised by a team comprised of nurses, respiratory therapists, dentists, dental hygienists and assistants, and laboratory technicians.

PARTICIPATION

There were a total of 1 326 participants, including 574 Nunavimmiut aged 16 to 30 years old and 752 Nunavimmiut aged 31 years and over, for total response rates of 30.7% and 41.5%, respectively. The participants' distribution between the two coasts (Ungava and Hudson) was similar. The distribution of men and women was unequal, with twice as many women (873) than men (453) participating in the survey. If the results obtained from this sample are to be inferred to the target population, survey weights must be used.

Overall, as compared to the 2004 survey, the response rate (i.e., the rate of participants over the total number of individuals on the sampling list) was lower than expected, especially among young people. This includes the refusal rate and especially a low contact rate. Several reasons might explain the low response rate, including the short time period available to contact individuals prior to the ship's arrival in the community and non-contact due to people being outside of the community or on the land. Nevertheless, among the individuals that were contacted (n = 1 661), the participation rate was satisfactory with an internal participation rate of 79.7%. More details on the collection, processing and analysis of the data are given in the Methodological Report (Hamel, Hamel et Gagnon, 2020).

2 INTRODUCTION

Cardiometabolic diseases include, most commonly, ischemic heart disease (including myocardial infarction or heart attacks), cerebrovascular diseases (including strokes), congestive heart failure, atherosclerosis, and metabolic disorders such as type 2 diabetes, chronic kidney disease and non-alcoholic fatty liver disease. A series of established risk factors contribute to the development of both cardiovascular diseases and type 2 diabetes (diabetes mellitus). They represent the most important modifiable risk factors and include a set of traditional risk factors such as insulin resistance, dysglycemia, elevated blood pressure, high waist girth, and atherogenic dyslipidemia (high low-density lipoprotein cholesterol (LDL-C), high triglyceride concentrations and low high-density lipoprotein cholesterol (HDL-C) concentrations). A number of determinants including lifestyle (e.g., smoking, physical inactivity and a diet poor in vegetables, fruits and whole grains) and cardiometabolic risk factors (e.g., blood cholesterol, hypertension, and obesity) are responsible for more than 50% of global all-cause mortality (Alam et al., 2019; Sperling et al., 2015). Exposure to environmental contaminants may also contribute to the development of cardiometabolic diseases, especially in the Inuit context (Cordier et al., 2020; Donaldson et al., 2010; Singh & Chan, 2018; Valera et al., 2013).

In 2004, prevalences of ischemic heart diseases and cerebrovascular diseases including strokes were both estimated at 3% among Nunavimmiut (Chateau-Degat et al., 2010). About 8% of both Canadians and Quebecers were living with an ischemic heart disease in 2004, while the occurrence of stroke was 2% (Public Health Agency of Canada, 2004). The prevalence of type 2 diabetes among Nunavimmiut in 2004 was 5% and that of impaired fasting blood glucose was 3% (Dewailly, 2007). Comparatively, 6% of Canadians and 5% of Quebecers were living with diabetes in 2004, and 90% of them had type 2 diabetes (Public Health Agency of Canada, 2004). A relatively stable prevalence of cardiovascular diseases and type 2 diabetes was observed in 2004 compared to the 1992 Santé Québec survey data for the Inuit population of Nunavik (Chateau-Degat et al., 2010; Dewailly, 2007). However, these pathologies remain a source of concern in Nunavik since an increase in the prevalence of risk factors such as elevated blood pressure and obesity has been observed in recent decades (Chateau-Degat et al., 2010; Dewailly, 2007).

Indeed, the proportion of Nunavimmiut with elevated blood pressure was two-fold greater in 2004 compared to 1992 (12% vs. 6%) (Chateau-Degat et al., 2010). In comparison, the prevalence of hypertension was 22% among Canadians aged 20 years and older in 2004 (Public Health Agency of Canada, 2004). An increase in the prevalence of high waist circumference was also noted among Nunavimmiut in 2004 compared to 1992 (36% in 2004 vs. 29% in 1992) and was mainly due to an increase among women (Dewailly, 2007). As observed in 1992, most blood lipid values among Inuit in Nunavik in 2004 remained low or within the normal values range and were healthier than those of other Quebecers (Dewailly, 2007). Differences between the sexes were observed, with women having a better blood lipid profile than men (Dewailly, 2007).

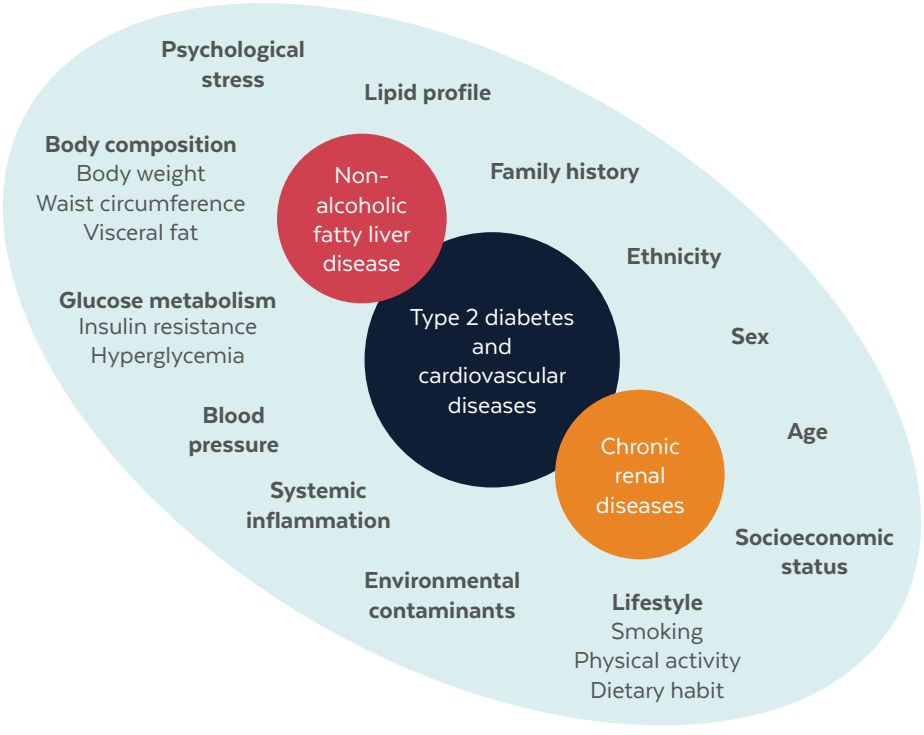
People with cardiovascular diseases, type 2 diabetes, elevated blood pressure and waist girth are at risk for multi-end organ damage, including non-alcoholic fatty liver disease and chronic kidney disease (Sperling et al., 2015). Non-alcoholic fatty liver disease is the most common cause of liver disease worldwide with an estimated global prevalence of 25% (Younossi et al., 2016), increasing in parallel with that of obesity and diabetes (Younossi et al., 2019). Non-alcoholic fatty liver disease is an excess of fat in the liver resulting from neither excessive alcohol consumption nor other secondary causes (Younossi et al., 2016). It is a multisystem disease affecting other organs and regulatory pathways and is associated with an increased incidence of cardiovascular diseases, independent of more traditional cardiovascular risk factors (Sinn et al., 2019). Very few data on hepatic health are available for the general Canadian population. Based on a retrospective chart review conducted among 450 apparently healthy adults from Ontario who underwent imaging for a primary complaint and were presumed to be free of liver pathology, 25% had steatosis using computed tomography criteria (Wells et al., 2016). Non-alcoholic fatty liver disease seems to be progressing at a similar rate in both the First Nations population and the non-Indigenous

population living in Manitoba, according to data from a retrospective population-based study (Uhanova et al., 2016). Yet, no data on hepatic health are available for the Inuit population in Canada.

Chronic kidney disease is characterized by kidney damage or decreased kidney function that is present for more than three months (Stevens et al., 2013). The most common risk factors for chronic kidney disease are diabetes and hypertension (Jha et al., 2013; Webster et al., 2017). However, several lifestyle habits could be associated with chronic kidney disease, such as smoking, physical inactivity and high chronic salt intake (Bruck et al., 2015; Stel et al., 2017). Chronic kidney disease commonly coexists with other diseases such as hypertension, diabetes and cardiovascular diseases and is also recognized as a risk factor for all-cause mortality (Di Lullo et al., 2015; Gansevoort et al., 2013; Jha et al., 2013; Shen et al., 2017; Webster et al., 2017). The renal health status of Inuit in the Nunavik population has not been studied yet. Considering the increase in the prevalence of risk factors such as elevated blood pressure and waist circumference that has been observed over the years in Nunavik, the renal health of Nunavimmiut needs to be assessed.

The study of cardiometabolic disease determinants is complex (Cardiometabolic Risk Working Group: Executive et al., 2011). First, there is an overlap between cardiometabolic diseases. For example, type 2 diabetes is often complicated by atherosclerosis, and cardiovascular diseases by non-alcoholic fatty liver, and *vice versa* (Kannel & McGee, 1979; Kengne et al., 2010; Motamed et al., 2017). Second, the interplay between various risk factors and the risk generated by the interaction of genetic and environmental risk factors is not fully understood. Finally, cardiometabolic risk factors may act as a cause (determinant) of cardiometabolic diseases, while also having their own respective determinants. For example, a person's blood lipid profile is associated with the risk of cardiometabolic diseases, but is also influenced by dietary habits, heredity, age, sex and body composition (D'Agostino et al., 2008). A non-exhaustive and simplified representation of the association between the potential determinants and risk factors of cardiometabolic diseases is presented in Figure 1.

Figure 1 Representation of classic determinants and risk factors of cardiometabolic diseases



(Armstrong & Guo, 2019; Burroughs Pena & Rollins, 2017; Cardiometabolic Risk Working Group: Executive et al., 2011; Gebreab et al., 2018; Kataria et al., 2015; Levey et al., 2003; Norris & Nissenson, 2008; Perumpail et al., 2017; Younossi, 2019).

The term "cardiometabolic risk" is a comprehensive concept including all factors that contribute to the development of cardiovascular diseases, type 2 diabetes, chronic renal disease and chronic liver disease. There is an interplay between the risk factors and an overlap between the main outcomes (e.g., non-alcoholic fatty liver disease, type 2 diabetes, cardiovascular diseases and chronic renal diseases). All of these risk factors are inter-related and increase the risk of cardiometabolic morbidity and mortality (Armstrong & Guo, 2019; Burroughs Pena & Rollins, 2017; Cardiometabolic Risk Working Group: Executive et al., 2011; Gebreab et al., 2018; Kataria et al., 2015; Levey et al., 2003; Norris & Nissenson, 2008; Perumpail et al., 2017; Younossi, 2019).

Inuit in Canada are exposed to mercury and lead mainly through the consumption of traditional foods (Gibson et al., 2016). While a linear association between lead concentrations and cardiovascular risk is consistently observed among studies, the impact of mercury on cardiovascular risk is unclear (Houston, 2011; Hu et al., 2017; Valera et al., 2013; Virtanen et al., 2005). Interestingly, the consumption of fish and traditional Inuit foods may protect against cardiovascular diseases despite high intakes of mercury (Buscemi et al., 2014; Hu et al., 2018; Pan et al., 2019). High intakes of selenium from traditional marine foods could counterbalance the potential negative effect of mercury on cardiovascular health (Mozaffarian, 2009). Exposure to mercury and lead could also affect the kidneys (Kataria et al., 2015; Webster et al., 2017).

Inuit culture, livelihood and ability to be on the land are important determinants of Nunavimmiut health and wellness (Inuit Tapiriit Kanatami, 2014) (Garner et al., 2010). Complex associations have been observed between health indicators and individual and community-level socioenvironmental determinants of health. For example, an inverse U-shaped association between socioeconomic conditions at the community level and elevated blood pressure was noted in the Inuit Health in Transition Greenland Survey 2005-2010 (Riva et al., 2016). Culture and traditions related to speaking the Inuit language at home were associated with a lower prevalence of obesity in the Inuit Health Survey 2007-2008 (IHS 2007-2008) (Zienczuk & Egeland, 2012). Inuit in Canada tend to attribute the loss of traditional culture and activities to poor health (Richmond & Ross, 2009), thus supporting the importance of traditional lifestyle as a key determinant of health among Nunavimmiut.

OBJECTIVES

This report aims to determine the prevalence and determinants of cardiometabolic diseases and their risk factors among adult Nunavimmiut in 2017.

The specific objectives of this thematic report are to:

1. Estimate the prevalence of cardiometabolic diseases (cardiovascular diseases, type 2 diabetes, liver and kidney diseases) and their risk factors (prediabetes, elevated blood pressure, elevated waist circumference, obesity, abnormal blood lipids) among Nunavimmiut in 2017 and, when possible, to draw comparisons with the *Qanuippitaa?* 2004 data, the general population of the province of Quebec and the general Canadian population;

2. Identify potential determinants of cardiometabolic diseases and their risk factors among already established determinants and other factors relevant to the Inuit context.

3 METHODOLOGICAL ASPECTS

A total of 1 326 individuals participated in the data collection process aboard the CCGS *Amundsen*. In agreement with current clinical practices, most of the measurements were conducted among non-fasting participants (N = 782/1 326) (Anderson et al., 2016). For the purpose of drawing comparisons with the 2004 data, all analyses targeted adults (18 years old and over) and excluded pregnant women (n = 30). They were conducted among 1 177 individuals at the most, depending on available data.

The cardiometabolic health of Nunavimmiut was assessed using information gathered from different sources. Firstly, information on diagnoses of cardiovascular diseases, diabetes and hypertension was retrieved from the Quebec Integrated Chronic Disease Surveillance System (QICDSS) in order to allow direct comparisons of disease prevalences between Nunavik and the province of Quebec. Secondly, information on medication use was obtained from the medical files of participants during a medical file review, carried out by trained research nurses in 2017. Thirdly, clinical tests were conducted during the survey on board the Amundsen and biological samples were collected for different laboratory tests in order to screen for diabetes/prediabetes and to assess certain risk factors. All laboratory analyses were performed at the Institut universitaire de cardiologie et de pneumologie de Québec (IUCPQ) (Québec, Qc, Canada), except for the mercury, lead and selenium analyses, which were carried out at the Centre de toxicologie du Québec (Québec, QC), and those for the determination of fatty acids in red blood cells, which were performed at the Laboratory of Nutritional Lipidomics at the University of Waterloo (Waterloo, ON).

PREVALENCE OF DIAGNOSED CARDIOVASCULAR DISEASES, DIABETES AND HYPERTENSION OBTAINED FROM THE QICDSS

In addition to the data collected in the present survey, information derived from the QICDSS was also used to estimate trends in the age-standardized prevalence of diagnosed ischemic heart diseases, cerebrovascular diseases, diabetes (type 1 and 2) and hypertension in the Nunavik region and the province of Quebec (including the Nunavik region) from 2003 to 2017. The impact of including the Nunavik region in the province of Quebec estimates was considered to be negligible since the Nunavik population aged 20 years and older (7 270 people) represents 0.1% of the 6.5 million Quebecers of the same age. The prevalence of the different diseases is presented for one administrative year, extending from April 1 to March 31. Briefly, the QICDSS was developed by the Bureau d'information et d'études en santé des populations (BIESP). It is a product of the linkage of five medico-administrative databases and covers the entire population of the province of Quebec insured by public health insurance. The results from the QICDSS database reported here are for adults aged 20 years and over.

The prevalence of diagnosed cardiovascular diseases (i.e., ischemic heart diseases and cerebrovascular diseases), **diabetes** (both type 1 and 2) and **hypertension** was obtained using data from the QICDSS for the Nunavik region in 2017. Validated case definitions were used. The case definition of ischemic heart disease is: (1) a hospital discharge abstract with a principal or secondary ischemic heart disease diagnosis code using the International Classification of Diseases (ICD); (2) a hospital procedure code in any field of coronary intervention (coronary artery bypass graft or percutaneous coronary intervention); or (3) at least two physician claims with an ischemic heart disease diagnosis code within a one-year period (Blais et al., 2020). The case definition of cerebrovascular disease is: (1) a hospital discharge abstract with a cerebrovascular

disease diagnosis code using the International Classification of Diseases (ICD); or (2) at least two physician claims with a cerebrovascular disease diagnosis code within a one-year period (Blais et al., 2020). The case definition of diabetes is: (1) two diagnoses of diabetes in the physician claims database within a two-year period using the ICD; or (2) one diagnosis of diabetes in the hospitalization database, with the exclusion of gestational diabetes (Blais, Jean, et al., 2014). The case definition of hypertension is: (1) two diagnoses of hypertension in the physician claims database within a two-year period using ICD; or (2) one diagnosis of hypertension in the hospitalization database (Blais, Jean, et al., 2014; Blais, Rochette, et al., 2014).

HEPATIC HEALTH

Hepatic enzymes

Early detection of non-alcoholic fatty liver disease is useful to identify individuals with potentially silent progressive fatty liver disease (National Guideline Centre (UK), 2016). Ultrasound is the preferred first-line diagnostic procedure for the imaging of non-alcoholic fatty liver disease, whereas liver biopsy (histology) has been documented as the gold standard method to assess the stage of fibrosis and the grade of steatosis (National Guideline Centre (UK), 2016). However, these measurements are invasive and expensive and remain impractical as screening diagnostic/prognostic tools in large epidemiological surveys. There is no consensus regarding the best measurement in clinical practice when trying to avoid liver biopsy. However, doing an assessment of scores based on hepatic enzyme concentrations in blood has been proposed as an acceptable alternative strategy for large-scale screening studies, even though this strategy may underestimate the prevalence of non-alcoholic fatty liver disease (National Guideline Centre (UK), 2016).

Alanine aminotransferase (ALT), aspartate aminotransferase (AST), and **gamma-glutamyl transferase (GGT)** are the hepatic enzymes most commonly used as simple nonspecific indicators of liver damage in the absence of alternative causes such as viral hepatitis, excessive alcohol use, and iron loading (Preiss & Sattar, 2008; Rinella, 2015). These biomarkers, which are neither sufficiently sensitive nor specific for the diagnosis of non-alcoholic fatty liver disease, tend to underestimate the prevalence of non-alcoholic fatty liver disease given that even people with advanced disease may have activity levels for these enzymes within the normal range (Preiss & Sattar, 2008). However, these biomarkers enter into the calculation of more complex screening or predictive indices (see fatty liver index (Bedogni et al., 2006) and the non-alcoholic fatty liver disease fibrosis score (Jaruvongvanich et al., 2017) below), and monitoring population trends in these liver enzymes may provide some insight into disease prevalence and the risk of liver disease mortality over time (Jaruvongvanich et al., 2017; Le et al., 2019; Sebastiani et al., 2015; Unalp-Arida & Ruhl, 2018). ALT, AST and GGT were measured in plasma on MODULAR *ANALYTICS* e170 from Roche Diagnostics GmbH (Mannheim, Germany).

Fatty liver index

The **fatty liver index (FLI)** (Bedogni et al., 2006) is a predictive algorithm developed to identify the presence of fatty liver. It uses clinical parameters such as triglycerides, body mass index, waist circumference and GGT using the following formula:

$$FLI = (e^{0.953*\log e(\textbf{triglycerides}) + 0.139*\textbf{body mass index} + 0.718*\log e(\textbf{GGT}) + 0.053*\textbf{waist circumference} - 15.745)}/(1+e^{0.953*\log e(\textbf{triglycerides}) + 0.139*BMI + 0.718*\log e(\textbf{GGT}) + 0.053*\textbf{waist circumference} - 15.745)}*100.$$

Using data from the US National Health and Nutrition Examination Survey, the performance of the FLI was compared with ultrasound-detected non-alcoholic fatty liver diagnoses (Le et al., 2019). An FLI < 30 can be used to rule out non-alcoholic fatty liver (sensitivity of 87% and specificity of 64%), while an FLI ≥ 60 can be used to rule it in (sensitivity of 61% and specificity of 86%) (Bedogni et al., 2006).

Non-alcoholic fatty liver disease fibrosis score

Given its consistent results in different non-alcoholic fatty liver disease populations (Rinella, 2015), the **non-alcoholic fatty liver disease fibrosis score (NAFLD fibrosis score)** is the best validated index for identifying people at high risk of advanced fibrosis/cirrhosis (Rinella, 2015). The score is calculated using simple clinical parameters (age, body mass index, presence or absence of hyperglycemia, platelet count, albumin level, and ratio of AST to ALT) with the following formula (Rinella, 2015):

NAFLD fibrosis score = -1.675 + 0.037*__age__+ 0.094*__body mass index__+ 1.13*__diabetes__ (yes = 1, no = 0) + 0.99*__AST/ALT__ ratio–0.013*__platelet count__–__albumin level__.

The prognostic performance of the NAFLD fibrosis score is sufficient compared to that of the gold standard methods (Sebastiani et al., 2015). Thus, an NAFLD fibrosis score below the low cut-off of -1.455 excludes advanced fibrosis with a sensitivity and specificity of 75% and 58%, respectively. An NAFLD fibrosis score above 0.676 identifies the presence of advanced fibrosis with a sensitivity and specificity of 33% and 98%, respectively (Guha et al., 2008; McPherson et al., 2010; Sebastiani et al., 2015).

RENAL HEALTH

Estimated glomerular filtration rate

The **estimated glomerular filtration rate (eGFR)** is considered to be the best overall index of kidney function and is calculated using the following equation:

$$eGFR = 141 \times \min\left(\frac{Scr}{\kappa}, 1\right)^{\alpha} \times \max\left(\frac{Scr}{\kappa}, 1\right) - 1.209 \times 0.993^{age} \times 1.018 \text{ (if female)} \times 1.159 \text{ (if black)}$$

Where Scr = serum creatinine

If male, $\kappa = 0.9$ and $\alpha = -0.411$

If female, $\kappa = 0.7$ and $\alpha = -0.329$

The normal value is approximately 125 ml/min/1.73 m^2 and decreased eGFR corresponds to values < 60 ml/min/1.73 m^2 (Levey et al., 2009). The eGFR was calculated from serum creatinine measured by kinetic colorimetric assay using the MODULAR *ANALYTICS* e170 from Roche Diagnostics GmbH.

Urinary albumin to urinary creatinine ratio

Albumin is the single most important protein lost in urine in chronic kidney disease (Stevens et al., 2013; Webster et al., 2017). Even if it is non-specific, since it may be the consequence of abnormal vascular permeability, atherosclerosis or renal disease, urinary albumin, or albuminuria, represents an important marker of kidney damage (Stevens et al., 2013; Webster et al., 2017). A single random measurement of the **urinary albumin to urinary creatinine ratio (ACR)** is the preferred method of screening for albuminuria (defined as ACR ≥ 3 mg/mmol) (Stevens et al., 2013; Webster et al., 2017) and it was used in the present survey. Urinary albumin and creatinine were measured in urine by immunoturbidimetric assay using the Integra 800 from Roche Diagnostics GmbH.

Chronic kidney disease risk

The **risk of chronic kidney disease** (low, moderate, high, very high) was assessed using the classification proposed by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) and the international guideline group Kidney Disease: Improving Global Outcomes (KDIGO) ("Chapter 1: Definition and classification of CKD," 2013; Levey et al., 2011). This classification combines both GFR (< 15, 15 to 29, 30 to 44, 45 to 59, 60 to 89, ≥ 90 ml/min/1.73 m^2) and albuminuria (< 3, 3 to 30, > 30 mg/mmol) values ("Chapter 1: Definition and classification of CKD," 2013; Levey et al., 2011).

CARDIOMETABOLIC RISK FACTORS

Diabetes biomarkers

HbA1c reflects plasma glucose over the past 8 to 12 weeks. In this survey, as recommended in Canadian diabetes guidelines, an HbA1c concentration ≥ 6.5% corresponded to a **diabetic state**, whereas a value in the range of 6.0% to 6.4% indicated a **prediabetic state** (Diabetes Canada Clinical Practice Guidelines Expert et al., 2018). A prediabetic state is known to increase the risk of developing type 2 diabetes ("WHO Guidelines Approved by the Guidelines Review Committee," 2011). HbA1c was measured in whole blood K_2-EDTA based on the turbidimetric inhibition validated immunoassay (TINIA) for hemolyzed whole blood using the Integra 800 from Roche Diagnostics GmbH.

In addition to HbA1c, fasting glycemia (≥ 7 mmol/L) or random (non-fasting) glycemia (≥ 11.1 mmol/L) were used to define a **diabetic state** (Diabetes Canada Clinical Practice Guidelines Expert et al., 2018). Plasma glucose was measured in plasma K_2-EDTA by an enzymatic colorimetric test using the MODULAR *ANALYTICS* e170 from Roche Diagnostics GmbH. Finally, information on the taking of diabetic medication was obtained from medical files and used to define a diabetic state (Diabetes Canada Clinical Practice Guidelines Expert et al., 2018).

Blood pressure

We defined **elevated blood pressure (or hypertension)** as a systolic blood pressure ≥ 140 mm Hg or a diastolic blood pressure ≥ 90 mm Hg or the use of hypotensive drugs as reported in medical files (Whelton et al., 2018). Blood pressure was measured with the ProBP 2400 Digital electronic device (Welch Allyn, New York, United States) according to the 2005 Canadian Hypertension Education Program (Hemmelgarn et al., 2005) for which measurement recommendations are as follows: "The patient should be resting comfortably for 5 minutes in the seated position with back support. The arm should be bare and supported with the blood pressure cuff at heart level, as a lower position will result in an erroneously higher systolic blood pressure and diastolic blood pressure. There should be no talking, and patients' legs should not be crossed. At least three measurements should be taken in the same arm with the patient in the same position. The first reading should be discarded and the latter two averaged."

Anthropometric measurements

The **body mass index (BMI)** is the most widely used measure to identify overweight and obesity in research studies (American College of Cardiology/American Heart Association Task Force on Practice Guidelines, 2014; Lau et al., 2007); it is calculated as the weight in kilograms divided by the square of the height in metres (kg/m^2). Height was measured in centimetres by a nurse using a measuring tape while participants were barefoot and standing on a solid surface against a wall. Weight was measured using the InBody apparatus (model 570, Ontario, Canada) based on bioelectrical impedance. BMI was classified using the National Institute of Health's classification (National Heart & Institute, 2013). A BMI under 18.5 was classified as underweight, while a BMI ≥ 25 was considered overweight. A BMI ≥ 30 was classified as class 1 obesity, ≥ 35 as class 2 obesity, and ≥ 40 as class 3 obesity.

However, BMI is of limited usefulness as a general index of obesity. Some studies have also highlighted that the application of current cut-offs to a diverse population leads to misclassification of a large number of people, with misclassification being especially prevalent in racial and ethnic minorities (Rao et al., 2015). As a consequence, measurements of abdominal obesity (i.e., **waist circumference and waist-to-height ratio**) have been suggested as better predictors of the risk of disease than BMI (American College of Cardiology/American Heart Association Task Force on Practice Guidelines, 2014; Czernichow et al., 2011; Lee et al., 2008; Shields et al., 2012). Waist circumference was measured over a layer of clothing between the last floating rib and the iliac crest. The measurement was repeated twice with the ribbon removed completely each time. A third measurement was conducted and was used as the final value if the difference between the first two was greater than one centimetre. Cut-off values for elevated waist circumference are 102 cm in men and 88 cm in women (American College of Cardiology/American Heart Association Task Force on Practice Guidelines, 2014) and 0.5 for elevated waist-to-height ratio for men and women (Browning et al., 2010). **Visceral adipose tissue** has also been shown to better predict cardiovascular diseases risk than BMI (Fox et al., 2007; Le Jemtel et al., 2018; Reijrink et al., 2019). Visceral fat area assessment was performed using a validated procedure on the InBody apparatus based on bioelectrical impedance (Faria et al., 2014). Because a visceral fat area ≥ 100 cm^2 determined using the InBody apparatus has been associated with cardiometabolic risk factors, it was considered as the cut-off value for **elevated visceral fat area** in this survey (Kang et al., 2015).

Lipid profile and lipoprotein metabolism

Blood lipids profile aims to characterize lipids and lipoprotein metabolism and it is used to detect and quantify cardiovascular risk (Anderson et al., 2016; D'Agostino et al., 2008). The difference in interindividual risk is poorly translated by the measurement of **total blood cholesterol** alone. The addition of anti-atherogenic high-density lipoprotein cholesterol (**HDL-C**) along with both the concentration of cholesterol in the atherogenic low-density lipoprotein cholesterol (**LDL-C**) and **triglyceride** concentrations provide a better quantification of cardiovascular risk (Anderson et al., 2016). Other measurements that also have the potential to help further quantify cardiovascular risk include **total apolipoprotein (apo) B** and **non-HDL-C** concentrations (Anderson et al., 2016). One apo B is present on each atherogenic lipoprotein and thus total apo B represents the concentration of circulating atherogenic lipoproteins. In the present report, the term **"high cardiovascular risk assessment index"** (Cardiometabolic Risk Working Group: Executive et al., 2011) is defined as the presence of either abnormal LDL-C concentrations (≥ 3.5 mmol/L), non-HDL-C concentrations (≥ 4.2 mmol/L) or apo B concentrations (≥ 1.2 g/L), and it is used, in addition to all the other cardiovascular risk factors, to provide a global assessment of cardiovascular risk (Anderson et al., 2016).

Total apo B was measured in plasma K2-EDTA by immunoturbidimetric assay using the Integra 800 from Roche Diagnostics GmbH, while total cholesterol, HDL-C and triglycerides were measured in plasma K2-EDTA by an enzymatic colorimetric test using the MODULAR *ANALYTICS* e170 from Roche Diagnostics GmbH. Non-HDL-C is derived from the calculation of total cholesterol minus HDL-C and represents the cholesterol transported in the atherogenic lipoprotein fraction. LDL-C concentration was calculated using the Friedewald equation (Friedewald et al., 1972).

Blood nutrients and contaminants measurements

Fatty acids in red blood cells (RBCs) were measured using gas chromatography on a Varian 3900 gas chromatograph with a DB-FFAP 15 m × 0.10 mm i.d. × 0.10 μm column (Agilent, Mississauga, ON). Values were expressed as the percentage of total fatty acids (by weight). Serum vitamin D was determined using the MODULAR ANALYTICS e170 from Roche Diagnostics GmbH. Whole blood mercury, lead and selenium concentrations were measured using inductively coupled plasma mass spectrometry (ICP-MS) with the NexION® instrument from PerkinElmer (Cleveland, Ohio, USA).

SOCIOENVIRONMENTAL DETERMINANTS OF CARDIOMETABOLIC HEALTH

In addition to traditional risk factors and determinants, we explored associations with certain relevant variables for the Inuit context, such as employment status (employed: paid work (job or self-employed); not employed: housework, hunter support program, retired or on pension, employment insurance, parental leave, income support or student), personal income (<$20 000; ≥$20 000), education (elementary school or less; secondary school attended but not completed; secondary school completed or higher), participation in traditional activities (yes; no), hunting frequency (1 to 3 times a month or more; never or less than once a month), consumption of traditional and market foods (under median; median or higher), food security (food secure; moderately food insecure; severely food insecure), house crowding (> 1 person per room; 1 person or less), house in need of repair (in need of major repairs; in need of minor repairs or regular maintenance) and life satisfaction (very satisfied or satisfied; not satisfied). Dietary intakes were assessed using a food frequency questionnaire (FFQ). The FFQ measured the frequency of intake for each item in the past three months. The FFQ collected information on the intake of country food (food obtained from hunting, fishing and harvesting) and market food (any store-bought food, most food being imported from southern Quebec). Details for food groups are presented in Table A (Appendix). In addition to the FFQ, questionnaires to document food security, lifestyle habits, sociodemographic and health characteristics were administered by trained interviewers. An adapted version of the Household Food Security Survey Module (HFSSM) was used to measure food insecurity among Inuit. Additionally, household overcrowding was quantified using the people per room (PPR) index; crowding occurs if there is more than one person per room.[2]

STATISTICAL ANALYSIS

This report presents both descriptive and bivariate analyses. The descriptive analyses focus on the prevalence of different cardiometabolic diseases, hepatic and renal health indicators, cardiometabolic risk factors and their respective determinants. A design weight was applied to each participant in order to account for the probability of them being selected in each unit of stratification. The weight used to calculate the estimates was based on the design weight but was also adjusted to consider the global non-response and test-specific non-response rates. Sample variance at 95% was estimated using the bootstrap method (500 replicates). The coefficient of variation (CV) was also used to assess the precision of estimates. The Institut de la statistique du Québec suggested CV thresholds to assure dissemination of high-quality estimates. Marginal estimates (CV between 15% and 25%) are identified with an asterisk and should be interpreted with caution due to high sampling variability. Unacceptable estimates (CV > 25%) are identified by double asterisks and are provided for information purposes only. When an estimate is based on fewer than 5 participants, the result is not presented (NP).

As specified previously, some risk factors (mainly type 2 diabetes, elevated blood pressure, high waist circumference and cardiovascular risk index) may act as both determinants and outcomes and have their own determinants. Prevalences of diseases or indicators were stratified according to age, sex, Nunavik ecological regions (Hudson coast: Kuujjuarapik, Umiujaq, Inukjuak, Puvirnituq and Akulivik; Hudson Strait: Ivujivik, Salluit, Kangiqsujuaq and Quaqtaq; Ungava Bay: Kangirsuk, Aupaluk, Tasiujaq, Kuujjuaq and Kangiqsualujjuaq) and community size (small: Kuujjuarapik, Umiujaq, Akulivik, Ivujivik, Kangiqsujuaq, Quaqtaq, Kangirsuk, Aupaluk, Tasiujaq and Kangiqsualujjuaq; large: Kuujjuaq, Salluit, Puvirnituq and Inukjuak). Stratification by ethnic groups (Inuit versus non-Inuit (n = 26)) did not produce relevant differences and, therefore, the results presented here combine all participants without regard to ethnicity. Bivariable analysis was used to compare the prevalence of diseases/indicators according to different categories of determinants with a global chi-square test. If this global test was significant, the categories were compared two by two through the construction of a Wald statistic based on the difference between the logit transformations of the estimated proportions. In order to provide insight on the relative impact of a determinant (risk or protective factor) on a dependent variable, prevalence ratios (PR) instead of prevalences are presented in the tables. Neither prevalences nor PRs were adjusted for potential confounding factors, except in the case of comparisons between 2004 and 2017, which were made on age-adjusted prevalences (to account for differences in age-structure between the two surveys), and prevalences calculated from the QICDSS, which were standardized according to the age structure of the Canadian population in 2011. Confidence intervals at 99% were calculated using the gamma method for prevalences estimated from the QICDSS. All of the statistical analyses for this report were done by two statisticians from the Institut national de santé publique du Québec using SAS software (SAS® Institute Inc., Cary, NC).

2. Please refer to the Methodological Report for survey questionnaires.

4 RESULTS

4.1 CARDIOMETABOLIC DISEASES

4.1.1 Cardiovascular diseases

Data extracted from the QICDSS were used to estimate the crude prevalence of diagnosed cardiovascular diseases among Nunavimmiut women and men in 2017-2018 (Table 1). The prevalence of ischemic heart diseases was similar among women and men in 2017-2018, but women seemed to experience cerebrovascular diseases slightly more frequently than men.

Table 1 Crude prevalence of cardiovascular diseases in adults aged 20 years and over, Nunavik, 2017-2018 (data from the Quebec Integrated Chronic Disease Surveillance System).

	Total	Women	Men
Ischemic heart diseases	5.4 (4.7 to 6.1)[1]	5.1 (4.2 to 6.2)	5.6 (4.7 to 6.7)
Cerebrovascular diseases	3.0 (2.5 to 3.5)	3.4 (2.7 to 4.3)	2.5 (1.9 to 3.2)

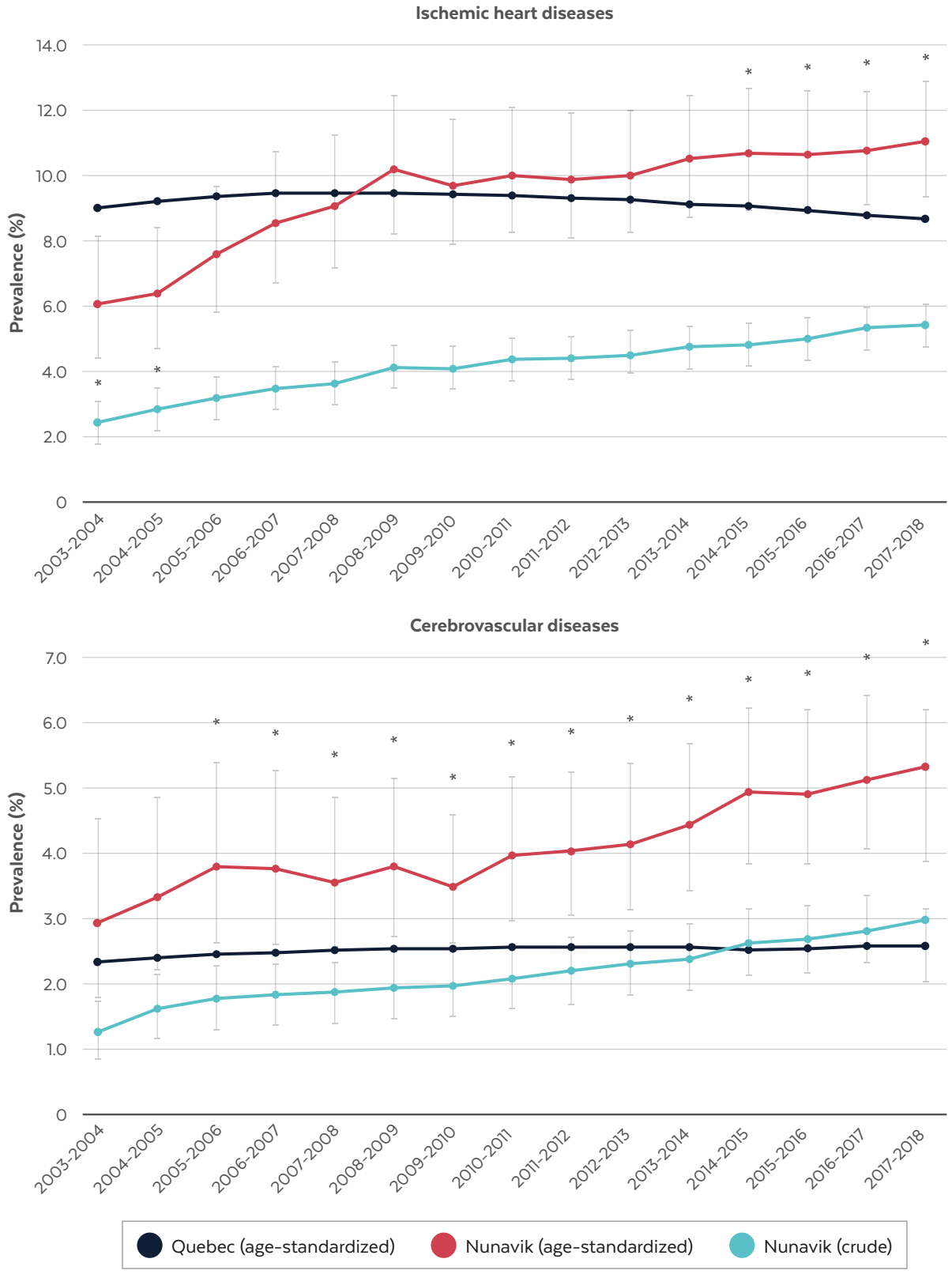
[1] Values correspond to mean crude prevalences (99% confidence interval).

Figure 2 shows the temporal trends for the crude prevalence of diagnosed cardiovascular diseases in Nunavik between 2003-2004 and 2017-2018, based on data from the QICDSS. An increase in the prevalence of both ischemic and cerebrovascular diseases was observed over the 15-year period. The crude prevalence of ischemic heart diseases increased from 2.4% (95% CI = 1.9 to 3.0) in 2003-2004 to 5.4% (4.7 to 6.1) in 2017-2018, whereas that of cerebrovascular diseases rose from 1.3% (1.8 to 2.9) in 2003-2004 to 3.0% (2.5 to 3.5) in 2017-2018. Also shown in Figure 2 are temporal trends for age-standardized prevalence of cardiovascular diseases in Nunavik and the province of Quebec as a whole, during the same period. While the age-standardized prevalence of ischemic heart diseases among Nunavimmiut was significantly lower than that of Quebecers in both 2003-2004 and 2004-2005, the situation reversed after 2014-2015. With regard to cerebrovascular diseases, as of 2005-2006, the age-standardized prevalence in Nunavik exceeded that of the province of Quebec and the gap has grown even more since 2012-2013.

4.1.2 Type 2 diabetes and prediabetes

The prevalence of type 2 diabetes in 2017, based on blood measurements and the use of antidiabetic drugs, was similar to that estimated in 2004 (5%) (Chateau-Degat et al., 2010) and did not vary across ecological regions or by community size (Table 2). The prevalence of type 2 diabetes increased with age and tended to be higher in women than in men (6% vs. 4%). Among Nunavimmiut without type 2 diabetes based on clinical tests, 4% experienced a prediabetes state as defined by a HbA1c value between 6.0% to 6.4% in 2017. HbA1c was not measured in 2004, but the prevalence of impaired fasting blood glucose (fasting glucose between 6.1 and 6.9 mmol/L) was 3% (Dewailly, 2007). The prevalence of prediabetes in 2017 tended to be higher in women than in men and in small communities compared to large ones. It also tended to increase with age.

Figure 2 Prevalence of cardiovascular diseases among adults aged 20 years and over in Nunavik and the province of Quebec, 2003-2004 to 2017-2018 (data from the Quebec Integrated Chronic Disease Surveillance System).



An "*" indicates a difference between Nunavik (age-standardized) and the province of Quebec (age-standardized) at $p<0.05$. Error bars represent 99% confidence intervals. The error bars for the province of Quebec are too small to appear on the figure. For age standardization purposes, the 2011 Quebec Census data were used as the standard population.

Data extracted from the QICDSS were used to assess the temporal trend in the prevalence of diagnosed diabetes (type 1 and type 2) among Nunavimmiut between 2003-2004 and 2017-2018, and to effect comparisons between Nunavik and the province of Quebec as a whole. Figure 3 shows the increasing temporal trend for the crude prevalence of diabetes in the Nunavik population over the 15-year period. The crude prevalence more than doubled, rising from 2.3% (95% CI = 1.8 to 2.9) in 2003-2004 to 6.5% (5.7 to 7.3) in 2017-2018. The age-standardized prevalence of diabetes in the Nunavik population was lower than that of the province of Quebec in 2003-2004 and 2004-2005. It then steadily increased to values exceeding those for the province of Québec in 2015-2016 and thereafter (Figure 3).

Table 2 Prevalence of type 2 diabetes and prediabetes among adults aged 18 years and over by sociodemographic characteristics, Nunavik, 2017

	Type 2 diabetes		Prediabetes	
	%	95% CI	%	95% CI
Total	4.7	3.6 to 6.1	4.1	3.2 to 5.4
Sex				
Men	3.5*	2.2 to 5.7	3.5*	2.2 to 5.6
Women	5.9*	4.3 to 7.9	4.7*	3.4 to 6.5
Age group				
18-29 years	1.0**	0.5 to 2.3	NP	NP
30-39 years	2.2**	0.9 to 5.1	NP	NP
40-49 years	5.3**	3.0 to 9.2	5.2**	2.7 to 9.5
50-59 years	7.9**	4.5 to 13.5	11.7*	7.6 to 17.6
60-69 years	13.6*	8.4 to 21.3	9.8**	5.3 to 17.2
70 years and over	22.0**	9.6 to 42.6	NP	NP
Region				
Hudson Bay	3.9**	2.3 to 6.6	4.5*	3.0 to 6.8
Hudson Strait	4.0**	2.4 to 6.5	5.2*	3.3 to 8.3
Ungava Bay	6.2*	4.4 to 8.6	2.8*	1.8 to 4.6
Community size				
Large	4.3*	2.9 to 6.2	3.2*	2.1 to 4.8
Small	5.4*	3.8 to 7.5	5.6*	3.9 to 7.9

Type 2 diabetes defined according to clinical tests (i.e., 2018 Canadian Diabetes Guidelines: (a) fasting glycemia ≥ 7 mmol/L; or (b) HbA1c ≥ 6.5%; or (c) glycemia at random ≥ 11.1 mmol/L)); or according to the use of medication for type 2 diabetes as reported in medical files.

Prediabetes state defined as a HbA1c value between 6.0 and 6.4%.

Values in coloured cells are statistically different according to a global chi-square test (p-value < 0.05).

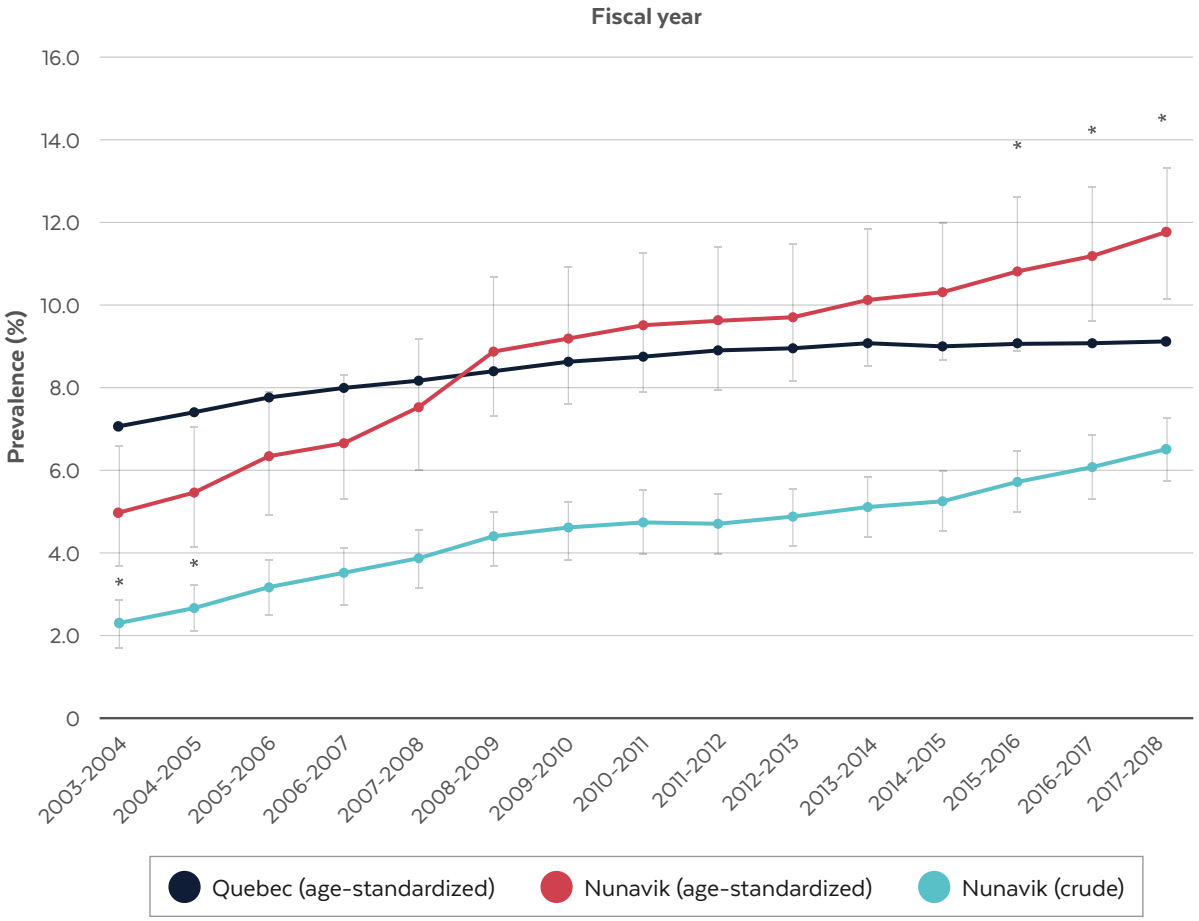
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.

** The coefficient of variation is greater than 25%. The proportion is shown for information only.

95% CI: 95% confidence interval.

NP: This value is not displayed since the cell has less than 5 respondents.

Figure 3 Prevalence of diabetes[1] among adults aged 20 years and over in Nunavik and the province of Quebec, 2003-2004 to 2017-2018 (data from the Quebec Integrated Chronic Disease Surveillance System)



[1] Type 1 and type 2 diabetes. An "*" indicates a difference between Nunavik (age-standardized) and the province of Quebec (age-standardized) at p<0.05.

Error bars represent 99% confidence intervals. The error bars for the province of Quebec are too small to appear on the figure. For age standardization purposes, the 2011 Québec Census data were used as the standard population.

4.1.3 Hepatic health

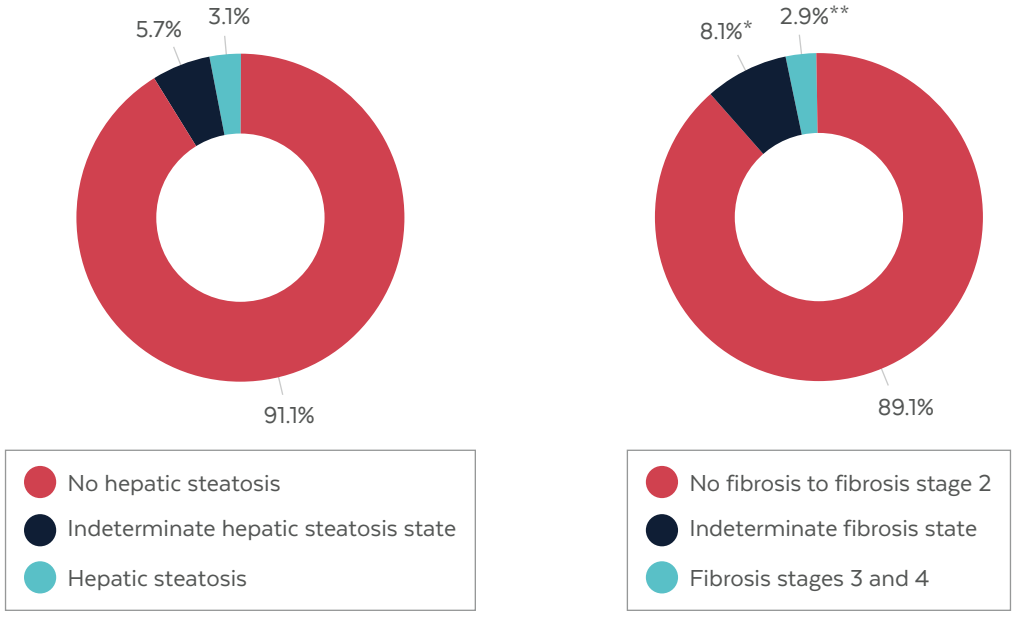
The prevalence of altered hepatic health, according to abnormal liver enzyme activities, was 2% based on high ALT activities, 2% according to high AST activities and 18% as assessed by high GGT activities (Table 3). Estimates were too unstable to compute prevalence by sex, age, region and community size for ALT and AST. The prevalence of high GGT activities was greater among women than men, but similar among age categories, regions and community sizes. According to the FLI and the NAFLD fibrosis score, the large majority of Nunavimmiut (about 90%) were free of hepatic steatosis or fibrosis in 2017; the estimated prevalence of steatosis or fibrosis (stage 3 and 4) was approximately 3% (Figure 4). Geometric means of hepatic health biomarkers are presented in Table B (Appendix).

Table 3 Prevalence of abnormal hepatic enzyme activities among adults aged 18 years and over by sociodemographic characteristics, Nunavik, 2017

	High alanine aminotransferase (ALT)		High asparate aminotransferase (AST)		High gamma-glutamyl transferase (GGT)	
	%	95% CI	%	95% CI	%	95% CI
Total	1.7*	1.1 to 2.8	2.1**	1.3 to 3.5	17.5	15.1 to 20.2
Sex						
Men	1.2**	0.5 to 2.9	2.6**	1.3 to 5.3	12.9*	9.5 to 17.3
Women	2.3**	1.4 to 4.0	1.6**	0.9 to 3.0	22.2	18.9 to 25.8
Age group						
18-29 years	1.8**	0.8 to 3.8	1.7**	0.8 to 3.9	12.2*	8.6 to 17.0
30-39 years	3.1**	1.2 to 8.0	NP	NP	19.3*	13.6 to 26.7
40-49 years	2.3**	1.0 to 5.1	4.5**	1.9 to 10.2	18.9*	13.8 to 25.3
50-59 years	NP	NP	NP	NP	21.3*	15.7 to 28.4
60-69 years	NP	NP	NP	NP	22.2*	15.4 to 30.9
70 years and over	NP	NP	NP	NP	31.3**	14.5 to 55.0
Region						
Hudson Bay	1.7**	0.7 to 4.0	2.7**	1.2 to 5.8	17.4	13.4 to 22.2
Hudson Strait	NP	NP	2.5**	1.1 to 5.6	18.3*	13.5 to 24.5
Ungava Bay	2.1**	1.1 to 4.2	1.2**	0.5 to 2.8	17.1	13.7 to 21.1
Community size						
Large	2.0**	1.1 to 3.6	2.5**	1.3 to 4.6	18.6	15.3 to 22.5
Small	1.3**	0.7 to 2.5	1.6**	0.7 to 3.4	15.8	12.5 to 19.7

Alanine aminotransferase activities ≥ 45 U/L for men and 35 U/L for women were considered high, as were aspartate aminotransferase values ≥ 45 U/L and gamma-glutamyl transferase values > 61 UI/L for men and 36 UI/L for women.
Values in coloured cells are statistically different according to a global chi-square test (p-value < 0.05).
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.
** The coefficient of variation is greater than 25%. The proportion is shown for information only.
95% CI: 95% confidence interval.
NP: This value is not displayed since the cell has less than 5 respondents.

Figure 4 Distribution of hepatic health indices among adults aged 18 years and over, Nunavik, 2017



An FLI < 30 can be used to rule out non-alcoholic fattyliver (no hepatic steatosis), while an FLI ≥ 60 can be used to rule in non-alcoholic fatty liver (hepatic steatosis). Values in between indicate an indeterminate hepatic steatosis state. An NAFLD fibrosis score < the low cut-off of 1.455 excludes advanced fibrosis (no fibrosis to fibrosis stage 2), while an NAFLD fibrosis score > 0.676 identifies the presence of advanced fibrosis (fibrosis stages 3 and 4). Values in between indicate an indeterminate fibrosis state.
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.
** The coefficient of variation is greater than 25%. The proportion is shown for information only.

4.1.4 Renal health

The prevalence of altered renal health markers was 4% based on high serum creatinine, 14% according to high ACR and 2% as assessed by low eGFR (Table 4). Estimates were too unstable to compute prevalence by sex, age, region and community size for serum creatinine and eGFR. The prevalence of high ACR was greater among women than men, tended to be associated with age, and did not vary by region or community size. For information purposes, geometric means of renal health markers are presented in Table C (Appendix). Using the classification proposed by the KDIGO to estimate the risk of chronic kidney disease, 85% of Nunavimmiut had a low risk of chronic kidney disease and 13% a moderate risk (data not shown). The prevalence of high or very high risk of chronic kidney disease was too low to be estimated in this population.

Table 4 Prevalence of altered markers of renal health among adults aged 18 years and over by sociodemographic characteristics, Nunavik, 2017

	High serum creatinine		High albumin/creatinine ratio (ACR)		Low estimated glomerular filtration rate (eGFR)	
	%	95% CI	%	95% CI	%	95% CI
Total	3.5*	2.4 to 5.0	13.6	11.6 to 15.8	1.6*	1.0 to 2.6
Sex						
Men	4.5*	2.8 to 7.2	10.4*	7.6 to 14.0	1.5**	0.7 to 2.9
Women	2.4**	1.4 to 4.3	16.8	14.0 to 20.0	1.8**	0.9 to 3.4
Age group						
18-29 years	1.5**	0.6 to 3.6	7.6*	5.3 to 10.8	NP	NP
30-39 years	NP	NP	8.4**	5.1 to 13.5	NP	NP
40-49 years	3.4**	1.5 to 7.7	11.8*	7.7 to 17.6	NP	NP
50-59 years	3.6**	1.5 to 8.4	19.0*	13.8 to 25.7	NP	NP
60-69 years	8.5**	4.0 to 17.0	37.1	27.9 to 47.3	8.5**	4.0 to 17.0
70 years and over	NP	NP	33.2**	16.6 to 55.3	15.3**	6.2 to 33.1
Region						
Hudson Bay	4.7**	2.6 to 8.3	14.3	10.8 to 18.7	1.4**	0.6 to 3.5
Hudson Strait	3.0**	1.5 to 6.0	9.9*	7.0 to 13.9	2.0**	0.8 to 4.7
Ungava Bay	2.4**	1.4 to 4.2	15.2	12.3 to 18.8	1.6**	0.8 to 3.1
Community size						
Large	2.7**	1.4 to 5.0	14.4	11.8 to 17.5	1.0**	0.4 to 2.4
Small	4.7*	3.1 to 7.2	12.3	9.7 to 15.4	2.6**	1.6 to 4.3

Serum creatinine values ≥ 110 µmol/L for men and 90 µmol/L for women were considered high, a urinary albumin/creatinine ratio > 3 was considered high and an estimated glomerular filtration rate < 60 ml/min/1.73 m^2 was considered low.
Values in coloured cells are statistically different according to a global chi-square test (p-value < 0.05).
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.
** The coefficient of variation is greater than 25%. The proportion is shown for information only.
95% CI: 95% confidence interval.
NP: This value is not displayed since the cell has less than 5 respondents.

4.2 CARDIOMETABOLIC RISK FACTORS

4.2.1 Elevated blood pressure

Almost one Nunavimmiut out of four experienced elevated blood pressure according to blood pressure measurements and the use of hypotensive drugs in 2017 (24%, Table 5). In 2017, the prevalence of elevated blood pressure was higher in men than women (29% and 18%, respectively) and increased with age. High blood pressure was more prevalent in Ungava Bay communities compared to those in Hudson Strait, but not compared to those in Hudson Bay. No association was observed between the prevalence of elevated blood pressure and the size of the community of residence.

The prevalence of elevated blood pressure in 2017 (23%) was almost 1.5 times greater than that observed in 2004 (17%) (Appendix, Table D). The age-adjusted prevalence in women was similar in 2017 and 2004 (17% vs. 14%), but men experienced a marked increase compared to 2004 (28% vs. 19%).

Table 5 Prevalence of elevated blood pressure among adults aged 18 years and over by sociodemographic characteristics, Nunavik, 2017

	%	95% CI
Total	23.5	20.9 to 26.5
Sex		
Men	28.8	24.4 to 33.7
Women	18.1	15.5 to 21.2
Age group		
18-29 years	13.5*	9.4 to 18.9
30-39 years	16.8*	11.3 to 24.2
40-49 years	23.1	17.0 to 30.5
50-59 years	33.8	26.4 to 42.2
60-69 years	53.8	44.1 to 63.2
70 years and over	52.6*	32.3 to 72.1
Region		
Hudson Bay	21.7	17.3 to 27.0
Hudson Strait	15.3*	11.2 to 20.5
Ungava Bay	31.5	26.9 to 36.5
Community size		
Large	25.6	21.8 to 29.8
Small	20.4	16.9 to 24.4

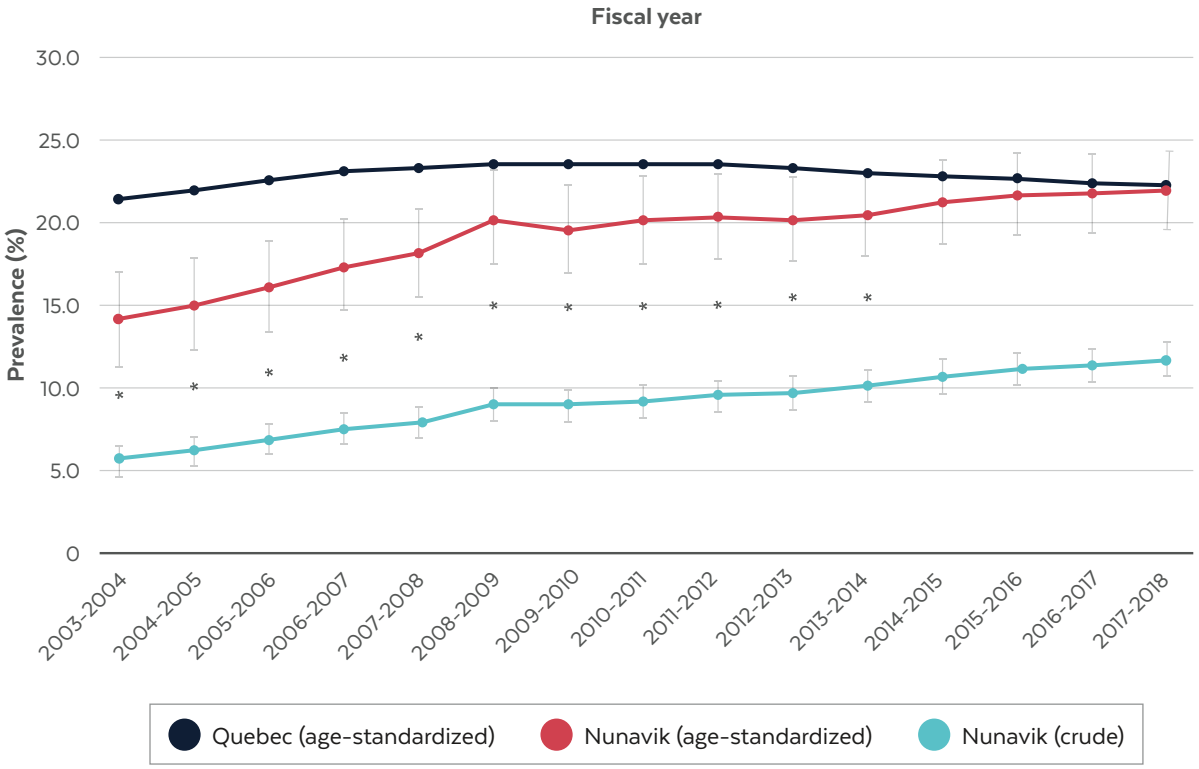
Elevated blood pressure was defined according to clinical tests (i.e., a systolic blood pressure ≥ 140 mm Hg or a diastolic blood pressure ≥ 90 mm Hg) or according to the use of hypotensive drugs as reported in medical files. Values in coloured cells are statistically different according to a global chi-square test (p-value < 0.05).

* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.

95% CI: 95% confidence interval.

Figure 5 shows temporal trends in the prevalence of diagnosed hypertension for the Nunavik population and the population of the province of Quebec during the period from 2003-2004 to 2017-2018, based on data extracted from the QICDSS. The crude prevalence for Nunavimmiut increased steadily during the 15-year period, from 5.5% (95% CI = 4.7 to 6.5) in 2003-2004 to 11.8% (10.8 to 12.8) in 2017-2018. Based on age-standardized data, the prevalence of hypertension in the Nunavik population was lower than that in the Quebec population from 2003-2004 to 2013-2014, but did not differ thereafter (Figure 5).

Figure 5 Prevalence of hypertension among adults aged 20 years and over in Nunavik and the province of Quebec, 2003-2004 to 2017-2018 (data from the Quebec Integrated Chronic Disease Surveillance System)



An "*" indicates a difference between Nunavik (age-standardized) and the province of Québec (age-standardized) at p<0.05. Error bars represent 99% confidence intervals. The error bars for the province of Quebec are too small to appear on the figure. For age standardization purposes, the 2011 Quebec Census data were used as the standard population.

4.2.2 Body composition

In 2017, nearly half of Nunavimmiut presented a high waist circumference (46%) or an elevated visceral adipose area (47%), whereas almost three out of four exhibited a high waist-to-height ratio (72%) (Table 6). According to all three measures performed, the prevalence of abdominal obesity was greater in women than in men and increased with age. The prevalence of abdominal obesity was highest in residents of Ungava Bay communities.

The prevalence of elevated waist circumference in 2017 was greater than that documented in 2004 (45% vs. 36%, Appendix, Table D). This increase was mainly due to an increase among women (63% in 2017 vs. 54% in 2004 for women; 26% in 2017 vs. 20% in 2004 for men). As for elevated waist-to-height ratio, although the global proportions were similar in both surveys (72% in 2017 vs. 76% in 2004), a statistically significant reduction was observed in men.

Table 6 Prevalence of high waist circumference, high waist-to-height ratio and high visceral adipose area among adults aged 18 years and over, Nunavik, 2017

	High waist circumference		High waist-to-height ratio		High visceral adipose area	
	%	95% CI	%	95% CI	%	95% CI
Total	45.5	42.4 to 48.7	72.3	69.2 to 75.1	47.2	43.9 to 50.5
Sex						
Men	27.4	22.7 to 32.7	60.7	55.5 to 65.7	32.4	27.5 to 37.7
Women	63.9	60.0 to 67.7	84.0	81.1 to 86.6	63.9	59.8 to 67.8
Age group						
18-29 years	36.5	31.5 to 41.7	60.2	54.9 to 65.3	37.5	32.2 to 43.1
30-39 years	46.5	39.6 to 53.5	70.5	62.5 to 77.4	48.8	41.0 to 56.7
40-49 years	51.8	44.1 to 59.5	82.3	75.6 to 87.5	50.7	42.5 to 58.9
50-59 years	51.0	43.8 to 58.2	76.9	69.8 to 82.8	52.1	44.9 to 59.3
60-69 years	52.0	42.9 to 61.0	90.0	83.0 to 94.3	57.1	47.9 to 65.9
70 years and over	66.2*	44.9 to 82.5	NP	NP	74.1	53.9 to 87.5
Region						
Hudson Bay	39.2	34.4 to 44.2	66.7	61.4 to 71.6	41.7	36.7 to 46.8
Hudson Strait	46.0	39.6 to 52.6	68.9	62.3 to 74.9	45.7	39.0 to 52.6
Ungava Bay	52.8	47.9 to 57.6	81.4	77.2 to 85.0	55.0	50.0 to 59.8
Community size						
Large	45.1	40.7 to 49.6	71.6	67.2 to 75.7	48.0	43.4 to 52.7
Small	46.0	41.9 to 50.2	73.2	68.8 to 77.2	46.0	41.6 to 50.5

Cut-off values were > 102 cm in men and > 88 cm in women for elevated waist circumference, 0.5 for elevated waist/height ratio in men and women and ≥ 100 cm^2 for elevated visceral adipose area in men and women.
Values in coloured cells are statistically different according to a global chi-square test (p-value < 0.05).
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.
95% CI: 95% confidence interval.
NP: This value is not displayed since the cell has less than 5 respondents.

Table 7 presents the proportion of Nunavimmiut in different BMI categories in 2017. The underweight and normal categories were combined since the underweight category represented less than 1% of the population in 2017. A greater proportion of men were in the underweight/normal category than women (49% and 35%, respectively), while the prevalence of overweight was similar among men and women (25% and 27%, respectively). The prevalence of type I obesity was 20% and similar among men and women, while the prevalence of type II and III obesity was 12% and higher among women than men (15% vs. 9%).

BMI was not related to community size; however, a higher prevalence of underweight/normal BMI and a lower prevalence of type I obesity were observed for Hudson Bay communities compared to those in Ungava Bay, but not compared to those in Hudson Strait. The prevalence of underweight/normal BMI was also higher for Hudson Strait communities compared to those in Ungava Bay. BMI seemed to be associated with age, with the underweight/normal category being more prevalent in the 18 to 29 age group, the overweight category being more prevalent in the 60 to 69 age group and the obesity (type I) category being more prevalent in the 20 to 59 age group (Table 7).

No difference was found in the distribution of BMI categories between 2004 and 2017 (Table 8).

Table 7 Distribution of body mass index categories among adults aged 18 years and over by sociodemographic characteristics, Nunavik, 2017

	Underweight/normal (< 25 kg/m²)		Overweight (25 to 29 kg/m²)		Type I obesity (30 to 34 kg/m²)		Type II and III obesity (≥ 35 kg/m²)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Total	42.5	39.2 to 45.8	25.9	23.3 to 28.7	19.7	17.1 to 22.5	11.9	9.8 to 14.4
Sex								
Men	49.1	43.9 to 53.4	24.6	20.5 to 29.1	17.4	13.7 to 22.0	8.9*	6.1 to 12.8
Women	35.0	21.3 to 39.1	27.4	24.1 to 31.1	22.2	19.2 to 25.5	15.4	12.6 to 18.8
Age group								
18-29 years	51.6	45.8 to 57.3	23.5	18.9 to 28.8	14.6	11.2 to 18.9	10.3*	7.1 to 14.8
30-39 years	39.5	32.0 to 47.6	27.0	21.0 to 34.0	24.5*	17.9 to 32.6	8.9*	5.8 to 13.4
40-49 years	38.6	30.8 to 47.0	23.3	17.6 to 30.3	21.5*	15.2 to 29.5	16.6*	11.2 to 23.8
50-59 years	40.9	33.8 to 48.4	25.7	19.9 to 32.6	20.0	14.9 to 26.2	13.4*	8.8 to 19.9
60-69 years	29.7	22.0 to 38.8	37.6	28.9 to 47.2	18.3*	12.7 to 25.6	14.4*	9.0 to 22.2
70 years and over	25.9**	12.5 to 46.1	24.0**	11.4 to 43.8	NP	NP	NP	NP
Region								
Hudson Bay	50.9	45.5 to 56.2	22.5	18.5 to 27.1	14.9	11.2 to 19.5	11.8*	8.7 to 15.8
Hudson Strait	42.5	35.8 to 49.4	26.4	21.1 to 32.3	20.3	15.4 to 26.3	10.9**	7.0 to 16.5
Ungava Bay	32.1	27.6 to 37.0	29.8	24.9 to 35.2	25.2	20.8 to 30.1	12.9	9.8 to 16.8
Community size								
Large	41.7	37.1 to 46.5	25.8	22.1 to 29.9	18.9	15.3 to 23.1	13.5	10.6 to 17.1
Small	43.5	39.1 to 48.1	26.0	22.2 to 30.2	20.7	17.4 to 24.5	9.7	7.2 to 12.9

Values in coloured cells are statistically different according to a global chi-square test (p-value < 0.05).
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.
** The coefficient of variation is greater than 25%. The proportion is shown for information only.
95% CI: 95% confidence interval.
NP: This value is not displayed since the cell has less than 5 respondents.

Table 8 Distribution of body mass index among adults aged 18 years and over by sex, 2004 and 2017, Nunavik

	Total		Men		Women	
	2004	2017	2004	2017	2004	2017
Underweight/normal (< 25 kg/m^2)	41.0 (37.5 to 44.7)	42.7 (39.2 to 46.1)	43.5 (38.5 to 48.7)	49.3 (44.0 to 54.5)	38.2 (34.2 to 42.5)	35.0 (31.2 to 39.1)
Overweight (25 to 29 kg/m^2)	29.6 (26.7 to 32.8)	25.8 (23.3 to 28.6)	29.6 (25.4 to 34.2)	24.5 (20.5 to 29.1)	29.7 (25.8 to 33.9)	27.3 (23.9 to 30.9)
Type I obesity (30 to 34 kg/m^2)	18.6 (16.0 to 21.6)	19.6 (17.1 to 22.5)	19.0 (15.6 to 23.0)	17.4 (13.6 to 21.9)	18.4 (15.0 to 22.3)	22.2 (19.2 to 25.5)
Type II and III obesity (≥ 35 kg/m^2)	10.7 (8.6 to 13.2)	11.9 (9.8 to 14.4)	7.9* (5.5 to 11.2)	8.8* (6.1 to 12.8)	13.7 (10.9 to 17.0)	15.5 (12.7 to 18.8)

Prevalences are age-adjusted (95% confidence interval).
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.

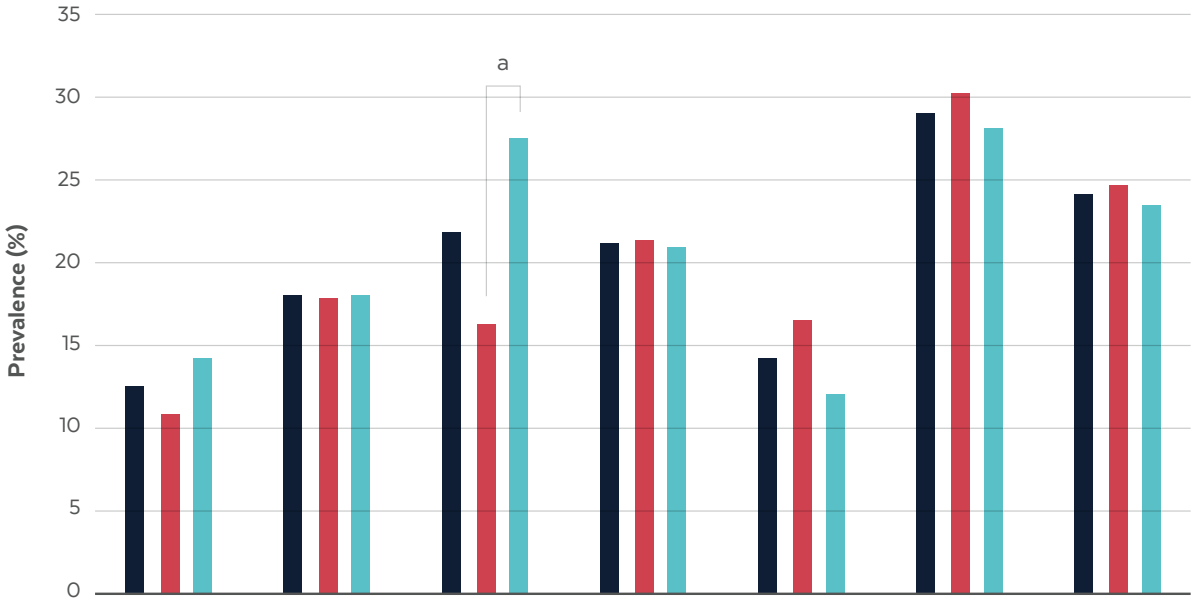
4.2.3 Blood lipids

In 2017, the prevalence of high total cholesterol concentrations among Nunavimmiut was 13%; that of high LDL-C, 18%; that of low HDL-C, 22%; that of high non-HDL-C, 21%; that of high total apo B, 14%; and that of high triglyceride concentrations, 29% (Figure 6). The prevalence of high triglyceride concentrations is presented for both fasting and non-fasting samples; non-fasting triglyceride concentrations were approximately 20% higher than fasting triglyceride concentrations. When analyzed separately, the prevalence of high triglyceride concentrations was higher in the non-fasting sample (36%) than in the fasting one (21%).

The prevalence of low HDL-C concentrations was greater among women than men (28% vs. 16%) whereas the prevalence of abnormal values for other blood lipid-related variables was similar in men and women. Almost one Nunavimmiut out of four (24%) was at high cardiovascular risk, according to blood concentrations of LDL-C, non-HDL-C and total apo B, and the prevalence of a high cardiovascular risk assessment index was similar among men and women (25% vs. 24%). Elevated total cholesterol, LDL-C, non-HDL-C, apo B, triglycerides and cardiovascular risk assessment index tended to increase with age, while low HDL-C concentrations tended to be more prevalent among younger Nunavimmiut (Table 9). Low HDL-C concentrations were more prevalent in Hudson Strait communities compared to Hudson and Ungava Bay communities; high apo B concentrations were more prevalent in Ungava Bay compared to Hudson Bay; and high triglyceride concentrations were more prevalent in Hudson Strait and Ungava Bay compared to Hudson Bay. Blood lipid concentrations are presented in the appendix (Table E).

An increase in the prevalence of low HDL-C (22% vs. 11%) but not high LDL-C concentrations (17% vs. 20%) was observed in 2017 compared to 2004 (Appendix, Table D).

Figure 6 Prevalence of abnormal lipid profiles among adults aged 18 years and over by sex, Nunavik, 2017



	Total C	LDL-C	HDL-C	Non-HDL-C	Apo B	Triglycerides	CV risk index
Total	12.6	18.1	21.9	21.2	14.4	29.1	24.2
Men	11.0*	18.0	16.4	21.4	16.6	30.2	24.7
Women	14.3	18.1	27.6	21.0	12.3	28.1	23.6

Cut-off values were ≥ 6.2 mmol/L for elevated total cholesterol (C) levels, ≥ 3.5 mmol/L for high low-density lipoprotein cholesterol (LDL-C) levels, < 1.03 mmol/L in men and <1.30 mmol/L in women for low high-density lipoprotein cholesterol (HDL-C) levels, ≥ 4.2 mmol/L for elevated non-HDL-C levels, ≥ 1.2 g/L for high apo B, and ≥ 1.7 mmol/L for high triglyceride concentrations.
CV risk index: cardiovascular risk assessment index based on an abnormal blood lipid profile. High cardiovascular risk assessment index was defined as LDL-C ≥ 3.5 mmol/L, non-HDL-C ≥ 4.2 mmol/L or apo B ≥ 1.2 g/L.
[a] Value statistically different by sex according to a global chi-square test (p-value < 0.05).
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.

Table 9 Prevalence of abnormal blood lipids among adults aged 18 years and over by sociodemographic characteristics, Nunavik, 2017

	Total cholesterol		LDL-C		HDL-C		Non-HDL-C		Apolipoprotein B		Triglycerides		CV risk index	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Age group														
18 - 29 years	5.6**	3.2 to 9.6	10.6*	7.3 to 15.0	24.5	20.0 to 29.6	10.2*	6.8 to 14.9	8.0*	5.0 to 12.6	21.5	16.6 to 27.5	12.6*	8.9 to 17.4
30 - 39 years	12.4**	7.2 to 20.7	17.5*	11.6 to 25.4	21.6	16.2 to 28.2	25.5	18.8 to 33.5	15.8*	10.0 to 24.0	32.9	25.7 to 41.0	29.6	22.5 to 37.8
40 - 49 years	11.6*	7.8 to 16.8	21.7*	16.0 to 28.8	27.6	21.1 to 35.2	27.6	20.8 to 35.5	20.0*	14.3 to 27.1	38.9	31.1 to 47.3	30.6	23.7 to 38.5
50 - 59 years	24.9	18.7 to 32.5	30.2	23.3 to 38.2	14.9*	10.3 to 21.2	32.1	25.1 to 40.0	20.2*	14.5 to 27.4	34.4	26.7 to 43.0	34.9	27.7 to 42.9
60 - 69 years	22.2*	14.8 to 31.9	19.7*	12.6 to 29.4	16.5*	10.6 to 24.7	23.6*	15.8 to 33.6	17.8*	10.9 to 27.7	26.2*	19.0 to 35.0	24.9*	17.1 to 34.8
70 years and over	12.5**	4.9 to 28.3	22.2**	9.6 to 43.4	NP	NP	24.7**	10.9 to 46.8	NP	NP	NP	NP	32.1**	15.9 to 54.1
Region														
Hudson Bay	10.3*	7.3 to 14.3	16.2	12.4 to 20.7	20.1	16.2 to 24.6	17.1	13.2 to 21.9	10.0*	6.9 to 14.2	23.8	18.9 to 29.4	20.1	16.0 to 25.1
Hudson Strait	13.2*	9.2 to 18.6	19.7	14.9 to 25.6	28.2	22.6 to 34.5	24.8	19.0 to 31.7	15.5*	10.7 to 21.9	33.6	27.3 to 40.6	27.9	21.9 to 34.9
Ungava Bay	15.0	11.7 to 18.9	19.2	15.3 to 23.7	19.7	16.0 to 24.1	23.5	19.6 to 28.0	18.9	15.3 to 23.2	32.2	27.6 to 37.2	26.2	22.0 to 30.9
Community size														
Large	13.8	10.9 to 17.4	17.8	14.5 to 21.7	21.5	18.1 to 25.5	21.5	17.9 to 25.6	16	12.8 to 19.8	29.3	24.9 to 34.1	23.4	19.6 to 27.6
Small	10.9	8.4 to 14.0	18.4	14.8 to 22.6	22.6	19.2 to 26.3	20.8	17.0 to 25.2	12.1	9.1 to 15.9	28.9	24.5 to 33.7	25.3	21.1 to 30.0

Cut-off values were ≥ 6.2 mmol/L for elevated total cholesterol (C) levels, ≥ 3.5 mmol/L for high low-density lipoprotein cholesterol (LDL-C) levels, <1.03 mmol/L in men and < 1.30 mmol/L in women for low high-density lipoprotein cholesterol (HDL-C) levels, ≥ 4.2 mmol/L for elevated non-HDL-C levels, ≥ 1.2 g/L for high apo B, and ≥ 1.7 mmol/L for high triglyceride concentrations.
CV risk index: cardiovascular risk assessment index based on an abnormal blood lipid profile. High cardiovascular risk assessment index was defined as the presence of either abnormal LDL-C concentrations (≥ 3.5 mmol/L), non-HDL-C concentrations (≥ 4.2 mmol/L) or apo B concentrations (≥ 1.2 g/L). Values in coloured cells are statistically different according to a global chi-square test (p-value < 0.05).

* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.

** The coefficient of variation is greater than 25%. The proportion is shown for information only.

95% CI: 95% confidence interval.

NP: This value is not displayed since the cell has less than 5 respondents.

4.3 DETERMINANTS OF CARDIOMETABOLIC DISEASES AND RISK FACTORS

The prevalence of cardiometabolic diseases and risk factors (i.e., type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference and high cardiovascular risk assessment index based on elevated blood lipids) among BMI categories is presented in Table 10. Prevalence ratios (PRs) for classic determinants of cardiometabolic diseases and risk factors are presented in Table 11. PRs for socioenvironmental determinants (risk and protective factors) including employment status, personal income, education, participation in traditional activities, hunting frequency, consumption of traditional and market foods, food security, house crowding, house in need of repairs and life satisfaction according to cardiometabolic diseases and risk factors are presented in Tables F to K (Appendix). The prevalence of altered hepatic and renal health was too low to conduct determinant analyses.

We must stress that the analysis of determinants presented here was conducted without any adjustment for potential confounding effects. Consequently, these results are shown for information purposes only and should be interpreted with caution.

4.3.1 Type 2 diabetes and prediabetes

The prevalence of type 2 diabetes and prediabetes tended to increase in step with BMI categories (Table 10). High waist circumference, high waist-to-height ratio, high visceral fat area, low HDL-C and high triglyceride concentrations were associated with type 2 diabetes and prediabetes prevalence (Table 11).

Table 10 Prevalence of selected cardiovascular disease risk factors across body mass index categories among adults aged 18 years and over, Nunavik, 2017

Body mass index category	Type 2 diabetes		Prediabetes		Elevated blood pressure		High waist circumference		High CV risk index	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Underweight/normal (< 25 kg/m^2)	0.9**	0.4 to 1.9	1.7**	0.8 to 3.4	10.9*	7.8 to 15.0	4.1*	2.8 to 5.9	10.1*	7.2 to 13.9
Overweight (25 to 29 kg/m^2)	4.3**	2.5 to 7.4	3.8**	2.1 to 6.8	26.6	21.0 to 33.1	50.8	44.6 to 57.0	26.6	21.2 to 32.9
Type I obesity (30 to 34 kg/m^2)	6.7**	3.9 to 11.3	6.3**	3.6 to 11.0	29.0	22.3 to 36.8	89.7	82.9 to 94.0	39.9	32.2 to 48.1
Type II and III obesity (> 35 kg/m^2)	16.9*	11.5 to 24.2	12.1**	7.2 to 19.8	53.8	44.1 to 63.3	NP	NP	43.8	34.3 to 53.9

CV risk index: cardiovascular risk assessment index based on an abnormal blood lipid profile. High cardiovascular risk assessment index was defined as LDL-C ≥ 3.5 mmol/L, non-HDL-C ≥ 4.2 mmol/L or apo B ≥ 1.2 g/L.
Values in coloured cells are statistically different according to a global chi-square test (p-value < 0.05).
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.
** The coefficient of variation is greater than 25%. The proportion is shown for information only.
95% CI: 95% confidence interval.
NP: This value is not displayed since the cell has less than 5 respondents.

Table 11 Prevalence ratio of classic cardiometabolic disease risk factors according to diabetes, prediabetes, hypertension, abdominal obesity and abnormal lipid profile status, adults aged 18 years and over, Nunavik, 2017

Risk factor	Type 2 diabetes	Prediabetes	Elevated blood pressure	High waist circumference	High CV risk index
High waist circumference					
> 102 cm for men, > 88 cm for women	1.76 (1.51 to 2.04)	1.89 (1.61 to 2.23)	1.53 (1.33 to 1.75)	-	1.74 (1.53 to 1.98)
High waist-to-height ratio					
> 0.5	1.35 (1.26 to 1.45)	1.25 (1.09 to 1.43)	1.33 (1.24 to 1.43)	NP	1.40 (1.31 to 1.50)
High visceral fat area					
≥ 100 cm^2	1.90 (1.68 to 2.15)	1.83 (1.53 to 2.18)	1.69 (1.48 to 1.92)	9.09 (6.87 to 12.03)	1.82 (1.61 to 2.07)
High LDL-C					
≥ 3.5 mmol/L	0.99** (0.51 to 1.93)	1.89* (1.18 to 3.03)	1.67 (1.23 to 2.28)	2.10 (1.52 to 2.88)	-
Low HDL-C					
< 1.03 mmol/L for men, < 1.30 mmol/L for women	1.97* (1.39 to 2.78)	1.90* (1.21 to 2.97)	1.33 (1.03 to 1.72)	5.23* (3.52 to 7.77)	1.66 (1.28 to 2.16)
High non-HDL-C					
≥ 4.2 mmol/L	1.09* (0.65 to 1.83)	2.41* (1.71 to 3.38)	1.80 (1.37 to 2.37)	3.04 (2.27 to 4.08)	-
High triglycerides					
≥ 1.7 mmol/L	1.90 (1.45 to 2.50)	1.84* (1.31 to 2.57)	1.84 (1.49 to 2.28)	3.06 (2.36 to 3.97)	3.10 (2.52 to 3.82)
High CV risk index					
Yes	1.05* (0.65 to 1.71)	2.08* (1.48 to 2.92)	1.61 (1.25 to 2.07)	2.53 (1.94 to 3.30)	-

Values are prevalence ratios (and their 95% confidence interval), calculated as the prevalence of a risk factor among individuals with a given condition (type 2 diabetes, prediabetes, elevated blood pressure, abdominal obesity, abnormal blood lipid profile) divided by the prevalence among those without the condition.
CV risk index: cardiovascular risk assessment index based on an abnormal blood lipid profile. High cardiovascular risk assessment index was defined as LDL-C ≥ 3.5 mmol/L, non-HDL-C ≥ 4.2 mmol/ or apo B ≥ 1.2 g/L.
Prevalence ratios in coloured cells are statistically significant (p-value < 0.05) according to the construction of a Wald statistic based on the difference between the logit transformations of the estimated proportions.
* The coefficient of variation is greater than 15% and lower than or equal to 25%. The proportion should be interpreted carefully.
** The coefficient of variation is greater than 25%. The proportion is shown for information only.
NP: This value is not displayed since the cell has less than 5 respondents.

Nunavimmiut with type 2 diabetes or prediabetes were more likely to be single, separated, divorced or widowed and to have an annual income of $20 000 or more compared to those without type 2 diabetes or prediabetes (Appendix, Table F). Moreover, having enough money to meet their needs was associated with type 2 diabetes (Appendix, Table F). Nunavimmiut in a prediabetic state were less likely to live in a crowded house compared to those not in a prediabetic state (Appendix, Table G). Nunavimmiut with type 2 diabetes or in a prediabetic state tended to be more food secure (Appendix, Table G). Nunavimmiut with type 2 diabetes or prediabetes were less likely to consume alcohol and to smoke daily, while those with prediabetes were more likely to go on the land often (Appendix, Table I).

Nunavimmiut with prediabetes tended to eat marine mammals more frequently, and processed meat, salty snacks, fast food, sweets and ice cream, less frequently, compared to individuals not in a prediabetic state (Appendix, Table J). Individuals with type 2 diabetes reported consuming processed meats, red meat from the

market, sugary beverages, and salty snacks and fast food less frequently than those without type 2 diabetes (Appendix, Table J). Type 2 diabetes was positively associated with the content of omega-3 fatty acids in red blood cells, serum vitamin D and blood mercury concentrations, while prediabetes was positively associated with omega-3 fatty acids in red blood cells, blood selenium and mercury concentrations (Appendix, Table K).

4.3.2 Elevated blood pressure

The prevalence of elevated blood pressure was greater among the type II and III obesity category (54%) than in all other BMI categories (Table 10). The prevalence of elevated blood pressure was similar among the overweight and the type I obesity categories (27% vs. 29%) but greater than in the underweight/normal category (11%). Elevated blood pressure was associated with all of the classic cardiometabolic risk factors presented in Table 11 (i.e., high waist circumference, high waist-to-height ratio, high visceral fat area, high LDL-C, low HDL-C, high non-HDL-C, high triglyceride concentrations and high CV risk index).

Nunavimmiut with hypertension were more likely to have an annual income of $20 000 or more (Appendix, Table F) and less likely to live in an overcrowded house (Appendix, Table G). People with hypertension were also more food secure and reported being satisfied with their life, but were more likely to perceive their health as being fair or poor (Appendix, Tables G and H).

Nunavimmiut with elevated blood pressure reported consuming less frequently wild berries, sugary beverages, salty snacks and fast food, and sweets and ice cream compared to those without elevated blood pressure (Appendix, Table J). Elevated blood pressure was positively associated with the content of omega-3 fatty acids in red blood cells and serum vitamin D concentrations (Appendix, Table K).

4.3.3 Elevated waist circumference

The prevalence of elevated waist circumference increased in step with BMI categories (Table 10) and was associated with classic cardiometabolic risk factors (i.e., high visceral fat area, high LDL-C, low HDL-C, high non-HDL-C, high triglyceride concentrations and high CV risk index) (Table 11).

People with a high waist circumference were more likely to be single, separated, divorced or widowed, to have an annual income of $20 000 or more, to have enough money to meet their needs and to have a lower level of education (elementary school or less) (Appendix, Table F). High waist circumference was associated with being food secure, with living in a less crowded house and with perceiving health as poor (Appendix, Tables G and H).

High waist circumference was inversely associated with alcohol consumption and smoking daily (Table I). In addition, high waist circumference was inversely associated with the consumption of marine mammals, fish and seafood, processed meat, and salty snacks and fast food (Appendix, Table J). High waist circumference was associated with higher vegetable consumption (Appendix, Table J), higher omega-3 fatty acid content in red blood cells and serum concentrations of vitamin D, as well as blood selenium and mercury concentrations (Appendix, Table K).

4.3.4 Blood lipids

In general, high cardiovascular risk assessment index, as assessed by high LDL-C, non-HDL-C or apo B concentrations, was positively associated with BMI (Table 10) and other classic cardiometabolic risk factors (i.e., high waist circumference, high waist-to-height ratio, high visceral fat area, low HDL-C and high triglyceride concentrations) (Table 11).

Nunavimmiut at high cardiovascular risk based on their blood lipid profile were more likely to be single, separated, divorced or widowed, to have an annual income of $20 000 or more and to have a lower level of education (elementary school or less) compared to those at lower cardiovascular risk (Appendix, Table F).

People with a high cardiovascular risk were also more likely to be food secure (Appendix, Table G), less likely to smoke daily and more likely to go on the land often and to participate in traditional activities compared to people at low risk (Appendix, Table I).

Nunavimmiut at high cardiovascular risk reported consuming sugary beverages and salty snacks less frequently than those at lower cardiovascular risk (Appendix, Table J). Cardiovascular risk was positively associated with omega-3 fatty acid content in red blood cells as well as serum vitamin D, blood selenium and mercury blood concentrations (Appendix, Table K).

5 DISCUSSION

The present report provides an overview of cardiometabolic diseases (including risk factors and potential determinants) among Nunavimmiut in 2017. The results of the *Qanuilirpitaa?* 2017 survey and data extracted from the QICDSS indicate that ischemic heart diseases, cerebrovascular diseases, type 2 diabetes, elevated blood pressure especially in men and abdominal obesity in women are becoming a growing health challenge in Nunavik. The prevalence of high LDL-C concentrations has remained stable over time, but the prevalence of low HDL-C concentrations increased in 2017 compared to 2004. Hepatic and renal health assessment was carried out for the first time as part of a health survey in this population and highlighted that the prevalence of hepatic steatosis and fibrosis as well as that of chronic kidney disease, which are often associated with diabetes, was very low among Nunavimmiut in 2017. Close monitoring of the evolution of cardiometabolic health in this population undergoing major lifestyle changes is crucial.

BURDEN OF CARDIOVASCULAR DISEASES AND RISK FACTORS

Cardiovascular diseases

Analysis of the diagnostic data extracted from the QICDSS revealed that the prevalence of **ischemic heart diseases** (including heart attacks) and **cerebrovascular diseases** (including strokes) has increased over the last two decades in Nunavik, reaching crude prevalences of 5% and 3%, respectively, in 2017. The age-standardized prevalence of cerebrovascular diseases among Nunavimmiut consistently exceeded that of Quebecers from 2003-2004 to 2017-2018. In contrast, while Nunavimmiut exhibited a lower prevalence of ischemic heart diseases in the early 2000s, values have exceeded those of Quebecers in recent years.

Data from the Inuit Health Survey of 2007-2008 (IHS 2007-2008) also suggest a higher prevalence of cardiovascular diseases in Inuit compared to the general Canadian population. The IHS 2007-2008 was conducted among Inuit living in Nunavut, Nunatsiavut and the Inuvialuit Settlement Region, and excluded Nunavimmiut and Inuit living in the South (Saudny et al., 2012). When standardized for the age structure of the Canadian population, the prevalence of self-reported **stroke** in the IHS 2007-2008 (around 2% for both men and women) was higher than the prevalence of self-reported stroke in the general Canadian population in 2007-2008 (around 1% for both men and women) (Hu et al., 2019).

The age-standardized prevalence of self-reported **heart attacks** in the IHS 2007-2008 (5% in men and 3% in women, excluding Nunavimmiut) was higher than the prevalence of self-reported heart attacks in the general Canadian population in 2007-2008 (4% in men and 2% for women) (Hu et al., 2019).

Elevated blood pressure

The prevalence of elevated blood pressure among the Inuit of Nunavik was estimated at 24% in 2017, a marked increase since the previous survey conducted in 2004 (17%). The prevalence in women was similar in 2017 and 2004 (17% vs. 14%), but men experienced a marked increase compared to 2004 (28% vs. 19%). Thus, the increased prevalence of elevated blood pressure that occurred in Nunavik from 2004 to 2017 is mainly due to an increase in men. Results of surveys conducted over the past few decades in Nunavik and Greenland have also indicated that hypertension is more frequent among men than women (Bjerregaard et al., 2003; Bjerregaard et al., 2002; Riva et al., 2016). In contrast, the IHS 2007-2008 reported a similar age-standardized prevalence of clinically-measured hypertension (25%) in men and women (Hu et al., 2019).

When standardizing the prevalence of hypertension among Nunavimmiut for the age structure of the adult Canadian population in 2017, the prevalence reached 37% for Nunavimmiut men and 24% for Nunavimmiut women; data not shown). In comparison, values for men and women in the general Canadian population in 2014-2015 were, respectively, 20% and 19% (Statistics Canada, 2017b). Supplemental analyses revealed that the prevalence of

hypertension was almost six-fold greater in young Nunavimmiut men aged 18 to 34 years (17%; data not shown) compared to their non-Inuit counterparts (3%; (Statistics Canada, 2017b)). The prevalence of hypertension was also higher in young Inuit women aged 18 to 34 years old compared to non-Inuit Canadian women of the same age group (8%; data not shown vs. 2%; (Statistics Canada, 2017b)). Clearly, this issue deserves attention from public health authorities and clinical practitioners. The determinants of hypertension in young Nunavimmiut men will be examined in the near future to identify actionable causes for policy makers.

It should be noted that elevated blood pressure seems to have been underdiagnosed in Nunavik, given that the prevalence of elevated blood pressure estimated using data on diagnosed hypertension from the QICDSS in 2017-2018 (12%) was 50% lower than the prevalence estimated using clinical test or medication use information in 2017 (24%). Clearly, there is a need for increased hypertension screening and treatment in Nunavik.

Body composition

In 2017, the prevalence of abdominal obesity in the Nunavik population, assessed by waist circumference measurement, was greater than that estimated in 2004 (45% vs. 36%), with the increase occurring mainly in women (63% vs. 54%). Interestingly, we did not find any difference in the distribution of BMI categories between 2004 and 2017 and even found a reduction in the prevalence of a high waist-to-height ratio in men.

According to data from the IHS 2007-2008, 44% of Inuit adults had a high waist circumference, a prevalence similar to that observed among Nunavimmiut in 2017 (Egeland et al., 2011). Data from the IHS 2007-2008 also indicated that women had a higher prevalence of obesity (abdominal and based on BMI) than men (Zienczuk & Egeland, 2012).

Without imaging studies using computed tomography, ultrasonography, or magnetic resonance imaging, it is not known whether the central obesity represented by the high waist circumference measurement is predominantly due to visceral or subcutaneous fat. The visceral fat area estimated using bioelectrical impedance was measured for the first time among Nunavimmiut in the 2017 survey. Using a cut-off value of 100 cm^2, the prevalence of elevated visceral fat area (47%) was similar to the prevalence of elevated waist circumference (46%). At the population level, fat mass measured by computed tomography and bioelectrical impedance are interchangeable, with bioelectrical impedance slightly underestimating fat mass for BMI values between 18 and 40 kg/m^2 (Achamrah et al., 2018). However, bioelectrical impedance is affected by a variety of factors, especially hydration status, and may lack sensitivity for visceral fat tissue estimation (Lemos & Gallagher, 2017).

Even if obesity was associated with other cardiovascular risk factors in this survey (i.e., high LDL-C concentrations, low HDL-C concentrations, high non-HDL-C concentrations and high triglyceride concentrations, type 2 diabetes, prediabetes and elevated blood pressure), waist circumference and BMI measurements may not reflect the same degree of metabolic risk in Nunavimmiut as they do in other populations (Chateau-Degat et al., 2008). Pooled data analysis of 2 545 participants from four studies conducted in four communities of the Bering Strait region of Alaska, eight communities in the Kivalliq region of the Nunavut territory, the 14 communities of Nunavik, and two towns and four villages on the west coast of Greenland indicated that as levels of obesity increase (measured by BMI or waist circumference), so do blood pressure, blood lipids, glycemia and insulin (Young et al., 2007). However, for each BMI or waist circumference category, Inuit had a better cardiometabolic risk profile than non-Inuit Canadians, except in the case of glycemia and insulin (Young et al., 2007). For example, Inuit men with a BMI > 30 kg/m^2 had HDL-C levels similar to those of non-Inuit Canadian men with a body mass index < 25 kg/m^2 (Young et al., 2007). Similarly, Inuit men with a waist circumference between 95 and 100 cm had triglyceride levels close to those of non-Inuit Canadian men with a waist circumference between 75 and 80 cm (Young et al., 2007). Comparable trends were observed among women (Young et al., 2007). These observations support the need for further investigation of the relationship between cardiovascular risk factors and the development of cardiovascular diseases among Nunavimmiut and the predictive value of biomarkers in this population.

Blood lipids

In 1992, the blood lipid profile of Nunavimmiut was healthier than that of Quebecers (Chateau-Degat et al., 2010; Dewailly, 2007). Twelve years later, mean blood lipid values remained within the normal range (Dewailly, 2007).

The prevalence of low HDL-C doubled between 2004 and 2017 (11% vs. 22%), an increase observed in both men (9% vs. 16%) and women (13% vs. 28%). This increase is concordant with the observed augmentation in the prevalence of abdominal obesity, since low HDL-C values are strongly associated with elevated waist circumference (van Dijk et al., 2012). The prevalence of low HDL-C concentrations in Inuit living in Nunavut and Nunatsiavut in the IHS 2007-2008 was 17% and 24%, respectively (Egeland, 2010a, 2010b).

The prevalence of high LDL-C concentrations did not change significantly between 2004 and 2017 (20% vs. 17%) and was similar in men and women in 2017. According to data from the IHS 2007-2008, the prevalence of elevated LDL-C concentrations in both Nunavut and Nunatsiavut was 24% (Egeland, 2010a, 2010b).

In contrast to other blood lipids, triglycerides are significantly affected by fasting status. Therefore, it was not possible to compare prevalences of high triglyceride concentrations in Nunavimmiut between 2004 and 2017, as triglycerides were measured in both fasting and non-fasting respondents in 2017, whereas all participants were fasting in 2004. The prevalence of elevated triglyceride concentrations among fasting participants in 2017 (a non-representative sub-sample of the Nunavik population) was 21%. The prevalence of elevated fasting triglycerides in the IHS 2007-2008 was 25% (Egeland et al., 2011). Unexpectedly, despite a twofold higher prevalence of high waist circumference in women compared to men in the IHS 2007-2008, the prevalence of hypertriglyceridemic-waist phenotype (as defined as high triglyceride values combined with high waist circumference) was similar in both sexes (Egeland et al., 2011).

BURDEN OF TYPE 2 DIABETES AND PREDIABETES

The crude prevalence of type 2 diabetes among Nunavimmiut in 2017, based on blood measurements or the use of antidiabetic drugs, was 4.8%. A similar prevalence had been estimated in the 2004 survey based on self-reported diagnosis and blood measurements (4.7%) (Chateau-Degat et al., 2010). The crude prevalence of prediabetic state defined using HbA1c concentrations in 2017 was 4%, similar to the prevalence of impaired fasting glucose noted in 2004 (3%) (Chateau-Degat et al., 2010). On face value, these results suggest that the disease is not progressing in Nunavik. However, these comparisons must be interpreted with caution because the methods used to assess type 2 diabetes and glucose metabolism alterations were different between the two surveys. In particular, HbA1c levels are known to be negatively affected by iron deficiency anemia (Cetinkaya Altuntas et al., 2021), whose prevalence is high in Nunavik, and this could have resulted in an underestimation of the prevalence of type 2 diabetes assessed using this biomarker in 2017 (Lavoie, 2020). Based on diagnosis data for 2017-2018 extracted from the QICDSS, the crude prevalence of diabetes (including both type 1 and type 2 diabetes) in the Nunavik population was 7%, a value slightly greater than that estimated using blood measurements and medication use in the present survey.

A similar prevalence of diabetes was previously reported in the other regions of the Inuit Nunangat. Indeed, in the IHS 2007-2008, 5.1% of the Inuit population in Nunavut, Nunatsiavut and ISR had type 2 diabetes (as defined as fasting plasma glucose ≥ 7 mmol/L, the use of antidiabetic drugs or plasma glucose concentrations at oral glucose tolerance test ≥ 11.1 mmol/L) (Egeland et al., 2011).

Similar to what was observed in 2004 (Dewailly, 2007), women in Nunavik tended to experience type 2 diabetes more frequently than men in 2017 (5.9% and 3.5%, respectively). Results from the IHS 2017-2008 also suggested a greater prevalence of diabetes in women than in men (5.8% vs. 4.5%; not statistically different) (Egeland et al., 2011). In contrast, non-Indigenous Canadian men are more likely to experience type 2 diabetes than women, a reverse trend compared to data from the present survey and those obtained in other Indigenous populations (Dyck et al., 2010; Statistics Canada, 2018). Comparisons between data from *Qanuilirpitaa?* and the age-standardized data for the Canadian population in 2017 revealed a lower prevalence of diabetes in Inuit men compared to non-Inuit Canadian men (6% vs. 9%) and a higher prevalence among Inuit women compared to non-Inuit Canadian women (9% vs. 7%) (Statistics Canada, 2017a). It should be noted that the data mentioned above for non-Inuit Canadians concern all types of diabetes and include 90% of type 2 diabetes, 9% of type 1 diabetes and 1% of other types of diabetes (Statistics Canada, 2018).

The etiology of type 2 diabetes could also be dependent on genetic predispositions. Recessive genetic models among the Inuit of Greenland with type 2 diabetes have shown that physiological mechanisms of the development of type 2 diabetes are related to body composition, fat distribution and insulin metabolism among carriers of *LARGE1* rs16993330, but not *ITGA1* rs870992, (Grarup et al., 2018). Investigators were not able to replicate their observations in other populations, suggesting that the genetic baggage of the Inuit of Greenland is unique (Grarup et al., 2018). Genome sequencing among a sample of Nunavik Inuit and Alaskan Inuit populations has shown that a mutation in *TBC1D4* is present in 27% of this population (Manousaki et al., 2016). Even if the association between Nunavimmiut genetics and the development of cardiometabolic diseases has been challenged in recent years (Chateau-Degat et al., 2010; Ronn et al., 2017), these observations suggest that genetics may influence the physiopathology of type 2 diabetes among Inuit populations to some extent. *TBC1D4* carriers with type 2 diabetes have an increased risk of underdiagnosis (odds ratio of 5.4 [2.5 to 12]) compared to non-carriers unless an oral glucose tolerance test is performed (Manousaki et al., 2016). Therefore, the mutation in *TBC1D4* may have resulted in an underdiagnosis of type 2 diabetes in the Nunavik population in 2017, since diabetes status was

assessed using glycemia and HbA1c rather than an oral glucose tolerance test, which is the gold standard for the diagnosis of diabetes (Phillips, 2012).

There are very few data regarding the burden of prediabetic state among other populations of the Inuit Nunangat. Data from the IHS 2007-2008 indicated a prevalence of glucose intolerance of 19% in men and 17% in women (Sefidbakht et al., 2016). A cross-sectional study conducted between 2005 and 2010 among the Inuit of Greenland reported a prevalence of impaired fasting glucose of 19% and an impaired glucose tolerance of 9% (Jorgensen et al., 2013), which was higher than the estimated prevalence of prediabetes among Nunavimmiut in 2017 (4%). Methods to assess the presence of altered glucose metabolism (i.e., impaired fasting glucose, impaired glucose tolerance, prediabetic state) vary across studies and display low reproducibility when only one test is used, which precludes meaningful comparisons across studies. Although the causality has not been investigated here and the prevalence of type 2 diabetes was low, Nunavimmiut with type 2 diabetes tended to cumulate other major cardiovascular risk factors, including high waist circumference, high waist-to-height ratio, high visceral fat area, low HDL-C and high triglyceride concentrations, compared to those who did not have type 2 diabetes in 2017. The Nunavik population is young and, not surprisingly, the prevalence of type 2 diabetes and prediabetes was associated with age. However, young Inuit who present risk factors for type 2 diabetes, including elevated HbA1c, obesity and elevated blood pressure are at risk of developing cardiovascular diseases later in life. Furthermore, when prevalence values based on QICDSS data are age-standardized to reflect the younger age of the Nunavik population compared to that of the province of Quebec as a whole, the prevalence of diabetes (type 1 and 2) in the Nunavik population has exceeded that of the Quebecers since 2014-2015.

BURDEN OF ALTERED HEPATIC HEALTH

The prevalence of increased liver enzymes concentrations (indicative of liver damage) was very low among Nunavimmiut in 2017, while the prevalence of hepatic fibrosis and steatosis was around 3%. No other epidemiological data are currently available on the prevalence of non-alcoholic fatty liver disease in Inuit populations and this topic was not covered in previous Nunavik health surveys.

With regard to other Indigenous populations in Canada, only one small retrospective, single-centred, non-population-based study has documented the prevalence, severity and natural history of non-alcoholic fatty liver disease and non-alcoholic steatohepatitis in First Nations and non-First Nations patients living in Manitoba (Uhanova et al., 2016). Results from liver imaging and biopsies indicated similar severity and progression of liver disease in First Nations and non-First Nations patients. Thus, despite an increase in the prevalence of diabetes and obesity in Canadian First Nation populations, the prevalence of non-alcoholic fatty liver disease does not appear to be increasing in these populations. Alcohol consumption is known to increase GGT concentrations (Miller & Anton, 2004). We did not consider alcohol consumption in our GGT concentrations assessment and this may have led to an overestimation of hepatic steatosis using the fatty liver index. The prevalence of hepatic steatosis was nonetheless very low among the Inuit of Nunavik population in 2017.

Risk factors for non-alcoholic fatty liver disease include insulin resistance, fasting hyperglycemia, type 2 diabetes, dyslipidemia, elevated blood pressure, and central obesity (Calzadilla Bertot & Adams, 2016; Iqbal et al., 2019). Not surprisingly, Nunavimmiut with type 2 diabetes or elevated blood pressure were more likely to experience altered hepatic health as defined by hepatic health markers (data not shown, estimates were too unstable). Because concentrations of hepatic enzymes and scores may underestimate the prevalence of non-alcoholic fatty liver disease (National Guideline Centre (UK), 2016), we cannot exclude the possibility of an underestimation of altered hepatic health. In addition, the FLI presents variable performance across ethnic groups (Le et al., 2019). However, the prevalence of almost all risk factors increases over time, and thus there is a need to monitor the hepatic health of Nunavimmiut in future health surveys.

BURDEN OF ALTERED RENAL HEALTH

Kidney health among the Inuit of Nunavik was investigated for the first time in the *Qanuilirpitaa?* 2017 survey. The results indicate that the prevalence of altered renal health markers was very low among Nunavimmiut.

Modifiable and treatable risk factors (e.g., diabetes, hypertension, and dyslipidemia) have been associated with high prevalence of chronic kidney disease among First Nations populations in Canada (Dyck et al., 2012). Taking into consideration the high prevalence of a number of chronic kidney disease risk factors in the Inuit of Nunavik population, screening and appropriate management to avoid complications is very important.

SOCIOENVIRONMENTAL DETERMINANTS OF CARDIOMETABOLIC HEALTH

Because the analysis of determinants was conducted using bivariate analyses, some of the associations between determinants and cardiometabolic risk factors and diseases could be explained by confounding factors. Results regarding lifestyle, behaviours and habits are very likely to be confounded by age and sex. For example, sex differences regarding the association between socioeconomic status and elevated blood pressure have already been reported (Riva et al., 2016).

In the present survey, type 2 diabetes, elevated blood pressure and waist circumference tended to be more prevalent in Ungava coast communities than in the Hudson Strait and Hudson Bay regions. The objective of this report was to provide an overview of cardiometabolic health determinants. Future analyses will investigate these determinants in different ecological regions. Nunavimmiut with cardiometabolic alterations (i.e., type 2 diabetes, prediabetic state, elevated blood pressure, high waist circumference and abnormal blood lipids) were most likely to live alone, have a personal income higher than $20 000 per year, have enough money to meet their needs, and be more food secure, and were less likely to consume alcohol, smoke daily or live in a crowded house. Similarly, in the IHS 2007-2008 (excluding Nunavik), higher socioeconomic status was associated with increased odds of obesity (Zienczuk & Egeland, 2012), and elevated waist circumference was more prevalent among Inuit who were more food secure (Huet et al., 2012). According to data from the IHS 2007-2008, higher education, employment, personal income and private housing were also positively associated with obesity in regression models adjusted for age, gender and region (Zienczuk & Egeland, 2012). On the other hand, Inuktitut as a primary language spoken at home was inversely associated with obesity (Zienczuk & Egeland, 2012). As discussed by Zienczuk and Egeland (Zienczuk & Egeland, 2012), a positive association between socioeconomic status (e.g., personal income, food security) and waist circumference may be attributable to the ability of those with high socioeconomic status to afford energy-dense food from the market. However, access to traditional foods is also dependent on socioeconomic status since hunting equipment, ammunition, gasoline and snowmobile acquisition remain expensive. Riva et al. reported an inverse U-shaped association between socioeconomic conditions and blood pressure, with lower blood pressure being observed in remote traditional villages with lower household income and in more urbanized towns with higher income (Riva et al., 2016). These observations suggest the presence of complex inter-relationships between individual and community factors and cardiometabolic health. The impact of modernization and globalization on health seems also to be dependent on the society's stage of socioeconomic development (Monteiro et al., 2004).

In the 2017 survey, Nunavimmiut with cardiometabolic health alterations were most likely to rate their health as fair or poor, but they reported participating in traditional activities more often compared to those without cardiometabolic alterations. The association between cardiometabolic health alterations and self-perceived quality of life indicators (i.e., life satisfaction, ability to get around and energy to complete everyday life activities) was not clear. These observations are somewhat surprising since Inuit in Canada tend to attribute the loss of traditional culture and activities to poor health (Richmond & Ross, 2009). Additional contextual factors need to be considered using multivariate models to better understand the impact of the adherence to Inuit culture and traditions on health in the 2017 survey (Daniel et al., 2011). Similarly, the findings for nutritional biomarkers and environmental contaminants were contradictory with respect to cardiometabolic diseases and risk factors, and more in-depth multivariate analyses are needed to further investigate the role of country food nutrients and environmental contaminants on these health outcomes.

Inconsistent associations between smoking status and cardiometabolic risk factors in the present report have already been reported in the literature among other Indigenous populations. Smoking status was not associated with blood pressure among the Inuit of Nunavik in 1992 (Bjerregaard et al., 2003) nor with intima-media thickness (an indicator of atherosclerosis progression) in *Qanuippitaa?* 2004 (Noel et al., 2012). Higher blood pressure was observed in non-smokers compared to smokers among Inuit living in Denmark while blood pressure was higher among former smokers compared to current smokers (Bjerregaard et al., 2002). The complex association between smoking status and health among Nunavimmiut is still misunderstood and further research is needed.

LIMITATIONS

The results of the 2017 survey must be interpreted in the context of certain limitations. Even if some questions were identical to those in the previous 2004 survey, a number of methodological aspects were different, limiting comparisons over time. Further investigations with a uniform questionnaire and clinical protocol are needed to understand whether the difference between the prevalence of cardiometabolic diseases observed in this population over time is real or due to differences in methodologies.

Some determinants such as smoking, participating in hunting and harvesting activities within the last year, alcohol consumption, gambling and going on the land were highly prevalent (> 70-80%) and had low variability among the population, which may also have led to an underestimation of associations with the prevalence of cardiometabolic diseases and risk factors. Some of the associations between determinants and cardiometabolic risk factors and diseases could also be explained by differences in age, sex, smoking status or other confounding factors. Omega-3 polyunsaturated fatty acids in red blood cells, blood selenium and mercury levels are often correlated since they are all associated with country food consumption. Confounding will be addressed by subsequently conducting multivariate analyses and publishing the results in peer-reviewed journals.

Triglycerides were measured among fasting and non-fasting Nunavimmiut in 2017, compared to fasting Nunavimmiut alone in 2004. Even if non-fasting state had little or no impact on cholesterol concentrations, non-fasting triglycerides were approximately 20% higher than fasting triglycerides, which may also have had an indirect influence on the LDL-C calculation (with an overestimation of 10 mg/dL or more when using the Friedewald equation) (Rahman et al., 2018). These methodological variations may have led to a slight overestimation of LDL-C (and of high LDL-C prevalence) and an overestimation of triglyceride concentrations in 2017. Indeed, in the present survey, the prevalence of high triglyceride concentrations was higher in the non-fasting sample (36%) than in the fasting one (21%).

The manual method frequently shows higher blood pressure than the automated one (Andreadis et al., 2018; Ezzatzadegan Jahromi et al., 2019; Filipovsky et al., 2018; Filipovsky et al., 2016; Mirdamadi & Etebari, 2017). Blood pressure was taken manually in 2004 and with a digital blood pressure monitor in 2017, which may have underestimated the difference observed between the estimates in 2004 and 2017.

Regarding data from the QICDSS, comparisons should also be interpreted with caution since physicians in Nunavik are not necessarily remunerated on a fee-for-service basis, which may lead to an underestimation of prevalence or a delay in case identification compared to the rest of the province of Quebec. This is why information obtained from the QICDSS is not usually presented for Nunavik. Since QICDSS prevalences are obtained from health administrative databases designed to meet administrative needs, each disease presented here has a validated case definition with its respective limits. For example, diabetes presented a sensitivity of 86% and a positive predictive value of 80% in a validation study from Ontario (Hux et al., 2002). Additionally, the provincial fee-for-service medical services billing system was modernized in 2016, leading to a possible slight underestimation of prevalence. Therefore, data for 2016 and subsequent years should be interpreted with caution. Finally, only health care services users and people who received a diagnosis have been included, thus leading to an underestimation of the actual prevalence of diseases.

Finally, because of the small size of the Inuit of Nunavik population, estimated prevalence and estimates may be variable. Nevertheless, these estimates are essential to complete the general portrait of cardiometabolic disease burden among Nunavimmiut.

CONCLUSIONS

Overall, data from the present survey and from the Quebec Integrated Chronic Disease Surveillance System suggest that diabetes, cardiovascular diseases, elevated blood pressure, particularly in men, and waist circumference in women are becoming a growing health challenge in Nunavik. Different trends in the progression of cardiovascular risk factors were observed between men and women over time. While women tended to cumulate cardiovascular risk factors to a greater extent than men in 2004, we observed a more substantial increase in elevated blood pressure among men along with a marked increase in central obesity among women in 2017. In general, cardiometabolic diseases and risk factors were more prevalent in Ungava coast communities than in the other regions and among older Nunavimmiut. The elevated prevalence of hypertension in young Nunavimmiut men is especially worrisomeand clearly deserves attention from public health authorities and clinical practitioners. More sophisticated analyses will be conducted to better understand the associations between sex, socioenvironmental characteristics, nutritional status, environmental contaminant exposures and cardiometabolic outcomes.

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APPENDIX

Table A Food frequency questionnaire categories, Nunavik, 2017

Category	Foods included
Marine animals	Dried beluga meat (*nikku*), beluga meat, beluga blubber (*misirak/ursuk*), beluga skin and blubber (*mattaaq*), seal meat, seal blubber (*misirak/ursuk*), seal liver, walrus meat (*igunak*).
Fish and seafood	Dried fish (*nikku, pitsik*), lake trout, brook trout, sea trout, salmon, arctic char, pike, walleye, lake whitefish, sculpin, mollusks (mussels, clams, scallops), urchins, seaweed.
Wild berries	Cloudberries, blackberries, blueberries, redberries.
Total fruits	Fresh or frozen fruits (orange, banana, apple, pear, store-bought berries, etc.), canned fruits, applesauce/fruit puree.
Total vegetables	Green vegetables, leafy vegetables, carrots, broccoli, cauliflower, cabbage, tomatoes, tomato juice, pepper, onions, corn, cucumber, celery, mushrooms, potatoes (fresh, frozen and canned).
Processed meat	Sliced or processed meat (ham, salami, bologna), sausage, hot dogs, bacon, beef jerky.
Red meat	Hamburger, beef, pork.
Sugary beverages	Regular soft drinks, energy drinks, fruit juices, fruit cocktails, sport drinks, powdered drinks.
Salty snacks, fast food	Pizza, bowl noodle soup, French fries, poutine, potato chips, corn tortillas chips, popcorn, crackers.
Sweets and ice cream	Cookies, cakes, muffins, chocolate, candy bars, candies, chocolate spread, jam, ice cream

All foods were reported as a frequency of consumption per week over the last three months.

Table B Geometric means of markers of hepatic health among adults aged 18 years and over, Nunavik, 2017

	Total		Men		Women	
	Geometric mean	95% CI	Geometric mean	95% CI	Geometric mean	95% CI
Alanine aminotransferase (ALT) (U/L)	10.51	10.12 to 11.00	11.13	10.41 to 11.95	9.91	9.49 to 10.35
Aspartate aminotransferase (AST) (U/L)	20.06	19.59 to 20.57	21.35	20.57 to 22.34	18.82	18.29 to 19.30
Gamma-glutamyl transferase (GGT) (UI/L)	24.78	23.78 to 26.04	26.96	25.09 to 29.36	22.75	21.69 to 24.05

95% CI: 95% confidence interval.

Table C Geometric means of markers of renal health among adults aged 18 years and over, Nunavik, 2017

	Total		Men		Women	
	Geometric mean	95% CI	Geometric mean	95% CI	Geometric mean	95% CI
Serum creatinine (µmol/L)	70.77	69.95 to 71.57	82.47	81.15 to 83.89	60.58	59.72 to 61.46
Albumin/creatinine (ACR)	1.04	0.97 to 1.10	0.89	0.81 to 0.98	1.21	1.12 to 1.32
Glomerular filtration rate (GFR) (ml/min/1.73 m^2)	101.46	100.48 to 102.41	98.77	97.18 to 100.28	104.26	02.93 to 105.61

95% CI: 95% confidence interval.

Table D Comparison of age-adjusted prevalences of cardiovascular risk factors between 2004 and 2017, among adults aged 18 years and over and stratified by sex, Nunavik

	Total				Men				Women			
	2004	95% CI	2017	95% CI	2004	95%CI	2017	95%CI	2004	95%CI	2017	95%CI
Elevated blood pressure	16.9	14.4 to 19.7	22.5	19.8 to 25.5	19.3	15.9 to 23.3	28.2	23.6 to 33.3	14.3	11.4 to 17.9	16.8	14.2 to 19.7
Elevated waist circumference	36.2	33.2 to 39.3	44.8	41.6 to 47.9	20.4	16.7 to 24.7	26.4	21.7 to 31.6	53.8	49.3 to 58.1	63.4	59.4 to 67.2
High waist-to-height ratio	75.5	72.7 to 78.1	72.3	69.2 to 75.0	68.2	64.0 to 72.1	60.4	55.3 to 65.4	83.7	80.2 to 86.8	84.0	81.1 to 86.5
High LDL-C concentrations	19.8	17.3 to 22.6	17.3	14.9 to 20.0	23.1	19.6 to 27.1	17.5	13.6 to 22.2	16.4	13.4 to 19.8	17.2	14.5 to 20.2
Low HDL-C concentrations	11.2	9.3 to 13.4	22.2	19.5 to 25.1	9.4	7.0 to 12.6	16.4	12.6 to 21.2	13.2	10.5 to 16.5	27.8	24.5 to 31.4

Prevalences are presented as age-adjusted estimates to allow comparison. A respondent was considered to have elevated blood pressure according to clinical tests (i.e., a systolic blood pressure ≥ 140 mm Hg or a diastolic blood pressure ≥ 90 mm Hg) or according to the use of hypotensive drugs as reported in medical files. Cut-off values for elevated waist circumference were > 102 cm in men and > 88 cm in women. The cut-off value for high waist-to-height ratio was > 0.5. Low-density lipoprotein cholesterol (LDL-C) concentrations ≥ 3.5 mmol/L were considered high, while high-density lipoprotein cholesterol (HDL-C) concentrations <1.03 mmol/L in men and <1.30 mmol/L in women were considered low. Values in coloured cells are statistically different according to a Wald statistic with age-adjusted prevalences (p-value < 0.05).

Table E Geometric means of blood lipid concentrations among adults aged 18 years and over, according to sex, Nunavik, 2017

	Total		Men		Women	
	Geometric mean	95% CI	Geometric mean	95% CI	Geometric mean	95% CI
Total cholesterol (mmol/L)	4.84	4.78 to 4.91	4.73	4.60 to 4.86	4.96	4.90 to 5.04
LDL-C (mmol/L)	2.55	2.50 to 2.62	2.50	2.40 to 2.61	2.60	2.55 to 2.67
HDL-C (mmol/L)	1.46	1.43 to 1.49	1.37	1.33 to 1.42	1.56	1.53 to 1.59
Non-HDL-C (mmol/L)	3.26	3.20 to 3.34	3.23	3.12 to 3.36	3.29	3.22 to 3.36
Apolipoprotein B (g/L)	0.88	0.87 to 0.90	0.89	0.86 to 0.92	0.89	0.86 to 0.89
Triglycerides (mmol/L)	1.31	1.27 to 1.37	1.34	1.25 to 1.44	1.29	1.24 to 1.34

95% CI: 95% confidence interval; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol.

Table F Prevalence ratio of sociodemographic determinants of cardiometabolic health, Nunavik, 2017

	Type 2 diabetes	Prediabetes	Elevated blood pressure	High waist circumference	High CV risk index
Matrimonial status					
Married, common law	0.69* (0.47 to 1.00)	0.58 * (0.36 to 0.95)	0.86 (0.72 to 1.04)	0.73 (0.63 to 0.86)	0.63 (0.50 to 0.81)
Single, separated, divorced, widowed	1.24 (1.05 to 1.48)	1.33 (1.12 to 1.58)	1.11 (0.98 to 1.27)	1.26 (1.12 to 1.42)	1.33 (1.17 to 1.51)
Employment					
Not employed	0.89 (0.75 to 1.06)	1.01 (0.89 to 1.16)	0.97 (0.90 to 1.05)	1.03 (0.97 to 1.09)	1.02 (0.95 to 1.09)
Employed	1.58* (0.92 to 2.74)	0.93** (0.34 to 2.50)	1.15* (0.79 to 1.68)	0.85 (0.63 to 1.16)	0.91* (0.61 to 1.36)
Unpaid work					
Yes	1.12 (0.84 to 1.50)	1.06** (0.74 to 1.54)	1.03 (0.85 to 1.24)	1.06 (0.90 to 1.25)	1.06 (0.89 to 1.27)
No	0.91 (0.71 to 1.18)	0.95 (0.71 to 1.28)	0.98 (0.85 to 1.13)	0.96 (0.85 to 1.08)	0.95 (0.83 to 1.09)
Personal income					
Less than $20 000	0.47** (0.27 to 0.79)	0.61* (0.38 to 1.00)	0.77 (0.63 to 0.94)	0.64 (0.55 to 0.74)	0.68 (0.55 to 0.84)
$20 000 or more	1.55 (1.30 to 1.86)	1.41 (1.12 to 1.78)	1.25 (1.08 to 1.44)	1.51 (1.31 to 1.73)	1.37 (1.18 to 1.59)
Enough money to meet needs					
Not at all or a little or moderately	0.74 (0.57 to 0.96)	0.88 (0.70 to 1.11)	0.95 (0.85 to 1.06)	0.80 (0.74 to 0.87)	0.92 (0.82 to 1.03)
Mostly or completely	1.63 (1.20 to 2.20)	1.29 (0.86 to 1.93)	1.12 (0.89 to 1.41)	1.63 (1.33 to 1.98)	1.21 (0.96 to 1.51)
Education					
Secondary school or higher	0.99** (0.49 to 2.00)	2.33** (1.12 to 4.82)	1.46* (0.98 to 2.17)	0.72 (0.48 to 1.07)	0.94* (0.57 to 1.55)
Secondary school not completed	0.90 (0.68 to 1.18)	0.81* (0.58 to 1.13)	0.81 (0.70 to 0.95)	0.81 (0.72 to 0.91)	0.74 (0.63 to 0.87)
Elementary school or less	1.19* (0.81 to 1.75)	0.96* (0.57 to 1.61)	1.24 (0.99 to 1.55)	1.64 (1.34 to 2.01)	1.61 (1.31 to 1.96)

Values are prevalence ratios (and their 95% CI), calculated as the prevalence of a risk factor among Nunavimmiut with a given condition (type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference or high cardiovascular risk) divided by the prevalence among those without the condition.
CV risk index: cardiovascular risk assessment index based on an abnormal blood lipid profile. High cardiovascular risk assessment index was defined as LDL-C ≥ 3.5 mmol/L, non-HDL-C ≥ 4.2 mmol/L or apo B ≥ 1.2 g/L.
Values in coloured cells indicate a statistical difference (p-value < 0.05) in the prevalence of risk factors among Nunavimmiut with and without type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference and high cardiovascular risk according to the construction of a Wald statistic based on the difference between the logit transformations of the estimated proportions.
Employment status was defined as having participated or not in paid work over the past 12 months (e.g., job or self-employment).
Unpaid work was defined as having participated or not in unpaid work over the past 12 months (e.g., childcare, volunteer).
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Table G Prevalence ratio of home-environment factors as determinants of cardiometabolic health, Nunavik, 2017

	Type 2 diabetes	Prediabetes	Elevated blood pressure	High waist circumference	High CV risk index
Food security					
Food secure	1.78 (1.39 to 2.27)	1.75 (1.32 to 2.31)	1.23 (1.01 to 1.51)	1.80 (1.48 to 2.20)	1.36 (1.11 to 1.66)
Moderate food insecurity	NP	0.53* (0.34 to 0.85)	0.91 (0.76 to 1.09)	0.83 (0.72 to 0.96)	0.88 (0.73 to 1.06)
Severe food insecurity	NP	0.94** (0.42 to 2.08)	0.82* (0.56 to 1.19)	0.49 (0.36 to 0.67)	0.71* (0.49 to 1.01)
House crowding (PPR)					
> 1 person per room	1.17* (0.78 to 1.75)	0.30** (0.12 to 0.73)	0.74 (0.56 to 0.99)	0.79 (0.64 to 0.97)	0.86 (0.67 to 1.11)
1 person or less	0.92 (0.74 to 1.15)	1.33 (1.21 to 1.46)	1.13 (1.02 to 1.26)	1.12 (1.01 to 1.23)	1.07 (0.96 to 1.19)
House in need of repairs					
In need of major repairs	1.00 (0.88 to 1.14)	1.06 (0.93 to 1.20)	1.03 (0.96 to 1.11)	1.07 (1.00 to 1.14)	1.04 (0.97 to 1.11)
In need of minor repairs or regular maintenance	1.00** (0.56 to 1.79)	0.77** (0.34 to 1.73)	0.87* (0.62 to 1.23)	0.75 (0.57 to 0.98)	0.85 (0.61 to 1.19)

Values are prevalence ratios (and their 95% CI), calculated as the prevalence of a risk factor among Nunavimmiut with a given condition (type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference or high cardiovascular risk) divided by the prevalence among those without the condition.
CV risk index: cardiovascular risk assessment index based on an abnormal blood lipid profile. High cardiovascular risk assessment index was defined as LDL-C ≥ 3.5 mmol/L, non-HDL-C ≥ 4.2 mmol/L or apo B ≥ 1.2 g/L.Values in coloured cells indicate a statistical difference (p-value < 0.05) in the prevalence of risk factors among Nunavimmiut with and without type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference and high cardiovascular risk according to the construction of a Wald statistic based on the difference between the logit transformations of the estimated proportions.
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Table H Prevalence ratio of self-perceived health factors as determinants of cardiometabolic health, Nunavik, 2017

	Type 2 diabetes	Prediabetes	Elevated blood pressure	High waist circumference	High CV risk index
Life satisfaction					
Very satisfied or satisfied	1.09 (0.99 to 1.20)	1.07 (0.97 to 1.18)	1.08 (1.02 to 1.14)	1.00 (0.94 to 1.06)	1.05 (0.99 to 1.11)
Not satisfied	0.59** (0.26 to 1.34)	0.69** (0.32 to 1.50)	0.68* (0.48 to 0.95)	1.02 (0.77 to 1.35)	0.79 (0.57 to 1.09)
Self-rated health					
Excellent, very good or good	0.81 (0.64 to 1.03)	0.78 (0.60 to 1.01)	0.89 (0.80 to 1.00)	0.86 (0.79 to 0.94)	0.96 (0.86 to 1.07)
Fair or poor	1.47* (1.04 to 2.09)	1.58* (1.11 to 2.24)	1.28 (1.03 to 1.60)	1.40 (1.14 to 1.72)	1.10 (0.85 to 1.41)
Ability to get around					
Very well or well	0.85 (0.73 to 1.00)	0.95 (0.83 to 1.09)	0.96 (0.89 to 1.03)	0.95 (0.90 to 1.00)	0.96 (0.90 to 1.03)
Not well	2.07* (1.21 to 3.52)	1.34** (0.58 to 3.12)	1.28* (0.86 to 1.90)	1.41 (0.99 to 2.01)	1.28* (0.82 to 1.99)
Enough energy to complete everyday life activities					
Mostly or completely	1.00* (0.86 to 1.16)	0.96** (0.80 to 1.16)	1.01 (0.93 to 1.09)	0.96 (0.90 to 1.03)	1.02 (0.93 to 1.11)
Not at all or a little or moderately	1.00 (0.63 to 1.58)	1.13 (0.65 to 1.97)	0.98 (0.74 to 1.29)	1.13 (0.90 to 1.41)	0.95 (0.71 to 1.27)

Values are prevalence ratios (and their 95% CI), calculated as the prevalence of a risk factor among Nunavimmiut with a given condition (type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference or high cardiovascular risk) divided by the prevalence among those without the condition.

CV risk index: cardiovascular risk assessment index based on an abnormal blood lipid profile. High cardiovascular risk assessment index was defined as LDL-C ≥ 3.5 mmol/L, non-HDL-C ≥ 4.2 mmol/L or apo B ≥ 1.2 g/L. Values in coloured cells indicate a statistical difference (p-value < 0.05) in the prevalence of risk factors among Nunavimmiut with and without type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference and high cardiovascular risk according to the construction of a Wald statistic based on the difference between the logit transformations of the estimated proportions.

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Table I Prevalence ratio of lifestyle factors as determinants of cardiometabolic health, Nunavik, 2017

	Type 2 diabetes	Prediabetes	Elevated blood pressure	High waist circumference	High CV risk index
Alcohol consumption					
Yes	0.76 (0.62 to 0.94)	0.80 (0.65 to 0.98)	0.98 (0.91 to 1.05)	0.90 (0.85 to 0.96)	0.93 (0.87 to 1.01)
No	2.32* (1.55 to 3.46)	2.17* (1.35 to 3.48)	1.11 (0.82 to 1.52)	1.64 (1.23 to 2.19)	1.38 (1.00 to 1.90)
Binge drinking					
≥ 1 time/month	0.68* (0.49 to 0.96)	0.69* (0.49 to 0.99)	1.02 (0.90 to 1.16)	0.90 (0.81 to 1.01)	0.97 (0.85 to 1.10)
< 1 time/month	1.51 (1.16 to 1.98)	1.52 (1.14 to 2.02)	0.97 (0.80 to 1.18)	1.17 (0.99 to 1.38)	1.05 (0.86 to 1.28)
Smoking					
Daily or occasional	0.75 (0.61 to 0.93)	0.73 (0.56 to 0.95)	0.88 (0.81 to 0.96)	0.82 (0.77 to 0.88)	0.87 (0.79 to 0.97)
Former established or abstainer	1.97* (1.38 to 2.80)	2.12* (1.38 to 3.25)	1.51 (1.17 to 1.95)	2.11 (1.59 to 2.80)	1.55 (1.16 to 2.06)
Spirituality					
Important	1.04 (0.92 to 1.18)	NP	1.02 (0.94 to 1.10)	1.03 (0.97 to 1.10)	1.05 (0.97 to 1.14)
Not important	0.79** (0.33 to 1.91)	NP	0.92* (0.62 to 1.37)	0.87 (0.64 to 1.18)	0.77* (0.48 to 1.24)
Going on the land					
Never	0.53** (0.22 to 1.29)	NP	1.13* (0.77 to 1.61)	0.56 (0.40 to 0.80)	0.57* (0.35 to 0.93)
Occasionally	1.25 (0.96 to 1.63)	NP	0.97 (0.81 to 1.16)	1.05 (0.89 to 1.23)	0.95 (0.78 to 1.13)
Often	0.90* (0.63 to 1.27)	1.50 (1.18 to 1.90)	0.99 (0.83 to 1.19)	1.12 (0.96 to 1.32)	1.20 (1.01 to 1.43)
Participation in harvesting or traditional activities					
Yes	1.05 (0.99 to 1.11)	NP	0.96 (0.91 to 1.02)	1.07 (1.03 to 1.12)	1.06 (1.02 to 1.11)
No	0.58** (0.21 to 1.61)	NP	1.33* (0.88 to 2.02)	0.52* (0.35 to 0.78)	0.51* (0.29 to 0.88)
Hunting frequency					
1 to 3 times a month or more	0.99 (0.81 to 1.22)	1.10 (0.90 to 1.33)	0.99 (0.89 to 1.11)	0.99 (0.90 to 1.10)	1.11 (1.00 to 1.24)
Never or less than once a month	1.02* (0.71 to 1.46)	0.82* (0.51 to 1.33)	1.01 (0.82 to 1.24)	1.01 (0.84 to 1.21)	0.81 (0.64 to 1.02)

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Values in coloured cells indicate a statistical difference (p-value < 0.05) in the prevalence of risk factors among Nunavimmiut with and without type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference and high cardiovascular risk according to the construction of a Wald statistic based on the difference between the logit transformations of the estimated proportions.
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Table J Prevalence ratio of dietary intakes as determinants of cardiometabolic health, Nunavik, 2017

	Type 2 diabetes	Prediabetes	Elevated blood pressure	High waist circumference	High CV risk index
Marine mammals					
Under median	1.05 (0.81 to 1.38)	0.56** (0.32 to 1.01)	1.14 (0.98 to 1.32)	1.21 (1.06 to 1.38)	1.02 (0.87 to 1.20)
Median or higher	0.94 (0.69 to 1.28)	1.48 (1.16 to 1.89)	0.86 (0.72 to 1.04)	0.81 (0.71 to 0.94)	0.97 (0.82 to 1.16)
Fish and seafood					
Under median	0.86* (0.61 to 1.21)	0.78* (0.50 to 1.22)	0.85 (0.71 to 1.03)	1.17 (1.01 to 1.35)	1.03 (0.86 to 1.22)
Median or higher	1.14 (0.87 to 1.50)	1.23 (0.91 to 1.67)	1.16 (0.99 to 1.36)	0.85 (0.73 to 0.99)	0.97 (0.81 to 1.17)
Wild berries					
Under median	1.19* (0.91 to 1.55)	0.95* (0.65 to 1.40)	1.26 (1.08 to 1.47)	1.06 (0.93 to 1.21)	1.05 (0.88 to 1.24)
Median or higher	0.82 (0.57 to 1.18)	1.05* (0.74 to 1.48)	0.78 (0.64 to 0.95)	0.94 (0.83 to 1.07)	0.95 (0.80 to 1.14)
Fruits					
Under median	1.18 (0.88 to 1.56)	0.97* (0.63 to 1.48)	1.07 (0.91 to 1.27)	0.90 (0.79 to 1.03)	0.98 (0.81 to 1.17)
Median or higher	0.85* (0.61 to 1.17)	1.03* (0.74 to 1.43)	0.94 (0.80 to 1.10)	1.10 (0.97 to 1.24)	1.02 (0.87 to 1.20)
Vegetables (including potatoes)					
Under median	0.83* (0.58 to 1.20)	0.99* (0.65 to 1.50)	1.02 (0.86 to 1.22)	0.72 (0.62 to 0.83)	0.91 (0.75 to 1.10)
Median or higher	1.14 (0.91 to 1.45)	1.01* (0.73 to 1.40)	0.98 (0.83 to 1.15)	1.34 (1.18 to 1.52)	1.08 (0.93 to 1.25)
Processed meat					
Under median	1.61 (1.34 to 1.95)	1.51 (1.17 to 1.95)	1.17 (0.99 to 1.38)	1.17 (1.01 to 1.36)	1.05 (0.88 to 1.25)
Median or higher	0.48* (0.29 to 0.77)	0.58** (0.34 to 1.00)	0.85 (0.71 to 1.02)	0.86 (0.74 to 0.99)	0.96 (0.81 to 1.13)
Red meat					
Under median	1.40 (1.08 to 1.80)	1.23* (0.84 to 1.78)	1.13 (0.94 to 1.36)	0.98 (0.83 to 1.16)	0.99 (0.82 to 1.20)
Median or higher	0.72* (0.52 to 1.00)	0.84* (0.58 to 1.22)	0.91 (0.78 to 1.06)	1.01 (0.90 to 1.15)	1.01 (0.88 to 1.16)
Sugary beverages					
Under median	1.33 (1.08 to 1.65)	1.15* (0.82 to 1.61)	1.29 (1.12 to 1.49)	1.10 (0.96 to 1.27)	1.22 (1.05 to 1.42)
Median or higher	0.68* (0.47 to 0.99)	0.85* (0.56 to 1.31)	0.75 (0.62 to 0.90)	0.90 (0.79 to 1.04)	0.80 (0.67 to 0.96)

	Type 2 diabetes	Prediabetes	Elevated blood pressure	High waist circumference	High CV risk index
Salty snacks and fast food					
Under median	1.32 (1.05 to 1.66)	1.50 (1.17 to 1.92)	1.24 (1.07 to 1.44)	1.25 (1.08 to 1.45)	1.16 (1.00 to 1.35)
Median or higher	0.70 (0.48 to 1.03)	0.55** (0.31 to 1.00)	0.79 (0.66 to 0.96)	0.81 (0.70 to 0.93)	0.85 (0.72 to 1.01)
Sweets and ice cream					
Under median	1.04 (0.78 to 1.39)	1.40 (1.09 to 1.79)	1.33 (1.14 to 1.56)	1.06 (0.92 to 1.22)	1.04 (0.89 to 1.22)
Median or higher	0.96 (0.70 to 1.31)	0.63* (0.39 to 1.02)	0.72 (0.58 to 0.89)	0.94 (0.82 to 1.08)	0.96 (0.82 to 1.12)

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Values in coloured cells indicate a statistical difference (p-value < 0.05) in the prevalence of risk factors among Nunavimmiut with and without type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference and high cardiovascular risk according to the construction of a Wald statistic based on the difference between the logit transformations of the estimated proportions.
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Table K Prevalence ratio of omega-3 fatty acids in red blood cells and vitamin D, selenium, lead and mercury concentrations as determinants of cardiometabolic health, Nunavik, 2017

	Type 2 diabetes	Prediabetes	Elevated blood pressure	High waist circumference	High CV risk index
Long-chain omega-3 fatty acids in erythrocytesa					
< median	0.63 (0.40 to 0.99)	0.54 (0.29 to 1.01)	0.62 (0.49 to 0.78)	0.76 (0.66 to 0.88)	0.72 (0.59 to 0.87)
≥ median	1.24 (1.11 to 1.62)	1.43 (1.17 to 1.76)	1.40 (1.23 to 1.60)	1.27 (1.11 to 1.45)	1.29 (1.14 to 1.45)
Vitamin D					
< 50 nmol/L	0.47** (0.22 to 1.03)	NP	0.67 (0.49 to 0.91)	0.74 (0.61 to 0.91)	0.71 (0.54 to 0.94)
≥ 50 nmol/L	1.24 (1.10 to 1.41)	NP	1.17 (1.06 to 1.29)	1.13 (1.04 to 1.24)	1.14 (1.04 to 1.25)
Selenium					
< 2.0 umol/L	NP	NP	0.79** (0.36 to 1.70)	0.53* (0.48 to 1.63)	NP
2.0 umol/L ≤ and ≤ 3.0 umol/L	NP	NP	1.02 (0.81 to 1.28)	0.61 (0.50 to 0.75)	NP
> 3.0 umol/L	1.18 (0.99 to 1.40)	1.40 (1.19 to 1.65)	1.01 (0.88 to 1.15)	1.38 (1.22 to 1.56)	1.29 (1.15 to 1.44)
Lead					
< 0.5 umol/L	NP	NP	0.99 (0.95 to 1.02)	0.99 (0.96 to 1.02)	1.01 (0.99 to 1.04)
≥ 0.5 umol/L	NP	NP	1.40** (0.63 to 3.10)	1.29** (0.61 to 2.77)	0.70** (0.30 to 1.65)
Mercury					
< 60 nmol/L	0.77 (0.56 to 1.06)	0.64* (0.42 to 0.98)	1.00 (0.88 to 1.15)	0.88 (0.78 to 0.99)	0.78 (0.67 to 0.91)
≥ 60 nmol/L	1.33 (1.02 to 1.73)	1.53 (1.19 to 1.97)	0.99 (0.82 to 1.21)	1.20 (1.01 to 1.42)	1.36 (1.15 to 1.61)

Values are prevalence ratios (and their 95% CI), calculated as the prevalence of a risk factor among Nunavimmiut with a given condition (type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference or high cardiovascular risk) divided by the prevalence among those without the condition.

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Values in coloured cells indicate a statistical difference (p-value < 0.05) in the prevalence of risk factors among Nunavimmiut with and without type 2 diabetes, prediabetes, elevated blood pressure, high waist circumference and high cardiovascular risk according to the construction of a Wald statistic based on the difference between the logit transformations of the estimated proportions.

[a] Long-chain omega-3 fatty acids in red blood cells (eicosapentaenoic acid, docosapentaenoic acid and docosahexaenoic acid).

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RÉGIE RÉGIONALE DE LA SANTÉ ET DES SERVICES SOCIAUX DU NUNAVIK
NUNAVIK REGIONAL BOARD OF HEALTH AND SOCIAL SERVICES