University of Alberta

Epidemiology and Use of Health Services for Chronic Obstructive Pulmonary Disease among Aboriginal Peoples in Alberta: Insights into Aboriginal Peoples' Respiratory Health

by

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To my loving parents Rosita and Carlos, my brothers Juan Camilo and Carlos Emilio, my nieces Lía, Daniela and Alicia, and my nephew Emilio. You are the beginning and end of all the unconditional love and joy in my life

Abstract

Background: Chronic obstructive pulmonary disease (COPD) is a major respiratory disorder and a leading cause of morbidity and mortality. There is limited information about the burden of disease for COPD among Aboriginal peoples in Canada.

Objectives: To compare the epidemiology and patterns of health services use for COPD between Aboriginal (First Nations peoples, Métis and Inuit) and non-Aboriginal peoples in Alberta, Canada while adjusting for important clinical and sociodemographic factors.

Methods: A systematic review synthesized epidemiological evidence on the prevalence, mortality and health services use for COPD in Aboriginal and non-Aboriginal populations from a variety of settings. Three retrospective cohort studies based on linkage of administrative health databases in Alberta, Canada from April 1, 2002 to March 31, 2010 compared prevalence and incidence rates of COPD between Aboriginal and non-Aboriginal cohorts in the province, and evaluated all-cause mortality, and rates of hospitalizations and emergency department (ED) visits following a diagnosis of COPD. Poisson regression and Cox's proportional hazard models were used in the multivariate analysis.

Results: Limited scientific evidence informed differences in COPD prevalence, mortality and health services use between Aboriginal and non-Aboriginal populations. The retrospective cohort studies found that Aboriginal peoples in Alberta have higher prevalence and incidence rates of

COPD than the non-Aboriginal cohort, with Registered First Nations peoples and Inuit having the highest rates of COPD. Overall, all-cause mortality in Aboriginal peoples did not differ from that of non-Aboriginals up to five years after being diagnosed with COPD. Métis and Inuit with COPD had a lower mortality hazard, whereas no differences in mortality were found between Registered First Nations peoples and non-Aboriginals. Given a diagnosis of COPD, Aboriginal peoples had higher hospitalizations and ED visits rates than non-Aboriginals, with Registered First Nations peoples having the highest utilization rates among the three Aboriginal groups.

Conclusions: While Aboriginal peoples in Alberta have a higher burden of COPD than the non-Aboriginal population, the condition affects the three Aboriginal groups differently. Reasons for these differences should be further explored within a framework of social determinants of health to effectively influence modifiable risk factors in each of the Aboriginal groups.

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Here comes the sun, here comes the sun
And I say it's all right
Little darlin' it's been a long cold lonely winter
Little darlin' it feels like years since it's been here
Here comes the sun, here comes the sun
And I say it's all right
The Beatles, 1969; Abbey Road

This dissertation is a milestone in my academic career. Most importantly, this dissertation and the six years of work and personal sacrifice that I left behind have been one of the most rewarding experiences in my life. I have certainly grown as a researcher, but most importantly, I want to believe that I came out of all this as a better person, which is the real measure of success to me.

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List of Abbreviations

ACCS	Alberta Ambulatory Care Classification System
AECOPD	Acute exacerbations of chronic obstructive pulmonary disease
AH	Alberta Health
AHCIP	Alberta Health Care Insurance Plan
AHS	Alberta Health Services
APS	Aboriginal Peoples Survey
BOLD	Burden of Obstructive Lung Disease
Can$	Canadian dollars
CI	Confidence interval
CIHR	Canadian Institutes of Health Research
CCHS	Canadian Community Health Survey
CHMS	Canadian Health Measures Survey
COLD	Canadian Obstructive Lung Disease
CTS	Canadian Thoracic Society
COPD	Chronic obstructive pulmonary disease
df	Degrees of freedom
DM	Diabetes mellitus
GINA	Global Initiative for Asthma
GOLD	Global Initiative for Chronic Obstructive Lung Disease
ED	Emergency department

List of Abbreviations (continued)

FEV_1	Forced expiratory volume in one second
FNIHB	First Nations and Inuit Health Branch
FVC	Forced vital capacity
HR	Hazard ratio
HREB	Health Research Ethics Board
HTP	Health Transfer Policy
IAPH	Institute of Aboriginal Peoples' Health
ICD	International Classification of Diseases
ICD-9	International Classification of Diseases, Ninth Revision
ICD-10-CA	International Classification of Diseases, Tenth Revision; enhanced Canadian version
ICU	Intensive care unit
IHD	Ischemic heart disease
IRR	Incidence rate ratio
κ	Kappa
LAMA	Leaving against medical advice
LLN	Lower limit of normal values
LOS	Length of stay
LWBS	Left without being seen
mL	Milliliter
MACAR	Morbidity and Ambulatory Care Reporting
MNA	Métis Nation of Alberta

List of Abbreviations (continued)

MNO	Métis Nation of Ontario
NHS	National Household Survey
NOS	Newcastle-Ottawa Scales
PHN	Personal health number
PLATINO	Proyecto LatinoAmericano de Investigación en Obstrucción Pulmonar
POR	Prevalence odd ratio
PRR	Prevalence rate ratio
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RHS	First Nations Regional Longitudinal Health Survey
RR	Risk ratio/ rate ratio
RUSIC	Resource Use Study In COPD
SD	Standard deviation
SES	Socioeconomic status
USA	United States

CHAPTER 1

Introduction

1.1. Dissertation Overview

Chronic obstructive pulmonary disease (COPD) is a major respiratory disorder, recognized as one of the leading causes of morbidity and mortality worldwide.[1] The global burden of COPD has increased over time and is expected to continue to grow in the coming years, reflecting the previous and current smoking habits of an aging population. Over the past decade, there has been considerable progress in our understanding of the epidemiology of COPD and the patterns of health services use for the condition.[1] Comprehensive epidemiological studies assessing COPD among Aboriginal peoples in Canada, however, are scarce. Whenever studies on COPD among Aboriginal peoples in Canada have been conducted, they have failed to address the inherent differences in the burden of COPD that may exist among the three Aboriginal groups in Canada, namely First Nations, Métis and Inuit.

This dissertation presents the results of three retrospective analytical cohort studies based on linkage of provincial administrative health databases from April 1st, 2002 to March 31st, 2010 that analyzed the epidemiology and health services use for COPD among Aboriginal peoples in Alberta (Canada). The primary purpose of this research was to evaluate and compare the prevalence, incidence, mortality, and patterns of health services use (i.e., hospitalizations and emergency department visits) for COPD between Aboriginal and non-Aboriginal peoples in Alberta, while adjusting for important sociodemographic factors. A second objective was to evaluate whether there were differences in the prevalence, incidence, mortality and health services use (i.e., hospitalizations and emergency department visits) for COPD among the three distinct Aboriginal groups in the province (i.e., First Nations peoples, Métis and Inuit) while adjusting for important clinical and sociodemographic factors.

As a background to the study, the reminder of Chapter 1 provides an overview of key concepts related to the definition, epidemiology, risk factors, diagnosis and

treatment for COPD, and how the condition relates to other comorbidities. The chapter continues with a comprehensive description of the characteristics and demographics of Aboriginal peoples of Canada and how they access health services. An examination is provided on what we know about the burden of COPD among Aboriginal peoples in Canada and Alberta, and the social determinants relevant to the study of COPD in this population. Finally, the scope of the dissertation, study rationale and context for the research questions and study hypothesis are stated in detail, and expected contributions from this work are discussed.

Chapter 2 presents the results of a systematic review of the literature that synthesized existing research-based evidence pertaining to the epidemiology and access to health care for COPD among Aboriginal populations compared to non-Aboriginal reference groups in a variety of settings. A full version of this work has been published in the *Canadian Respiratory Journal*,[2] and provided a basis for the current study.

Chapters 3 through 5 are presented in paper format, with each chapter addressing a specific research question. Each chapter has its own introduction, methods, results, and discussion sections. They are written as stand-alone manuscripts with the intent that they will be submitted for publication. Because the same data sources were used for the studies described in Chapters 3 to 5, some overlap exists in the description of study methods and procedures.

In Chapter 3, the period prevalence, and incidence of COPD in a cohort of Aboriginal peoples in Alberta were compared to a non-Aboriginal cohort derived from eight years of data (2002/2003 to 2009/2010) from administrative health databases. The study also assessed whether there were differences in these epidemiologic indicators of COPD burden among the three Aboriginal groups in the province (i.e., Registered First Nations peoples, Inuit and Métis). In Chapter 4, the all-cause mortality rates from 2005/2006 to 2009/2010 in a cohort of Aboriginal peoples with COPD were compared to a cohort of non-Aboriginal individuals with COPD. In Chapter 5, eight years of data (2002/2003 to 2009/2010) regarding hospital admissions and emergency department visits of

Aboriginal and non-Aboriginal populations with COPD in Alberta were described and compared.

Finally, Chapter 6 consists of a general summary of results, discussion and conclusions, in which findings from the four studies are synthesized and discussed in the context of what we know from previously reported research in this field. This chapter also situates the results within a broader framework of social determinants of health that underlie potential inequalities in respiratory health and the services required to address them. Strengths and methodological limitations of the study are discussed and implications of study results for Aboriginal communities, clinicians, policy makers and researchers are outlined.

Study tables and figures are presented at the end of each chapter. A general appendix includes other materials that supported the work presented in this dissertation (e.g., search strategy for the systematic review; letters of ethics approval from the University of Alberta Health Research Ethics Board, letter of support from the Métis Nation of Alberta [MNA], and letters granting permission of copyrighted material included in this dissertation).

The material presented in this dissertation describes research completed during my registration as a PhD candidate at the University of Alberta School of Public Health from September 2007 to September 2013 under the supervision of Dr. Brian H. Rowe and Dr. Don Voaklander. This dissertation and the research to which it refers constitute my original work, with the necessary input from my supervisors and dissertation committee members (Dr. Ambikaipakan Senthilselvan, Dr. Malcolm King, and Dr. Michael Stickland).

As supervisors of the PhD dissertation, Dr. Brian Rowe and Dr. Don Voaklander oversaw all aspects of the project and manuscripts preparation. They both secured funding for this research. Specifically, Dr. Rowe provided substantive expertise in respiratory medicine, methodological input in study design and implementation, and helped secure Canadian Thoracic Society (CTS) graduate student funding. Dr. Voaklander helped to acquire administrative health data from Alberta Health (formerly referred to as Alberta Health and Wellness) and provided special expertise in record linkage from administrative health

records, statistical analysis of retrospective cohort studies, and helped secure Alberta Health funding. Dr. Senthilselvan (committee member) contributed key input on biostatistical issues in the design and analysis of data. Dr. King (committee member) contributed expertise in Aboriginal health research. Dr. Stickland (committee member) provided expertise in COPD pathophysiology, classification and measurement, and provided input into the analytical plan for the manuscripts. All supervisors and dissertation committee members provided critical editorial feedback for the dissertation proposal and for the preparation of the chapters of this dissertation.

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I am responsible for the scientific quality of this work. To the best of my knowledge, this dissertation does not infringe upon anyone's copyright nor violate any proprietary rights. Any ideas, quotations or any other material from the work of other scholars included in this dissertation, published or otherwise, were fully acknowledged in accordance to standard referencing practices. Any omissions or errors are unintentional and will, if brought to my attention, be corrected and publicly acknowledged.

1.2. Definition and Characteristics of Chronic Obstructive Pulmonary Disease

A major respiratory disorder, COPD is characterized by a chronic and persistent limitation of expiratory airflow owing to predominantly fixed airway obstruction. The airway limitation is progressive, not fully reversible in response to pharmacologic agents, and it is associated with airway hyperreactivity and chronic inflammatory reaction of the lungs due to inhalation of noxious particles or gases.[3] Clinical manifestations of COPD include cough, sputum production, dyspnea (shortness of breath), with increasing frequency and severity of symptom exacerbations over time.[3,4]

Chronic airflow limitation in COPD results from structural abnormalities affecting the lung parenchyma. For example, emphysema, the destruction of the alveoli (the grape-like gas-exchanging surfaces of the lung), leads to abnormal airspace enlargement far from the terminal bronchioles.[3,5] As a result of emphysema, there is a significant loss of alveolar surface area, which contributes to peripheral airway collapse and, ultimately, to the presence of non-specific symptoms such as effort dyspnea.[6] Chronic bronchitis, on the other hand, refers to the presence of excessive mucus secretion and recurrent productive cough for at least three months in two consecutive years.[3] Daily cough and sputum production constitute a cardinal feature of COPD. Mucus accumulates in the airway causing narrowing of the lumen that results in airway remodelling, a reduction in airway caliber and thus, airflow obstruction. Chronic bronchitis is an important component of the characteristics of airway disease that is difficult to recognize without measurement.[7] COPD requires a functional assessment of progressive and not fully reversible airflow limitation by spirometry.[3,8,9]

The natural history of COPD is complex and variable; not all individuals follow the same clinical course over time. The chronic and progressive course of the disease is complicated by exacerbations.[10,11] Acute exacerbations of COPD (AECOPD) result from complex interactions between the host, respiratory viral or bacterial infections and environmental pollution.[10] They are characterized by an acute worsening in respiratory symptoms associated with increased airway and

systemic inflammation.[12] Airway inflammation during AECOPD causes dyspnea, increased sputum production, airway edema, and bronchospasm that, in severe cases, can lead to respiratory failure and cardiovascular effects.[12] One of the hallmarks of AECOPD is that the lung never fully recovers after an episode, so the aggressive treatment and prevention of exacerbations is central to the evidence-based COPD management.[3,4]

1.3. Burden of COPD

1.3.1. Prevalence

A systematic review and meta-analysis of 37 population-based studies carried out in 28 countries between 1990 and 2004[13] yielded a pooled prevalence of COPD of 7.6%. Spirometric-based definitions of COPD produced higher prevalence estimates (9%) than those based upon physician's diagnosis (5.2%) or patient self-reported diagnosis (4.9%).[13] The review also identified important differences in prevalence based on age, sex, and study setting. Pooled estimates have shown that COPD is more prevalent among individuals aged 65 years and over (15%) compared to individuals of younger age groups (40-64 years: 7.6%; less than 40 years: 2.7%).[13] Similarly, the pooled prevalence of COPD in males is almost twice that in females (11% versus 5%).[13] Separate analysis of pooled prevalence by geographic location showed that COPD is more frequent in urban (10.2%) compared to rural (8%) settings.[14] While variations in prevalence estimates can be attributed to differences in diagnosis and case identification methods, regional and national differences in sociodemographic and environmental factors also contribute.

Large variations in COPD prevalence were also identified in a recent systematic review of 80 studies published between 2000 and 2010.[14] COPD prevalence estimates ranged from 0.2% to 37% across the studies. Most of the results, however, confirmed those reported by Halbert et al.[13]: COPD prevalence was higher in men and those aged 65 years and older, with estimates by spirometry being higher than those based on symptoms and physician reports.[14]

Recent research initiatives such as the Burden of Obstructive Lung Disease (BOLD) study[15,16] and the *Proyecto LatinoAmericano de Investigación en Obstrucción Pulmonar* (PLATINO) study[17,18] have facilitated the standardization of COPD prevalence estimates at an international level. In the BOLD study,[15] prevalence data were collected from 12 countries using the COPD criteria recommended by the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines. Using a uniform spirometry definition of COPD, prevalence was calculated in 10.1% (11.8% for men; 8.5% for women) with numbers increasing steadily with age. Prevalence estimates from the BOLD study are within the same range as those reported in the PLATINO study of five Latin American countries (7.8% to 19.7%).[17]

Current prevalence estimates, however, are likely to be underestimated as disabling COPD symptoms do not appear in the early stages of the disease, and many of the studies assessing COPD prevalence have used case definitions in which the diagnosis is usually made relatively late in the disease's natural history when pulmonary function is significantly impaired.[19,20] A long asymptomatic phase, and the well-known fact of underdiagnosis of COPD by physicians means that its prevalence in the community will be underestimated if physician-diagnosed or self-reported disease measures are preferred over objective spirometric testing.[21]

1.3.2. Incidence

Compared to studies investigating the prevalence of COPD, there are fewer population-based studies that have investigated its incidence. A systematic review of COPD incidence data from 15 studies published from 2000 to 2010 found substantial variations in the estimates across countries.[14] A wide range of incidence rates was observed varying between 2 to 16 cases per 1,000 person years, depending on the COPD definition used and the population under study.[14] Direct comparison of these estimates, however, is difficult as studies included in the review used different units and covered different periods of follow-up.

1.3.3. Mortality

COPD is the fifth leading cause of premature mortality in high-income countries.[1] By the year of 2020, it is estimated that COPD will become the third leading cause of death worldwide,[22] and by year 2030, it will be ranked fourth.[23]

A systematic review of COPD mortality rates issued from national mortality registries in 21 European countries reported estimates ranging from 7.2 to 36.1 per 100,000 population, being between 1.3 to 13 times higher in men than in women.[24] Variations in COPD mortality rates reported in another systematic review of 25 studies from countries worldwide[14] were even larger: 3 to 111 deaths per 100,000 population with trends towards a greater mortality among males and adults aged 75 years and older.

Mortality data reported in these systematic reviews should be interpreted with caution. First, there is evidence that COPD is frequently and inappropriately excluded from the list of disorders causing death.[25] Second, changes over time in the International Classification of Diseases (ICD) system and the diagnostic codes for COPD mortality data can also lead to variations in mortality rates across studies. Not least important, the lack of standardization of death certificates and differences in diagnostic practices across countries can also account for the wide variability of mortality indicators for COPD.[25]

1.3.4. Epidemiology of COPD in Canada

The majority of population estimates of COPD prevalence in Canada have been based on self-reports of health professional diagnosis. The most recent national survey data from 2009 to 2011[26] indicate that 4% of Canadians aged 35 to 79 years report having been diagnosed with COPD by a health professional. Surprisingly, there were no differences in COPD prevalence estimates across the age groups 40 to 57 years and 60 to 79 years. Contrary to other international studies, women were more likely to report a COPD diagnosis than men. Direct spirometry measurements of lung function from the Canadian Health Measures Survey (CHMS) indicate that 13% of Canadians had a lung function measurement indicative of COPD, with no differences in the likelihood of having airflow

obstruction between males and females.[26] This disparity between self-reported COPD (4%) and COPD based on spirometry measurements in the CHMS (13%) suggests that COPD is underdiagnosed in Canada.

The underreporting of COPD prevalence in the Canadian general population is confirmed by multi-site, national epidemiological studies of lung health that have measured the prevalence of COPD in Canada using interview-administered questionnaires and spirometry. Using the BOLD methodology, the Canadian Obstructive Lung Disease (COLD) study estimated the prevalence of COPD in adults aged 40 years and older living in five Canadian cities.[27] Overall, 16.7% of study participants were identified as COPD prevalent cases by the GOLD criteria;[27] a measure that was 2.5 times higher than the rate for self-reported physician diagnosis in the same study (5.3%) and four-fold higher than estimates from community surveys.[26,28]

Results from cohort studies based on administrative health data have also revealed important information about the prevalence of COPD in Canada. A retrospective cohort study based on administrative health data in Ontario from 1996 to 2007[29] reported a COPD prevalence of 9.5% in 2007, which represented a relative increase of 23% from COPD prevalence in 1996. Previous longitudinal analyses of administrative health data in Quebec from 1994 to 1999 reported a lower COPD prevalence of 3% in the general population over a five-year period.[30]

While results from epidemiological studies indicate that COPD prevalence has increased in Canada over the last few years, analysis of COPD incidence based on administrative health data[29] has shown that the age- and sex-standardized incidence of COPD has decreased from 11.8 per 1,000 population in 1996 to 8.5 per 1,000 population in 2007. This represents a relative decrease of 28.3%, with greater decreases found in men (from 13.9 to 9.4 per 1,000 population) and individuals older than 65 years of age (37.2 to 21.6 per 1,000 population).[29] COPD incidence in Canada is higher among males than females (9.4 versus 8.5 per 1,000 population) and in older age groups.[29]

In 2004, COPD was ranked as the fourth leading cause of death for both men and women in Canada (4% of all deaths in Canada).[8] Evidence from Canadian

longitudinal cohort studies[29] indicate that all-cause mortality in COPD in 2007 was 4.3%. Changes in age composition of the Canadian population with growing numbers of people aged 65 years of age and older predict a sharp increase in mortality rates for COPD (particularly in women) in the upcoming years.[29,31]

1.3.5. Impact of COPD on health services use in Canada

Patients with COPD often require a wide variety of health services, including emergency department (ED) visits and hospitalizations, particularly to treat AECOPD, concomitant complications, and comorbidities.

Canadian statistics of hospital admissions reveal that COPD accounts for the highest rate of hospital admissions among all major chronic illnesses in Canada (96 per 100,000 population).[32] Of the 17,200 patients who had COPD at first admission in 2006, 18% were readmitted once over one year and 14% returned to hospital at least twice within the same year to receive treatment for COPD or another chronic disease.[32] Current estimates predict that COPD-related hospitalizations will double by the year 2015.[32]

Data for Canada from a large-scale international cross-sectional survey conducted in 2002, the Confronting COPD in North America and Europe,[19] revealed that 30% of COPD patients had been hospitalized at some point in their lives, with 14% reporting at least one hospitalization during the last year. Approximately 17% of COPD patients reported at least one ED visit due to exacerbations in the year prior to the survey.[19]

A longitudinal population-based study of administrative health data conducted in Alberta[33] examined the rates of ED visits for COPD from 1999 to 2005 among individuals 55 years of age and older. ED visits rates for COPD over the study period ranged from 25.6 per 1,000 population in 1999 to 25.1 per 1,000 population in 2005, with an average of 2.2 visits per patient. The majority of COPD-related ED visits concluded in discharge from the ED (67.2%), with 32.5% of ED visits being admitted to hospital.[33]

A retrospective cohort study using administrative health data for 2008 in Ontario[34] evaluated the proportion of hospital visits, ED visits and ambulatory

visits for COPD. After adjusting for several factors, the study found that individuals with COPD used one fifth to one third of all health services in the province. Hospitalization rates (562 per 1,000 population), ED (641 per 1,000 population) and ambulatory visits (981 per 1,000 population) were, respectively, 63%, 85%, and 48% higher than the rest of the population without COPD.[34]

A 52-week, multicentre, prospective, observational study, the Resource Use Study In COPD (RUSIC),[35] was conducted in Canada in 2008 to quantify the amount of health services use, namely ED visits, outpatient visits and hospitalizations for moderate and severe AECOPD. Approximately 93% of severe COPD cases were admitted to the ED prior to hospitalization. Of all the AECOPD evaluated, study results revealed that 78% used outpatient resources, 31% used ED resources and 19.1% were hospitalized.[35] The average length of hospital stay due to AECOPD was 10 days, with 16% of patients having intensive care unit (ICU) admissions averaging 6.2 days each.[35] In summary, COPD is a chronic condition characterized by frequent exacerbations, concomitant complications, and comorbid conditions, for which a wide variety of health services, including acute hospitalizations and ED visits, are required. Routine physician visits and medication use are also frequent[34] and they all constitute important health care events for COPD patients and the health care system.

1.3.6. Economic costs of COPD in Canada

The economic burden of COPD in Canada is enormous. An economic analysis of Canadian data from the Confronting COPD in North America and Europe survey revealed that by 2002, the direct cost of the disease was Can $1997.81 per patient per year, with half of the expenses due to hospitalizations. Indirect costs were in the amount of Can $1,198.18, a third of the total per patient annual cost for COPD to society (Can $3,195.97).[19]

A recent cross-sectional study of patients with moderate to severe COPD (GOLD 2 and 3) examined the annual costs of maintenance therapy and treatment for AECOPD (including hospitalizations, ED visits, ambulatory care and medications).[36] As of 2008, the average annual COPD-related cost per patient was

Can $4,147. The cost of managing stable COPD was Can $2,475 per patient per year, whereas the cost of treating AECOPD was Can $1,673 per patient.[36]

The prospective RUSIC study[35,37] evaluated the average cost of health services for moderate and severe COPD. Results from this study indicated that the economic burden of AECOPD in Canada exceeded Can $736 billion per year.[37] The overall mean annual costs of ambulatory, ED and hospitalization services per exacerbation were Can $114, Can $774 and Can $8,669, respectively.[37]

1.4. Risk Factors for COPD

Exposure to cigarette smoke is the most important etiologic agent in the development of COPD, accounting for 80% to 90% of the cases in industrialized countries.[3,5,38,39] Importantly, second-hand (e.g., occupational or household) exposure to cigarette smoke can also cause non-smokers to develop COPD.[40,41] A systematic review of 218 epidemiological studies published up to 2006[42] confirmed the causal relationship between smoking and COPD. Based on random-effects meta-analyses of adjusted risk ratios (RR), the review found an increased risk of COPD for the categories of "ever smoking" (pooled RR = 2.89; 95% confidence interval [CI]: 2.63, 3.17), "current smoking" (pooled RR = 3.51; 95% CI: 3.08, 3.99) and "ex smoking" (pooled RR = 2.35; 95% CI: 2.11, 2.63).[42]

Exposure to other environmental factors can also contribute to the development of COPD. For example, occupational exposure to fibrogenic dusts (e.g., coal, silica, asbestos), mineral dust, gas, vapor, and fume combinations have been associated with increased airflow obstruction.[5] Recent evidence suggests that, although the accumulated exposure over time to these occupational substances is an important risk factor, other aspects such as the interaction between smoking and dust traces substantially speedup the progression of the disease.[43]

There is controversy regarding the role of air pollution in the development of COPD in the absence of smoking. For example, scientific evidence suggests that both outdoor air pollution (e.g., from fossil fuel combustion from motor vehicle emissions) and indoor air pollution (e.g., from cooking with wood or coal

materials as a heat source, or poorly ventilated dwellings) are risk factors for COPD;[3,39,44] however, the evidence is insufficient to prove a causal relationship between exposure to these air pollutants and COPD.

A variety of host susceptibility factors for COPD have been described in the scientific literature. Genetic factors related to deficiencies in alpha-1-antitrypsin, an enzyme that protects the lung structure and tissue against deterioration,[38,45] account for a very small proportion of COPD cases. Other risk factors cited in the literature include a history of severe and repeated viral respiratory infections in childhood,[46] and bronchial hyperresponsiveness resulting from asthma.[45] The relationship between asthma and COPD will be discussed later on this chapter.

Over the last few years, there has been a growing interest in the role of social determinants of health in the development of COPD. The socioeconomic gradient in COPD is greater than in any other disease.[47] There is evidence of a strong association between low socioeconomic status (expressed as reduced income and/or less education) and the risk of developing COPD that is independent of smoking.[48] Similarly, there is evidence that men from unskilled manual occupations are 14 times more likely to die from COPD than men employed in professional occupations.[49] Interactions between social deprivation and smoking, occupational exposures, pollution, housing conditions, nutrition, and prenatal and childhood exposures to cigarette smoking are important intermediate factors that influence the development of COPD. The relationship of social determinants of health and the development of COPD is an important one and further research is needed to determine the excess risk of COPD that can be attributed to social inequalities.

1.5. Comorbidities in COPD

Significant systemic manifestations and extra-pulmonary effects of COPD often result in or are accompanied by other, serious comorbidities such as weight loss, nutritional abnormalities, and skeletal muscle dysfunction. Comorbidities in patients with COPD have an important impact on the prognosis of the disease. Some of these conditions occur regardless of COPD; some of them are related by

virtue of having a common underlying cause (e.g., systemic inflammation), whereas others share similar risk factor clusters. It is increasingly recognized that the presence of cardiovascular diseases,[12,50,51] diabetes mellitus, dyslipidemia,[11] cancer, osteoporosis, psychological disorders,[11] glaucoma,[5] and other pulmonary diseases such as pulmonary embolism, cancer, pneumonia, and asthma[11,52,53] contribute substantially to the severity of the disease and are strong predictors of poor diagnosis and management.[38,52]

1.6. Diagnosis of COPD

1.6.1. Airflow obstruction and spirometry assessment

According to the GOLD clinical guidelines, COPD is suspected in a patient who has the following symptoms: dyspnea, chronic cough or sputum production, and a history of exposure to risk factors for the disease.[3] Clinical confirmation of COPD requires the use of spirometry, which is considered the gold standard for diagnosing, assessing disease severity and monitoring its progression.[8,9] Additional investigations include bronchodilator and corticosteroid reversibility testing, chest imaging (e.g., radiography and computerized tomography), arterial blood gas measurements, alpha-1-antitrypsin deficiency screening, and exercise testing.[3]

The definition of COPD established by GOLD emphasizes the importance of the functional assessment of progressive and not fully reversible airflow limitation. According to the GOLD criteria, airflow obstruction diagnosed by spirometry is defined as the ratio between the forced expiratory volume in 1 second by forced vital capacity (FEV_1/FVC) of less than 0.7 after bronchodilator administration.[3] The GOLD definition also classifies reversibility as an FEV_1 increase of 200 mL or a 12% improvement above the baseline FEV_1 following the administration of either inhaled corticosteroids or bronchodilators.[3] The term "not fully reversible" describes a condition of patients who, in fact, have reversibility in the airflow obstruction in response to administration of either corticosteroids or bronchodilators; yet, their best FEV_1 and FEV_1/FVC ratio classify them as having persistent airflow limitation.

Spirometry also helps to describe the severity and progression of COPD. The GOLD criteria defines four grades of airflow limitation based upon specific spirometry cut-off points: GOLD 1 (mild): $FEV_1 \geq 80\%$ predicted; GOLD 2 (moderate): $50\% \leq FEV_1 < 80\%$ predicted; GOLD 3 (severe): $30\% \leq FEV_1 < 50\%$; and GOLD 4 (very severe): $FEV_1 < 30\%$ predicted,[3] while using the fixed $FEV_1/FVC < 0.7$ to define airflow limitation. The current GOLD classification of severity of airflow limitation abandoned the concept of staging from previous versions of the COPD spirometry-based system. Certain components of the definition, such as reference to respiratory failure in GOLD 4, are now considered arbitrary and not supported by current evidence.[3]

The GOLD criteria constitute a landmark for COPD diagnosis as this is established through a reproducible test of lung function. One advantage of the GOLD criteria is that, by classifying COPD into four grades of severity upon spirometry results, treatment recommendations can be made. Nevertheless, it is important to keep in mind that the cut-off points to classify the severity of airflow limitation have not been clinically validated in full.[3] The GOLD classification of COPD severity has been criticized because it does not necessarily relate to individual symptom severity and does not address the role of other markers of disease progression such as clinical evaluation, the presence of emphysema on CT scanning, or markers of pulmonary inflammation.

One disadvantage of the GOLD criteria is that, because it is expected that the FEV_1/FVC ratio will decline naturally with increasing age, a fixed FEV_1/FVC cut-off of 0.7 for all age groups would underestimate the prevalence of COPD in young adults and overestimate it in older adults.[3] By using the GOLD definition alone, the majority of cases of airflow limitation in young populations would be missed. Similarly, because women have, on average, higher FEV_1/FVC ratios than their male counterparts, the application of the GOLD criteria may lead to underdiagnosis of COPD in women.[54]

Evidence from retrospective studies suggests that the GOLD criteria ($FEV_1 < 80\%$ predicted and $FEV_1/FVC < 0.7$ after bronchodilator) can miss an important subgroup of patients with mild COPD. Almost 14% of patients clinically

diagnosed as having COPD may not be identified because their FEV_1/FVC ratios are greater than 0.7, despite having FEV_1 <80% predicted.[54] This combination of characteristics is not represented in the GOLD classification. Application of the GOLD criteria can result in a low rate of GOLD 1 cases being identified, cases that constitute approximately 4% to 5% of patients seen in clinical practice.[54] As the distribution of the GOLD grades, especially GOLD 1, does not seem to be homogeneous, the usefulness of the criteria as a clinical tool is reduced.

1.6.2. Differential diagnosis of COPD

The definition of COPD excludes other obstructive pulmonary diseases that are associated with poorly reversible airflow limitation such as bronchiectasis, cystic fibrosis, bronchiolitis, pulmonary tuberculosis and asthma, except if these conditions overlap with COPD.[55,56]

COPD and asthma have similar characteristics such as the signs of coughing and wheezing; however, they are two distinct conditions in terms of disease onset, frequency of symptoms and reversibility of airway obstruction.[55] Very often, COPD is misdiagnosed and persons with COPD are treated instead for asthma, particularly at early stages of the disease or when exacerbations occur.[57] Misdiagnosis between COPD and asthma is common; up to 25% of patients older than 40 years who are previously diagnosed with asthma, in fact have COPD,[58,59] and many patients in primary care are treated as COPD cases when, in fact, they have asthma.[60]

An accurate differential diagnosis of COPD and asthma is essential because these two conditions require different management approaches. Spirometry testing helps to differentiate COPD from asthma. Both asthma and COPD are characterized by airflow obstruction; however, one major discriminatory factor is represented by the response of patients to a bronchodilator.[3] The distinguishing feature of asthma is the reversibility of airflow limitation in response to treatment with inhaled bronchodilators. Spirometry FEV_1 values in asthma normalize after administration of bronchodilators whereas, in COPD, albeit these values may improve, airflow limitation remains largely irreversible. Patients with COPD

typically show a persistent decrease in FEV_1 (e.g., FEV_1 <80% predicted) and FVC together with an FEV_1/FVC ratio of less than 70%.[3] Methacholine challenges can be used to demonstrate airway hyperresponsiveness and to confirm clinical suspicion of asthma when spirometry test results are normal.[61] The severity of asthma is the magnitude of variable airflow limitation whereas the severity of COPD is the degree of chronic airflow limitation. Another difference between asthma and COPD is based on the response to treatment: inhaled corticosteroids are essential for the control of asthma symptoms whereas, in COPD, they are helpful in moderate to severe cases of the disease and for frequent episodes of AECOPD.[61]

While asthma can usually be distinguished from COPD based on the reversibility of airflow limitation in response to treatment with inhaled bronchodilators, there is epidemiologic evidence that longstanding asthma on its own can lead to fixed airflow limitation.[56] The Global Initiative for Asthma (GINA) guidelines state that individuals with asthma who are exposed to noxious agents, such as cigarette smoking, may develop fixed airflow limitation and present a mixture of asthma-like and COPD-like inflammation symptoms.[61] In these instances, it is assumed that asthma and COPD coexist.

1.7. Treatment of COPD

No curative treatments for chronic airflow obstruction exist and management is restricted to symptom relief, prevention and management of exacerbations and comorbidities, and improvement of patient tolerance to physical exertion.[3] According to the GOLD guidelines, smoking cessation is the single most effective and cost-effective way to reduce the risk of developing COPD and stop its progression.[3] Both pharmacological (i.e., nicotine replacement products, varenicline, bupropion and nortriptyline) and counselling therapies have been shown to increase long-term tobacco smoking quit rates.[3] Pharmacological treatment for stable COPD is aimed at reducing symptoms and the frequency of exacerbations, and to improve the health status and exercise tolerance. Classes of medications recommended for stable COPD management in clinical guidelines

include bronchodilators (e.g., anticholinergic agents, beta-agonists, and methylxanthines), as well as oral and inhaled corticosteroid therapy.[3] Other pharmacological treatments that have been proposed but for which evidence for their effectiveness is weak include antibiotics, vaccines, mucolytic agents, immunoregulators and vasodilators, among others.[3]

Non-pharmacological treatments for stable COPD include pulmonary rehabilitation, mainly comprised by exercise training, smoking cessation, nutrition counselling and education.[3] For patients experiencing the most advanced and terminal forms of COPD, both end-of-life and hospice care are recommended. For the management of AECOPD, three classes of medications are commonly used: short-acting bronchodilators, corticosteroids, and antibiotics. Non-pharmacological treatments for AECOPD include respiratory support provided through oxygen therapy and ventilatory support (i.e., non-invasive and invasive mechanical ventilation).[3]

1.8. Aboriginal Peoples in Canada

"Aboriginal" is a term that has been used to describe an ethnic group with a distinctive identity and affiliation who inhabit a territory or geographic region with which they have the earliest known historical connection.[62] The term Aboriginal peoples has been used collectively in Canada to refer to the original inhabitants of North America and their descendents. From a cultural perspective, Aboriginal peoples in Canada comprise more than 50 diverse and distinct groups with separate identities, traditions, political structure, and history. Each group represents a complex network of communities and kinship systems, often with distinct language dialects and spiritual beliefs.[63] From a legal perspective, three groups are recognized by the Canadian government as Aboriginal peoples in Canada, as affirmed in sections 25 and 35 of the Canadian Constitution Act of 1982.[64] These three groups are First Nations peoples, Inuit and Métis.

1.8.1. First Nations peoples

First Nations peoples include a variety of ethnic groups such as the Iroquois, Blackfoot, Iglulik, Huron, Cree, Sioux, Haida, Tsimshian, Mi'kmaq, Algonquin, and Dene, among others. According to the Assembly of First Nations[65] there are 633 First Nations communities spread across Canada, representing 52 nations or cultural groups. First Nations peoples have been further described by the Canadian government as Status Indians and non-Status Indians depending on whether they are registered under the Indian Act[66] because their communities signed a Treaty with the Government of Canada or upon settlement in reserves (Figure 1.1).

1.8.2. Inuit

Inuit is a collective term used to describe a group of culturally similar Aboriginal peoples inhabiting the Canadian arctic and subarctic regions. Inuit have lived in the far north of Canada for thousands of years. Inuit communities have traditionally settled in the area bordered by the Mackenzie Delta in the Canadian west, the Labrador coast in the east, the southern area of Hudson Bay in

the south and the High Arctic islands in the north. The Inuit were not initially covered under the Indian Act;[66] however, the Supreme Court of Canada ruled in 1939 that the federal government's power to make laws affecting Status First Nations peoples extended to the Inuit.[67]

1.8.3. Métis

The term Métis was originally used to describe the children resulting from the union of Algonquian, Athapascan, Iroquian, Cree, Ojibwa, and Dene women and French, Scottish, and Irish men who initially settled along the St. Lawrence River and the area around the Hudson Bay back in the 17th century during the early years of the Fur Trade boom.[68] Today, the term is used broadly to describe a group of people with mixed First Nations and European Canadian heritage, with a unique combination of values, language and cultural traditions.

Definitions of who is considered Métis have evolved over time and change from province to province. The Métis National Council[69] (the Métis national body that represents the Métis in British Columbia, Alberta, Saskatchewan, Manitoba and Ontario) has defined Métis as "a person who self-identifies as Métis, is of historic Métis Nation ancestry, is distinct from other Aboriginal peoples, and is accepted by the Métis Nation".[70] The recognition of the Métis as one of the Aboriginal peoples of Canada in the Canadian Constitution Act of 1982[64] did not encompass the same Aboriginal rights as those granted to Status First Nations and Inuit.

On January 8, 2013, the Federal Court of Canada ruled that Métis and non-Status Indians in Canada are "Indians within the meaning of the expression 'Indians and lands reserved for Indians' in section 91 (24) of the Constitution Act of 1967".[71] The Court decision entitled Métis and non-Status First Nations peoples the same federal rights as those granted to Status Indians and Inuit under the Canadian Constitution Act. The Federal Court decision, however, did not order the federal government to immediately assume the fiduciary duties (e.g., provision of health care, housing, and tax exception benefits) toward approximately 200,000 Métis and 400,000 non-Status First Nations peoples.

1.9. Demographic Characteristics of Aboriginal Peoples in Canada

According to data from the 2011 National Household Survey (NHS), a total of 1,400,685 people in Canada report Aboriginal ancestry, representing 4.3% of the total Canadian population.[72] Of these, 60.8% (851,560) identified themselves as First Nations peoples (of which 74.9% were Status Indians registered under the Indian Act), 32.3% (451,795) as Métis and 4.2% (59,445) as Inuit.[72] An additional 2.7% reported other Aboriginal identities or more than one Aboriginal identity.[72]

Over the last few years, the Aboriginal population has grown at a much faster rate than the rest of the non-Aboriginal Canadian population (i.e., a growth of 45% among Aboriginal peoples versus 8% among non-Aboriginals between the years of 1996 and 2006).[73] Aboriginal peoples accounted for 2.8% of the population enumerated in the 1996 Census, 3.3% in the 2001 Census and 3.8% in the 2006 Census.[72] By 2017, the annual rate increase for the Aboriginal population will double the rate projected for the total population of Canada (1.8% versus 0.7%, respectively).[74] Of the three Aboriginal groups, the Métis experienced the greatest increase (91%) in the past decade; a number that was more than three times greater than the 29% increase in First Nations peoples and the 26% among the Inuit.[75]

The Aboriginal population in Canada is younger than the non-Aboriginal population. In 2011, almost half (46.2%) of the Aboriginal population were aged 24 years and under, compared with 29.4% of the non-Aboriginal population.[72] By 2011, the median age of First Nations peoples was 26 years; which was much lower than the median age of the non-Aboriginal and Métis populations (31 years), but higher than the Inuit median age of 23 years.[72]

Ontario and the four western provinces are home to the largest proportion of Canada's Aboriginal population (8 of every 10 Aboriginal peoples live in these provinces). In 2011, more than half of Canada's Aboriginal peoples lived in Ontario (301,425), British Columbia (232,290), Alberta (220,695), Manitoba (195,900) and Saskatchewan (157,740).[72] By 2017, Alberta's Aboriginal population is expected to grow by 39 percent and by then, Alberta will overtake

British Columbia to have the second largest Aboriginal population after Ontario.[74] The majority of First Nations peoples live in Ontario and the western provinces (83% of this group's total population) much like the Métis; however and overall, First Nations peoples are more evenly distributed throughout all of Canada compared to the other two Aboriginal groups.

From the mid-1960 decade onwards, there was a significant migration of Aboriginal peoples out of reserves, small communities and settlements towards urban centres. In 2006, 56% of the total Aboriginal population in Canada lived in urban areas.[75] Among provinces, British Columbia, Saskatchewan and Manitoba have the highest proportion of Aboriginal peoples living in rural or remote areas compared to Ontario, Québec and the Maritimes, which have the highest proportion of Aboriginal peoples living in urban settlements.[75] Aboriginal peoples in the Yukon, Nunavut and the Northwest Territories live almost entirely in rural or remote areas. Among large Canadian urban centres, Edmonton had the second largest number of Aboriginal peoples living in a city (52,100 by 2006) after Winnipeg (nearly 56,000). Ranking fifth, Calgary is also home of a relative large number of urban Aboriginal peoples (26,575).[73]

In 2011, a greater proportion of First Nations peoples lived off reserve (54.7%) than on reserve (45.3%; 98% being Status Indians).[72] Nearly half (47%) of off-reserve First Nations peoples lived in census metropolitan areas while 31% lived in small urban centres and 21% in rural areas.[75] Similarly, nearly seven out of 10 Métis (69%) lived in urban areas. The majority of Inuit (78%) live in remote communities distributed in Nunatsiavut (Labrador), Nunavik (Quebec), Nunavut, and the Inuvialuit settlement region of the Northwest Territories.[72-75]

1.10. Aboriginal Peoples in Alberta

In 2011, 15.8% of people who self-identified as Aboriginal in Canada lived in Alberta.[72] The province is home to 45 First Nations communities distributed across three treaty areas for which agreements were signed with the Government of Canada (Figure 1.2): Treaty 6 located in central Alberta; treaty 7 located in southern Alberta, and treaty 8 located in northern Alberta. All combined, the

treaty areas include 140 reserves spread over 812,771 hectares of land.[76,77] By 2011, there were 116,670 First Nation peoples living in Alberta.[72] Of them, approximately 48.6% lived in reserves, 26.5% in metropolitan areas, 14.7% in urban, non-metropolitan areas and 10.2% in rural areas.[74,75]

Alberta has the largest Métis population in Canada. There were 96,865 Albertans who identified themselves as Métis in the 2011 NHS.[72] Alberta is the only Canadian province with a system of land holding for Métis settlements.[78] Eight Métis settlements were established by legislation under the Alberta Métis Settlements Accord,[79] covering 512,121 hectares of land and housing over 8,000 Métis in the province: Buffalo Lake, East Prairie, Elizabeth, Fishing Lake, Gift Lake, Kikino, Paddle Prairie and Peavine.[80] By 2011, 43.5% of Métis in Alberta lived in metropolitan areas; 26.6% in urban, non-metropolitan areas and 29.9% in settlements and rural areas.[74]

As of 2011, there were 1,985 Inuit living in Alberta.[72] Most Inuit in Alberta live in urban centres (85.7%) and 14.3% live in rural or remote areas.[74] About 36% of the total Inuit population in the province has chosen Edmonton as their home, compared to 15% of Inuit living in Calgary.[74]

1.11. Delivery of Health Care Services for Aboriginal Peoples in Canada

The organization of Aboriginal health care in Canada comprises a complex set of policies and legislations resulting in a great diversity of health services provided across provinces and territories.

The Constitution Act of 1982 (sections 25 and 35)[64] guarantees and reaffirms Aboriginal rights and freedoms that were recognized by the Royal Proclamation of 1763, and those that were acquired by First Nations peoples by way of treaties. The provision of health care services, however, was not specifically addressed in the numbered treaties signed between the Crown and the First Nations peoples. Only Treaty 6 included a health care clause in the written text:

"*That a medicine chest shall be kept at the house of each Indian Agent for the use and benefit of the Indians at the direction of such agent*."[81]

The medicine chest clause has been interpreted to mean that the federal government has the obligation to provide all forms of health care to Registered First Nations peoples living on and off reserves, and to the Inuit living in their traditional territories. With the establishment of the current national health system in the 1970s, in which provinces and territories assumed responsibility for care of all residents, there was no mandate for provinces to provide specific care to Aboriginal peoples.

The federal government's role in the delivery of health services for First Nations peoples and Inuit switched its focus to public health, health promotion and prevention services offered to on-reserve Registered First Nations and Inuit communities through the First Nations and Inuit Health Branch (FNIHB) of Health Canada.[82] The FNIHB retained responsibility of providing primary care services to on-reserve First Nations and Inuit living in remote and isolated areas where there are no provincial services readily available.[83] The delivery of physician services and hospital care was left under the jurisdiction of provinces and territories in the same manner as for the non-Aboriginal population. The FNIHB reimburses provincial and other health care agencies for services provided to off-reserve Aboriginal populations. The FNIHB provides non-insured health benefits (e.g., prescription drugs, medical supplies and equipments, dental and vision care, and transportation to medical facilities) to Registered First Nations peoples and Inuit.[82]

Despite recognition of the Métis as an Aboriginal group under the 1982 Constitution Act, no specific legislation indicates a fiduciary responsibility of the federal government to provide health care services to the Métis through the FNIHB. In the absence of treaties signed between the Métis and the federal government, the delivery of care for this Aboriginal group remains a provincial responsibility as for all other Canadians. Similarly, the FNIHB framework does not address the health care needs of First Nations peoples and Inuit who are neither registered nor living on traditional territories.

The past thirty years have seen a switch in the paradigm for the development of policies that shape the delivery of health care to Aboriginal peoples in Canada;

from policies often referred to as protective and paternalistic, to policies that respect Aboriginals' cultural identity and political autonomy. The 1986 Health Transfer Policy (HTP) was designed to increase participation of Aboriginal peoples in the planning and management of community-based health programs.[84] The HTP provides funds to First Nations and Inuit communities through FNIHB for public and community health programs (e.g., communicable diseases control, environmental health). The HTP also funds initiatives directed at specific health-related issues identified by the communities as their own health priorities. Medical and hospital services are excluded from the HTP, as well as non-insured health benefits.[84]

1.11.1. Health care access for Aboriginal peoples in Alberta

Like all other Canadian provinces, Alberta has a universal, publicly funded health care system, the Alberta Health Care Insurance Plan (AHCIP) that guarantees Albertans receive free access to medically necessary hospital and physician services. Virtually all Alberta residents[85] are covered by the AHCIP.

Aboriginal peoples living in Alberta are entitled to all regular provincial health services (i.e., community, acute, and continuing care) provided off reserve by Alberta Health Services (AHS) and Alberta Health (AH). Where do they access available health services depends on two things: where they live and their Treaty/Registration status.

First Nations reserves in Alberta have health centres or nursing stations for the provision of primary health care services, health promotion and prevention programs, and basic continuing care services that are funded through the FNIHB. Health centres are usually located in communities with some access to health services in nearby towns or urban centres. These health centres usually have nurses, community health practitioners, and provide some homecare services. Many have dental, nutritional, and mental health therapists, physicians, and other health professionals on a part-time basis. The type of facility and the range of services available in each community depend on how isolated the community is. Nursing stations are located in smaller or more remote First Nations communities

across Alberta; they provide emergency health services, primary care, and comprehensive health promotion programs. Tele-visitation services are available in some reserves.[86]

While the federal government is responsible for health services provided to First Nations peoples on reserves and Inuit living in isolated regions, the provincial government is responsible for higher levels of health care. Therefore, First Nations peoples living on reserves and Inuit from remote communities access AHS facilities (e.g., provincially funded hospitals, extended care facilities, mental health clinics and health units) in larger centres and AH-funded clinical services (e.g., family physicians offices, nurse practitioners, etc.) to receive secondary and tertiary levels of care.

There are no unique health benefits or services for Métis settlements like those available to Registered First Nations peoples living on reserves or Inuit. Métis access health services like non-Aboriginal Albertans in the province. The Métis Settlements Accord,[79] and more recently, the Métis Settlements Act[87] included a number of health care provisions such as the right to "make bylaws to promote the health, safety and welfare of the residents of the settlement area"; invest money in "hospital districts or health regions under the Regional Health Authorities Act in Alberta"; and "make bylaws respecting and controlling the health of residents of the settlement area and against the spread of diseases".[87]

1.12. Chronic Obstructive Pulmonary Disease among Aboriginal Peoples in Canada

Much has been written from an epidemiological perspective about the gap that exists between Aboriginal and non-Aboriginal populations in Canada in their health status and access to health services.[88-92] Over the last two decades, epidemiological evidence has accumulated on the higher rates of morbidity and mortality among Aboriginal peoples in Canada compared to their non-Aboriginal counterparts, and the significant barriers they face to access health care services for diagnosis and treatment.

First Nations peoples, Métis and Inuit have a higher burden of respiratory diseases compared to other non-Aboriginal Canadians.[93] Overall, respiratory diseases constitute the fourth leading cause of death among Aboriginal peoples in Canada[94] and a prominent cause of morbidity and health services use.

There is limited information about the burden of disease for COPD among Aboriginal peoples in Canada. Epidemiological evidence and analysis of patterns of health services use for COPD in Aboriginal peoples are mainly derived from cross-sectional population surveys and administrative health databases.

Results from the 2008 Canadian Community Health Survey (CCHS)[95] suggest that First Nations peoples living off reserve, Métis and Inuit are twice as likely to develop bronchitis or emphysema compared with the non-Aboriginal population, with females most at risk.[95]

Published data from the Aboriginal Peoples Survey (APS), a national survey of First Nations peoples living off reserve, Métis and Inuit, suggest that 6% of adult Métis reported having been told by a health professional that they had chronic bronchitis.[96] Métis women were more likely than Métis men to report having chronic bronchitis (8% and 5%, respectively).[96] There were no differences in the prevalence of chronic bronchitis among Métis living in urban or rural areas. Across Canada, only half of Métis adults with chronic bronchitis reported receiving treatment for the condition. An estimated 1% of Métis adults in Canada reported a physician diagnosis of emphysema. No differences were observed in the prevalence of emphysema between male and females, or by geographic location.[96] National estimates from the 2006 APS about the prevalence of bronchitis and emphysema for First Nations peoples living off reserves and Inuit have not been published; however, it has been reported that a significant number of diagnosed cases remain untreated.[93]

Data from the First Nations Regional Longitudinal Health Survey (RHS) 2008-2010 provide evidence of the prevalence of chronic bronchitis and emphysema among First Nations adults aged 18 years or older living on reserves.[97] Results showed that 3.6% of First Nations adults living on reserves report a diagnosis of chronic bronchitis. The prevalence of physician reported

emphysema among First Nations peoples living on reserves was 0.8%.[97] Overall, a larger number of First Nations peoples diagnosed with emphysema reported that they were currently undergoing treatment for their condition, compared to those diagnosed with chronic bronchitis (60% versus 52.3%, respectively).[97]

Only a few longitudinal studies based on administrative health data[33,98-100] have provided information regarding important aspects of the problems associated with COPD among Aboriginal peoples in Canada.

The Manitoba Centre for Health Policy in collaboration with the Manitoba Métis Federation evaluated the health status and health care utilization patterns of the Métis population in Manitoba.[99] Analysis of administrative health data for the year 2006 showed that Métis have a higher prevalence of a cluster of respiratory conditions (including asthma, chronic or acute bronchitis, emphysema and chronic airway obstruction) compared to the general Manitoban population (13.6% versus 10.6%).[99]

A retrospective cohort study based on probabilistic linkage between the Métis Nation of Ontario citizenship registry and Ontario administrative health data compared the incidence, prevalence and mortality rates for COPD between Métis and non-Métis in the province.[100] The study also examined and compared the patterns of health services utilization (including primary care and specialist visits, ED visits, and hospitalizations) between Métis and non-Métis populations in Ontario for the years 2007 and 2008.

In this study, the prevalence of COPD was significantly higher in the Métis than in the non-Métis population during both years of study. The COPD prevalence for Métis in 2007 was 14.2%, compared to 9.9% in the non-Métis population.[100] Data for 2008 indicate that COPD prevalence was 14.7% and 10.7% for Métis and non-Métis groups, respectively.[100] The incidence of COPD in the study was 1.5 times higher among Métis compared to non-Métis in both years of study. The incidence of COPD for 2007 in the Métis group was 10.7 per 1000 persons compared to 7.8 per 1000 persons in the non-Métis group. For the year 2008, COPD incidence rates per 1000 persons were 12.4 and 8.33, respectively.[100]

Analysis of all-cause mortality for the year 2007 showed that Métis with COPD had lower mortality rates (2.6 per 100 persons) compared with COPD cases among the non-Métis population (4.5 per 100 persons).[100] Similar results were obtained for the analysis of 2008 data (2.6 versus 4.54 per 100 persons for each group).[100] Health services utilization data from the study suggested that there were no significant differences between Métis and non-Métis in overall or COPD-specific primary care visits; however, the mean number of specialist visits was lower among the Métis.[100]

Overall, ED visits among individuals diagnosed with COPD were 1.3 times higher among the Métis compared to the non-Métis population, while there were no significant differences in COPD-ED specific visits.[100] Finally, hospitalizations among individuals diagnosed with COPD were 15% higher overall among Métis compared with the non-Métis population. There were no differences in COPD-specific hospitalizations between the two groups.[100]

Two studies published to date[33,98] have provided evidence of health care utilization issues among Aboriginal peoples in Alberta. Rosychuk et al.[33] conducted a retrospective population-based cohort study based on administrative health data that described the epidemiology of COPD and asthma presentations to EDs in Alberta between the years of 1999 and 2005. The authors found that Aboriginal peoples in Alberta were approximately four times more likely to visit the ED than the non-Aboriginal Albertan population. The Aboriginal population in the Rosychuk et al.[33] study included only Registered First Nations peoples. Therefore, data were not available for non-Registered First Nations peoples, Métis and Inuit in Alberta, limiting the external validity of the findings beyond Registered First Nations peoples living in the province.

Sin et al.[98] conducted a retrospective population-based cohort study of people residing in Alberta between the years 1996 and 1997, and evaluated the relationship between Aboriginal status and health services use for COPD. The authors found that, compared to the non-Aboriginal population, Registered First Nations peoples in Alberta were 1.6 times more likely to have an ED and office visit for COPD.[98] Compared to non-Aboriginal COPD patients, Registered First

Nations peoples with COPD were 55% less likely to have seen a specialist, and 66% less likely to have had spirometric testing during the one-year study period.[98]

The study by Sin et al.[98] provided a general overview of how Registered First Nations peoples in Alberta seek health services for COPD. The study, however, had some important limitations. First, analysis included only Registered First Nations peoples and therefore, the results are not generalizable to non-Registered First Nations, Inuit and Métis in the province. Second, the length of the follow-up period (i.e., one year) was relatively short to provide a strong basis for the observed differences in Registered First Nations peoples' trends of health care utilization when compared to the non-Aboriginal population. Last, the study did not address whether the pattern of health care utilization for COPD was similar across the three distinct Aboriginal groups (First Nations peoples, Métis and Inuit) and whether disparities in the COPD epidemiological profile existed among these groups. There is no published data on health services use for COPD specific to non-Registered First Nations peoples, Métis and Inuit in Alberta.

1.13. Social Determinants of Health and Barriers for Accessing Health Services Relevant to the Study of COPD

Poor respiratory health status for COPD in Aboriginal peoples is closely linked to determinants of health, such as education, income, and social and physical environments.[88] The Canadian Population Health Initiative[101] states that "the social, economic and environmental conditions of Aboriginal peoples are worse than those of non-Aboriginal peoples. These include education, work status, income, housing, water and sewage systems and nutritional options".[101] These conditions impact the ability of Aboriginal communities to meet many of the social determinants of health, making them more vulnerable to the development of chronic conditions such as COPD.

Several studies have reported that smoking rate among certain Aboriginal groups in Canada is double the rate of the rest of the Canadian population.[89,102] Overall, the proportion of First Nations peoples over 20 years of age who smoke has been calculated as 57% compared to 27% in the non-Aboriginal population in

Canada.[103] If true, and if smoking is the most important etiologic agent in the development of COPD, one could expect that the epidemiology and impact of COPD would be higher among Aboriginal peoples. For example, it has been documented that certain Aboriginal groups, such as First Nations peoples who smoke tobacco either for traditional or non-traditional purposes, are at a higher risk of developing respiratory diseases.[104]

Similarly, Aboriginal peoples, particularly those who follow a traditional lifestyle or living on reserves are exposed to environmental contaminants derived from biomass fuel burned for cooking and heating in poorly ventilated areas that can increase the risk of COPD, particularly in women.[88]

Access to health services has been widely considered an important determinant of health.[105] Several studies have examined the barriers to access health care services that contribute to health inequalities between Aboriginal peoples and the rest of the population. A systematic review on health care access among Aboriginal peoples in North America, Australia and New Zealand[106] has identified important barriers to health care services that disproportionately affect Aboriginal communities compared to the non-Aboriginal population. They include socioeconomic position, geographic location, lack of infrastructure and health care professionals, and language and cultural factors.[105]

Overall, factors that impede or delay the adequate access to prevention, diagnosis and treatment services for COPD have the potential to create health inequalities affecting the respiratory status of Aboriginal populations. Aboriginal peoples face obstacles to access appropriate health care for their COPD condition; as a result, the degree of severity of COPD manifestations can worsen due to a lack of proper diagnosis, treatment, and prevention.

At a population level, the prevalence of COPD in Aboriginal peoples is likely to be underestimated because Aboriginal peoples with COPD are not properly identified. For example, results from the study by Sin et al.[98] in Alberta would suggest that lower access to spirometry testing and specialist services for COPD among Aboriginal peoples in Alberta constitute barriers to quality health care that negatively impact the diagnosis and prognosis of Aboriginal patients with COPD.

If spirometry testing is systematically less available for Aboriginal peoples in the province, it is likely that the prevalence rates of COPD would be underestimated for this population, if diagnosis is based on spirometry results.

1.13.1. Socioeconomic barriers

Rates of economic disadvantage and poverty among Aboriginal populations are considerably higher than the rest of the population in a variety of countries.[107] Aboriginal peoples in Canada have higher rates of poverty and lower income levels than non-Aboriginal Canadians.[108] Particularly, Aboriginal peoples constitute an important proportion of the homeless population in major urban centres, being 10 times greater than the representation of non-Aboriginal individuals.[109] Particularly in Edmonton and Calgary, they constitute 35% and 18% of the homeless population within these cities, respectively.[110]

Several studies have reported that Canadians with low income levels, particularly Aboriginal populations, show lower rates of health care access than other Canadians, albeit having greater health care needs.[111-113] There is evidence of a higher incidence of COPD in Aboriginal peoples of lower socioeconomic status, particularly those living in urban areas.[98]

1.13.2. Geographical and infrastructure barriers

Barriers to access diagnosis and treatment services for COPD differ depending on whether Aboriginal peoples live in cities or rural and remote areas. Living in a rural location in Canada has been identified as a barrier to adequate respiratory care, regardless of ethnicity. A retrospective cohort study based on administrative health data in Saskatchewan examined rural-urban differences in health care utilization for COPD.[114] The study found that overall, there were differences in the number of primary care physician visits and access to home care services, with significantly fewer physician visits made by residents of rural and remote locations compared to those living in urban settings.[114] Similarly, COPD patients living in rural and remote locations were less likely to receive home care services and physical therapy.

Approximately 49% of First Nations peoples and 30% of Métis live in reserves and settlements across the province.[74] Additionally, about 14.7% of First Nations peoples live in non-reserve, rural areas.[74] Health care facilities in rural and remote areas, reserves and settlements, are infrequent and more dispersed than in urban areas. As a result, Aboriginal peoples living in rural and remote areas typically have to travel large distances to access COPD diagnosis and therapeutic services that cannot be obtained in their local communities. This issue is particularly important because transportation problems and risks often delay the access to timely treatment for AECOPD and end-of life issues related with COPD.[33,98,115]

Similarly, health care facilities in rural and remote areas tend to be understaffed and experience shortages of primary health providers and respiratory specialists. Evidence from studies conducted in rural and remote communities in Australia suggest that health practitioners living in rural and remote areas have low levels of experience, knowledge and confidence related to the management of COPD.[116]

Health care access issues faced by Aboriginal peoples living in cities are somewhat different from those living on reserves, rural or remote areas. While the availability of health care services does not seem to be a major problem in urban settings, poverty, discrimination, and cultural differences can create obstacles for Aboriginal peoples seeking health services for COPD in cities. Other barriers affecting urban Aboriginal peoples in accessing health care services for COPD include a lack of knowledge of services available, transportation issues, and cultural insensitivity or discrimination by health providers.[117]

1.13.3. Cultural and language barriers

The impact that cultural and language barriers have on the access for COPD services by Aboriginal peoples in the province have not yet been evaluated. Qualitative research assessing the delivery of health services for Aboriginal peoples with COPD in Australia has indicated that poor access to culturally appropriate health services, dislocation from cultural support systems, exposure to

racism and poor communication with health professionals, constitute important barriers to access health care.[118]

Finally, effective communication between patients and providers is of paramount importance in establishing optimal care for COPD.[119] Language barriers present a formidable obstacle to accessing adequate health care for COPD in Aboriginal peoples in Alberta (particularly among elders) that are not proficient in spoken or written English. Aboriginal peoples who speak English as a second language can experience difficulties in approaching ED, ambulatory and hospital services to obtain information and treatment for their condition.

In summary, socioeconomic, geographic, infrastructure, and cultural barriers to health care access affecting Aboriginal peoples are important factors that can create inequalities in their respiratory health status compared to the rest of the non-Aboriginal population. It is critically important to identify more precisely the patterns of inequalities in health status and access to health services for COPD that affect Aboriginal peoples in Alberta and the areas in which public health, therapeutic interventions and policies for health care access should be oriented to tackle these inequalities.

1. 14. Objectives and Scope of Dissertation

1.14.1. Study rationale and significance

The evidence on the epidemiology and patterns of health care use for COPD in Aboriginal peoples of Canada is mainly derived from cross-sectional population surveys or longitudinal analyses of administrative health data. Research findings from cross-sectional surveys[96,97] provide limited data on the prevalence of self-reported chronic bronchitis and emphysema without reference to a comparison group of non-Aboriginal Canadians. A cross-sectional analysis of the CCHS[95] provided comparative data on the prevalence of self-reported chronic bronchitis and emphysema between Aboriginal and non-Aboriginal populations in Canada. Self-reported survey data, however, can underestimate the true prevalence of COPD and the validity of such data is questionable. Furthermore, the use of separate categories of chronic bronchitis and emphysema to describe

the burden of COPD creates some problems in the interpretation of the estimates. Additionally, none of these studies provide information specific for Alberta.

Several longitudinal cohort studies based on administrative health data[33,98-100] have provided insight into the differences in the epidemiology and health services use for COPD between Aboriginal peoples and non-Aboriginal populations in Canada. These studies, however, have some limitations. The majority of these studies have relatively short follow-up periods that prevent conclusions about medium- or long-term epidemiological outcomes of a chronic condition to be drawn.[98-100] Comparisons with non-Aboriginal reference groups have been generally restricted to specific Aboriginal groups (i.e., Métis,[99,100] or Registered First Nations peoples[33,98]).

The two studies that have been conducted in Alberta, have restricted their analysis to specific health services outcomes for COPD (i.e., ED and ambulatory visits[33,98]) or have used broad definitions for case ascertainment (COPD and asthma combined[98]) thus creating a limited picture of the true burden of COPD among Aboriginal peoples in the province. Similarly, the studies did not evaluate differences in the epidemiological and health services use indicators across the three distinct Aboriginal groups.

The impact of COPD burden among the three Aboriginal groups has not been fully assessed in the context of Alberta. There is a need of comprehensive epidemiological studies profiling the epidemiology and patterns of health services use among Aboriginal peoples living in Alberta, and how these indicators compare to those of non-Aboriginal Albertans. Similarly, it is important to account for the inherent differences between First Nations, Métis and Inuit populations when reporting research results. The paucity of this information hampers the ability of the health system to identify priority areas for prevention and treatment as they relate to COPD in the three distinct groups of First Nations peoples, Métis and Inuit.

The goal of this research is to expand the current knowledge base of the burden of COPD affecting Aboriginal peoples in Canada. The research presented in this dissertation is the most comprehensive longitudinal analysis of eight years

of administrative health data to examine the epidemiology and health services utilization patterns of COPD among the three Aboriginal groups in Alberta.

More importantly, results of this research are expected to help identifying whether inequalities exist in the respiratory health status and access to health services for COPD among Albertans. The identification of how COPD impacts the three Aboriginal groups in the province, constitutes an important step towards addressing potential health inequalities and identifying the areas in which specific approaches to improve their respiratory health status and access to health services for COPD are needed.

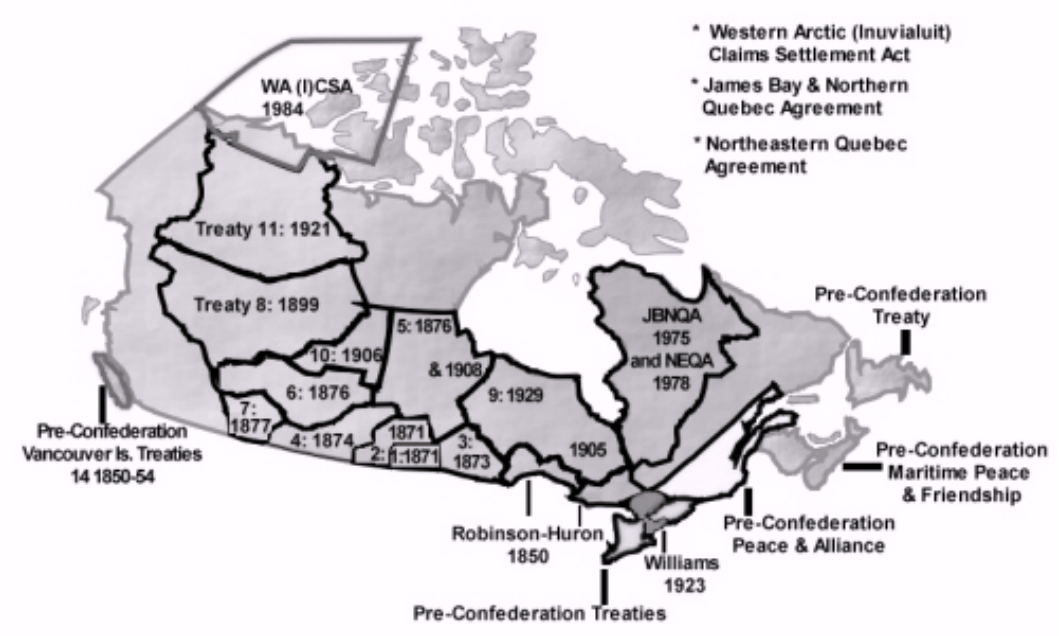
The main hypothesis of this research is that Aboriginal populations in Alberta have disproportionately higher COPD morbidity and mortality compared to the non-Aboriginal population and that there are differences in the epidemiological profile of COPD among First Nations peoples, Métis and Inuit in the province. A secondary hypothesis of this study is that Aboriginal peoples have a distinct pattern of health services utilization (i.e., more hospitalizations and ED visits) for COPD compared to that of the non-Aboriginal population in Alberta and that differences exist in the patterns of health services use among the three Aboriginal groups.

1.14.2. Research objectives

The objectives of this research are:

1. To evaluate and compare the prevalence and incidence of COPD among the three Aboriginal groups of Registered First Nations, Métis and Inuit relative to the non-Aboriginal population in Alberta.
2. To evaluate and compare all-cause mortality rates in individuals with COPD among the three Aboriginal groups of Registered First Nations peoples, Métis and Inuit relative to a non-Aboriginal population with COPD in Alberta.
3. To evaluate and compare the patterns of health services use (i.e., hospitalizations and ED visits) in individuals with COPD among the three Aboriginal groups of Registered First Nations peoples, Métis and Inuit relative to a non-Aboriginal population with COPD in Alberta.

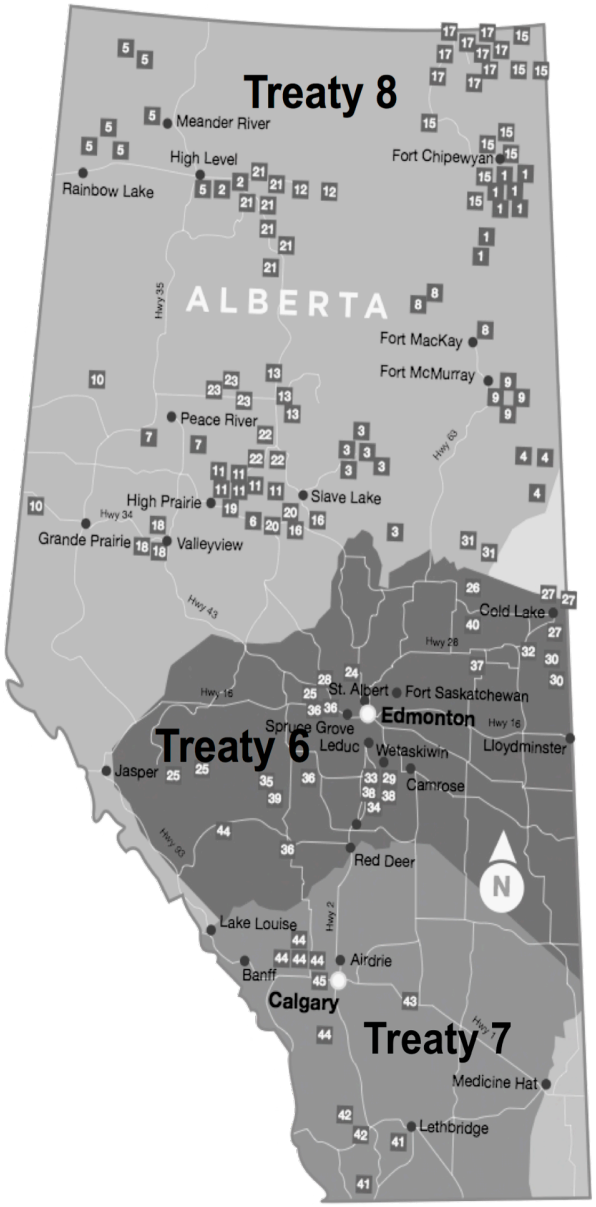
Figure 1. 1. Map of the eleven numbered Indian Treaty areas in Canada



Note: Reproduced by permission from Dr. Egmond Lee on behalf of The Applied History Research Group©, 2000.[120] (Appendix A)

Figure 1. 2. Treaty map and First Nations communities in Alberta

Treaty 8
1 Atbahasca Chipewyan First Nation
2 Beaver First Nation
3 Bigstone Cree Nation
4 Chipewyan Prairie First Nation
5 Dene Tha' First Nation
6 Driftpile First Nation
7 Duncan's First Nation
8 Fort McKay First Nation
9 Fort McMurray First Nation
10 Horse Lake First Nation
11 Kapawe'no First Nation
12 Little Red River Cree Nation
13 Loon River First Nation
14 Lubicon Lake Indian Nation
15 Mikisew Cree First Nation
16 Peerless Trout First Nation
17 Sawridge Band
18 Smith's Landing First Nation
19 Sturgeon Lake Cree Nation
20 Sucker Creek First Nation
21 Swan River First Nation
22 Tallcree First Nation
23 Whitefish Lake First Nation (Atikameg)
24 Woodland Cree First Nation
Treaty 6
25 Alexander First Nation
26 Alexis Nakota Sioux First Nation
27 Beaver Lake Cree Nation
28 Cold Lake First Nations
29 Enoch Cree Nation
30 Ermineskin Cree Nation
31 Frog Lake First Nation
32 Heart Lake First Nation
33 Kehewin Cree Nation
34 Louis Bull Tribe
35 Montana First Nation
36 O'Chiese First Nation
37 Paul First Nation
38 Saddle Lake First Nation
39 Samson Cree Nation
40 Sunchild First Nation
41 Whitefish Lake First Nation (Goodfish)
Treaty 7
42 Blood Tribe
43 Piikani Nation
44 Siksika Nation
45 Stoney Tribe
46 Tsuu T'ina Nation



Note: Reproduced by permission from the Government of Canada©, 2009.[76] (Appendix A)

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CHAPTER 2
A Systematic Review of the Epidemiology of Chronic Obstructive Pulmonary Disease in Aboriginal peoples

2.1. Introduction

Chronic obstructive pulmonary disease (COPD) is a respiratory condition that has a major effect on morbidity and mortality and constitutes an important contributor to health services expenditures. Up to 10 percent of adults over 40 years of age have COPD,[1,2] with perhaps millions remaining undiagnosed. Mortality from COPD is common; this condition has emerged as the only major cause of death whose incidence is on increase.[3,4] Similarly, use of health services for COPD is an important issue in industrialized countries, particularly for exacerbations episodes.[5,6]

COPD carries the potential for inequalities in diagnosis, treatment and access to health care affecting vulnerable groups in our society.[7,8] Aboriginal identity is a key social determinant that contributes to health inequalities and to difficulties in accessing health care worldwide.[9-11] Systematic reviews of epidemiological research on Aboriginal health[12,13] have consistently shown that, compared to the general population, Aboriginal peoples experience a considerable gap in their health status that negatively impacts their life expectancy and worsens the burden of many conditions, including respiratory diseases. Inequalities in the frequency, mortality and access to health care for COPD between Aboriginal peoples and non-Aboriginal populations have not been systematically documented.

With these considerations in mind, the aim of this systematic review was to analyze the evidence from epidemiological studies on the prevalence, mortality and access to health services for COPD in Aboriginal adult populations compared to non-Aboriginal populations in a variety of settings and countries.

2.2. Objectives

1. To summarize and analyze the evidence on the prevalence of COPD in Aboriginal populations compared to that of non-Aboriginal populations.

2. To summarize and analyze the evidence on mortality and health services use for COPD in Aboriginal populations compared to that of non-Aboriginal populations.

2.3. Methods

The study design is a systematic review for which an *a priori* protocol was designed to define the search strategy, set the study selection criteria, outline quality assessment and data extraction procedures, and plan the analysis of data. An original manuscript from this chapter has been published as a systematic review of COPD *and* asthma;[14] however, for this chapter, only results of the COPD analysis will be presented and discussed.

2.3.1. Literature search and article retrieval

Databases and search terms. We searched MEDLINE, EMBASE, Circumpolar Health Bibliographic Database, and Native Health Database from inception date to October 2011. For optimum sensitivity, we used a broad search strategy that included a combination of Medical Subject Headings and text words: (respiratory tract diseases OR pulmonary disease chronic obstructive, lung diseases, obstructive, respiratory function tests OR asthma OR bronchoconstriction) AND (Aborigine*OR Aborigi* OR Aboriginal* OR Indigenous people* OR Indigenous population* OR Maori* OR Inuit* OR Eskimo* OR Aleut* OR Native American* OR Native Canadian OR Native Canadian* OR Native Alaskan* OR American Native* OR Alaskan Native* OR Canadian Native* OR American Indian* or Canadian Indian* OR Amerind* OR Inupiats OR Inupiat OR Kalaallits OR Kalaallit OR Tribes OR Natives OR Indigenous OR First Nations OR Metis) (Appendix B).

In addition, the reference lists of relevant studies (e.g., included studies, other systematic or narrative reviews) were scanned to identify additional references not identified by the electronic search strategy. Hand searches of *The Journal of Aboriginal Health* (2004 - November 2009), *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* (2003 – Winter 2009), *Australian Aboriginal*

Studies Journal (2001 – Issue 1, 2010) were also conducted. Web-based searches were conducted to identify unpublished work. No restrictions were imposed in terms of language or publication status.

2.3.2. Study eligibility criteria

Table 2.1. summarizes the study eligibility criteria for the review. For the analysis of prevalence (objective #1), studies were included if they were observational analytical (cross-sectional and cohort) studies that compared COPD prevalence between Aboriginal peoples and non-Aboriginal adult populations. For the analysis of mortality and health services use (objective #2), population-based analytical cohort studies comparing COPD mortality and health services use between Aboriginal and non-Aboriginal adult populations were included.

In this review, the term "Aboriginal" refers to an ethnic group with a defined identity and affiliation who inhabit a territory or geographic region with which they have the earliest known historical connection.[15] Studies including Aboriginal populations from Australia, New Zealand, United States, Canada, and other countries of the Northern Circumpolar Region were potentially eligible as health disadvantages associated with Aboriginal ethnicity in these countries have been largely documented in the scientific literature.[16-19] Only studies conducted in adult populations or that provided separate data for predominantly adult age groups were included.

The primary outcomes of interest were: a) prevalence of COPD and b) mortality rates due to COPD. Secondary outcomes included health care utilization measures such as hospitalizations, hospital length of stay (LOS), emergency department (ED) visits, and spirometry testing. No restrictions were made based on instruments or diagnostic criteria for case ascertainment. Studies reporting exclusively on the epidemiology of individual symptoms were not considered for inclusion. Other chronic respiratory conditions (e.g., asthma, bronchiectasis, hypersensitivity pneumonitis, interstitial lung disease, pulmonary hypertension, chronic pleural diseases, pneumoconiosis, sarcoidosis, lung cancer, cystic fibrosis

and sleep apnea syndrome) were excluded from the analysis presented in this chapter.

Data presented in graphs and figures were used only if numbers were described in the text or graph data could be extracted. Studies that derived estimates from modelling of other variables, or extrapolations from other populations were excluded. Multiple publication data[20-22] was incorporated to the information reported in the main publication.

2.3.3. Study selection process

Two reviewers independently screened titles and abstracts of each citation and obtained full-text copies of potentially relevant studies, which were further assessed using a standard form that outlined the eligibility criteria. The level of agreement between the two reviewers was calculated with the Kappa (κ) statistic,[23] as a measure of internal quality of the study selection process. A κ score ranging from 0.0 to 0.40 was considered poor agreement; 0.41 to 0.60 moderate agreement; 0.61 to 0.80 substantial agreement, and 0.81 and above was near perfect agreement.[24] Disagreements about study eligibility were resolved by consensus among reviewers. Studies that did not meet the selection criteria were excluded and the reasons for exclusion were documented. A flow chart of the study selection process was prepared according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[25]

2.3.4. Evaluation of the methodological quality of the studies

Methodological quality addresses the question of how well the studies are protected against systematic bias, non-systematic bias and inferential error in the design, conduction, and analysis.[26,27] The review approach to methodological quality focused on an assessment of the internal validity of the individual studies, defined as the extent to which study design, conduction, and reporting prevent or reduce bias in the results.[26,27]

Assessing the methodological quality of observational epidemiological studies poses different challenges compared to the assessment of randomized and non-

randomized intervention studies. A variety of instruments have been proposed for assessing the methodological quality of observational epidemiological research; however, there is currently no consensus on which tool is the best to use.[28]

Two quality assessment tools were chosen for this systematic review: study quality of cross-sectional studies was assessed with an eight-item rating system developed by Loney et al.[29] that evaluated the methods of sampling, sampling frame, sample size, outcome measurement, outcome assessment, response rate, statistical reporting, and interpretation of study results. Each item is assigned a score of one or zero points to generate an overall single quality score that ranges from zero to eight (the maximum score possible). Loney quality ratings from one to three points indicate poor quality, ratings between four and six points are considered of moderate quality and those between seven to eight indicate high methodological quality.[29]

The methodological quality of cohort studies was assessed with the Newcastle-Ottawa Scales (NOS),[30] an eight-item instrument that evaluates the methods of participants' selection, the comparability between cohorts, and outcomes ascertainment. The Cochrane Non-Randomized Studies Methods Working Group recommends the use of the NOS and studies on their psychometric properties are in progress.[30] Overall, NOS quality scores range from zero to nine (zero to four points = poor quality; five to seven points = moderate quality; and eight to nine points = high quality).

An individual components approach based on the susceptibility to bias was adopted to report the results of the methodological quality assessment rather than reporting the overall quality scores only.[28,31] Two reviewers independently assessed study quality, with disagreements resolved by consensus.

2.3.5. Data collection

One reviewer extracted information from the included studies onto a pretested data extraction form and double-entered it for accuracy and completion. The following information was extracted from individual studies, where possible: country, publication year, study design, observation period, data source, case

definitions, geographical location (i.e., rural, urban, mixed), study settings (i.e., national, regional, municipal, remote community), Aboriginal group, predominant reference group, age, and gender.

COPD prevalence estimates or raw numerators and denominators needed for calculations were extracted from the individual studies. Data on the type of estimate (i.e., point, period prevalence) and sex-specific prevalence estimates were also extracted. COPD mortality and health services rates for both Aboriginal and non-Aboriginal populations were obtained or re-calculated based on the information available in the individual studies. Both adjusted and unadjusted rates were obtained with the latter preferentially used. Attempts were made to contact the senior authors of studies included in the review to obtain additional data or data not reported in the publications.

2.3.6. Data analysis and synthesis

Key details of the included studies (article's source, study design and methods, study population, case ascertainment methods, and outcomes) are presented in evidence tables sorted by first author and year of publication (Table 2.2 and Table 2.3).

Prevalence. COPD prevalence estimates were reported separately as percentages with 95% confidence intervals (CI). Prevalence odds ratios (POR) and 95% CIs were calculated for Aboriginal groups with reference to a non-Aboriginal group. A value greater than 1.0 in the POR indicated that the odds of having the respiratory condition of interest were higher among Aboriginal peoples compared to the non-Aboriginal reference group.

Meta-analyses using the method of inverse-variance weighting under a DerSimonian and Laird random effects model[32,33] were planned in the presence of small or moderate statistical heterogeneity (indicated by a p-value less than 0.05 for the Cochran's Chi-squared test[34] and a I^2 statistic less than 74%[35]). Because only one study assessing COPD prevalence was identified, the meta-analysis was not conducted and results were reported in a narrative way.

Mortality and heath services use. The reporting of mortality rates was varied and incomplete, and the methods and time periods to evaluate mortality data, heterogeneous. Unsuccessful attempts were made to contact the corresponding author of individual studies to obtain data that would allow to re-calculate mortality rates per group. Therefore, meta-analysis of mortality and health services use were not conducted.

Median mortality rate ratios (RR) were calculated for studies in which median mortality rates were reported or obtained.[36] This approach has been used in other systematic reviews to summarize rate data.[36-39] The median mortality rate constitutes the mid-point of all mortality rate values in the individual studies, and it was interpreted as the rate at which half of the studies have the same or higher number of deaths per person years. Median mortality RRs greater than 1.0 indicate that mortality rates in Aboriginals were greater than those of non-Aboriginals. Forest plots of individual study RRs with median RRs, if appropriate, were used to describe the results. Mortality rates were reported as number of deaths per 100,000 person-years. Subgroup analysis of mortality data by sex was presented for studies that provided enough data. The analytical approach for COPD health services use was similar to that of mortality rates. Health services utilization rates for hospitalizations, ED visits, medication and spirometry testing were reported as number of events per 1000 person-years.

Study selection, methodological quality assessment, and data extraction were managed with Microsoft® Excel® 2008 for Mac®, Version 12.1.5 (Microsoft Corporation, Redmond, WA). Data from graphs were converted using GraphClick® for Mac® (Arizona, San Francisco, CA) and indicated as such in the presentation of the results. Statistical analyses were undertaken using Predictive Analysis Software Statistics for Mac® (PASW® version 18.0, IBM SPSS, Somers NY) and Review Manager (RevMan version 5.0. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration; 2008).

2.4. Results

2.4.1. Search results

The systematic searches resulted in the identification of 2,136 citations. After screening of titles and abstracts, 132 references were considered potentially relevant.

From the 132 articles judged as potentially relevant, 28 studies satisfied the eligibility criteria for the main review published in Ospina et al.[14] Ten of them were included in the analysis of prevalence. Of these, two[40,41] were multiple publications from one report.[42] Therefore, the main review[14] included eight cross-sectional analytical prevalence studies reported in ten publications. Of these, only one[43] provided data for the analysis of the prevalence of COPD in Aboriginal peoples compared to a reference group of non-Aboriginals.

For the main analysis of mortality and health services use, 18 studies were included in the main review; from whom nine studies[44-52] assessed mortality and health services outcomes for COPD. Figure 2.1 outlines the flow of study retrieval and selection for the main review and the number of studies included in the analysis presented in this chapter. The level of agreement among reviewers for study selection was substantial ($\kappa = 0.86$; 95% CI: 0.77, 0.95). Results are reported separately for objective #1 (prevalence) and objective #2 (mortality and access to health services).

2.4.2. Analysis of COPD prevalence data

Study characteristics. One cross-sectional study[43] presented prevalence data of COPD in Aboriginal and non-Aboriginal groups from both urban and rural settings. The study compared the prevalence of COPD between Native Americans compared to a reference group of individuals described as “whites”. The frequency of COPD was based on self-report of doctor or other health professional diagnosis regarding the presence of emphysema or chronic bronchitis.[43]

Quality assessment. Overall, the methodological quality of the study assessing COPD prevalence[43] was rated as moderate (quality score = 6). The

study used a probabilistic sampling to assemble the study population. The sample size was adequate. While the study did not use objective and standardized criteria for assessing the presence of COPD, trained and independent assessors measured the study outcome. The proportion of respondents in the study was greater than 70%. The study did not report 95% CI to indicate the level of confidence around the prevalence estimate. Finally, the study fully described the sociodemographic characteristics of participants in order to understand the applicability of the results.

COPD prevalence. Native Americans in the study were not statistically more likely to report COPD compared to individuals of white race (POR = 1.08; 95% CI: 0.81, 1.44).[43]

2.4.3. Analysis of mortality and health services use for COPD

Study characteristics. Nine retrospective analytical cohort studies[44-52] assessed mortality and health services use for COPD. Aboriginal ethnicities in the studies were Australian Aboriginal peoples,[51,52] Canadian Aboriginal peoples,[47,50] Native Americans and Alaska Natives.[44,45,48,49] Non-Aboriginal reference groups were individuals described as "whites",[44,45,48] individuals of "European descent",[49] and in some instances,[50-52] they were described generically as "non-Aboriginals". One study made comparisons against a group of non-Aboriginals[47] that did not receive health care subsidies.

Administrative health data were used to determine ethnicity in all the studies. All studies used a formal diagnostic classification system for COPD case definition. International Classification of Diseases (ICD) versions used in the studies varied from ICD-7 to ICD-10, with some[48,51] using more than one version to cover long spans of time.

Quality assessment. Overall, the methodological quality of the nine retrospective cohort studies was moderate (median NOS score = 6; interquartile range: 5.5, 8). All the studies (Figure 2.2) protected against selection bias including representative samples of Aboriginal populations. The majority of studies described the setting from which the non-Aboriginal groups were

recruited, with eight of them drawing the non-Aboriginal groups from the same population as the Aboriginal cohort. Detection bias was not entirely controlled for: four out of nine studies used independent and reliable methods for the ascertainment of ethnicity. Six studies provided evidence that the outcome of interest was not present at start of the study. The majority of studies (eight studies) adjusted for potential confounders either in the design or analysis. In terms of attrition bias, the follow-up period in all studies was considered reasonable for the outcomes to occur; however, only one study reported losses to follow-up.

COPD mortality. Six cohort studies[44-46,48,49,51] assessed COPD mortality outcomes. A variety of mortality measures were used (e.g., age-standardized mortality rates, overall[44,45] and by sex;[44,45,49] incidence-density mortality rates by sex;[46] and annual change in mortality rates[51]). Some studies reported COPD mortality by age groups or birth cohorts.[48,51]

Two studies[44,45] compared age-standardized COPD mortality rates between Alaska Natives and a "white" non-Aboriginal population (Figure 2.3). Individual study results consistently showed that Alaska Natives had more deaths attributed to COPD than the "white" non-Aboriginal population (median COPD mortality RR = 1.5).

Three studies compared COPD mortality rates by sex between Alaska Natives[44,45] and Native Americans[49] and their counterparts in the white United States population (Figure 2.4). Alaska Native males and females had higher COPD mortality rates compared to the white population in the United States whereas Native American males and females had lower COPD mortality rates than those of the non-Aboriginal group (median COPD mortality RR = males: 1.4; females: 1.5).

Health services use for COPD. Three cohort studies analyzed the following COPD health services outcomes: hospitalizations,[52] ED visits for acute exacerbations of COPD (AECOPD),[47,50] and spirometry testing.[50] Australian Aboriginal peoples had more COPD hospitalizations than the non-Aboriginal groups (median RR = 8.6).[52] Two studies compared ED visit rates for COPD

exacerbations between Canadian First Nations peoples and non-Aboriginal Canadians.[47,50] First Nations peoples were more likely to visit the ED for COPD exacerbations than their non-Aboriginal counterparts (RR = 5.96).[47] Similar results were found when all asthma and COPD ED visits were combined (RR = 2.1).[50] Finally, First Nations peoples with COPD were less likely to undergo spirometry testing than non-Aboriginal Canadians (RR = 0.34).[50]

2.5. Discussion

This systematic review summarized the best available evidence from epidemiological studies to compare the prevalence of COPD between adult Aboriginal and non-Aboriginal populations from a variety of settings and countries. Similarly, this analysis has identified substantial gaps in our understanding of the differences in mortality and health services use for COPD between adult Aboriginal peoples living in industrialized countries and non-Aboriginal groups of diverse background.

2.5.1. Prevalence of COPD among Aboriginal and non-Aboriginal populations

The review identified only one study that compared the prevalence of COPD between Native and non-Native Americans, with no differences reported between the two groups.

This review found limited evidence to inform differences in COPD prevalence between Aboriginal peoples and non-Aboriginal populations. The methodological quality of prevalence data for COPD identified in this review was rated as moderate; however, there were certain limitations in the methodological approach of the individual study that should be considered. The use of probabilistic sampling to assemble the study populations in the COPD prevalence study[43] was likely to control for the effect of referral bias. However, the prevalence of COPD in the study was based on self-report of doctor or other health professional diagnosis regarding the presence of emphysema or chronic bronchitis. The absence of standardized criteria and objective measures of COPD limits the

interpretation of the study results. For example, some cases of COPD may be misdiagnosed as asthma; and in general, clinical diagnoses underestimate respiratory diagnoses.[53] Finally, the COPD prevalence study did not report nor accounted for differences in the severity of symptoms and levels of disability between Aboriginal and non-Aboriginal groups.

Similarly, the study did not provide sufficient detail to analyze whether genetic, social (e.g., socioeconomic level, geographic location) and environmental (e.g., nutrition, smoking, crowding, housing, and indoor, outdoor and work-related air quality) factors accounted for the differences in the prevalence of COPD between Aboriginal and non-Aboriginal populations.[4,54] The impact of inequalities in the respiratory health status of Canadians (especially those of Aboriginal peoples) by these factors warrants further investigation. Future epidemiological studies should improve our understanding of how Aboriginal status intersect with other social and health determinants to create inequitable conditions that may be associated with a higher incidence and prevalence of COPD.

2.5.2. Mortality and health services use for COPD among Aboriginal and non-Aboriginal populations

Individual study results provided evidence of inequalities in COPD mortality affecting Alaska Natives of both sexes. In contrast, Native American males and females had less deaths attributed to COPD than those among the non-Aboriginal group. It is unknown whether these results are statistically significant as data to calculate 95% CIs were not available in the studies. Aboriginal peoples from Australia and Canada had higher COPD hospitalization rates than the non-Aboriginal groups. Similarly, ED visits for COPD exacerbations were higher in First Nations peoples in Canada compared to those of non-Aboriginals. Finally, access to spirometry testing by First Nations peoples was lower compared to that of non-Aboriginals. While other systematic reviews of COPD mortality and health services use by Aboriginal identity have not been previously conducted, there is a

prevailing view in the literature regarding a negative socioeconomic gradient in mortality for respiratory causes among Aboriginal peoples.[12,13]

The findings of this systematic review emphasize the importance of investigating and assessing context-specific factors that account for the between-group differences in COPD mortality and health services outcomes if mechanisms to redress inequalities are to be designed. Much of the disparities in COPD epidemiologic indicators between ethnic groups are likely to be mediated by intermediate risk factors for poor respiratory health such as smoking, poverty, indoor air pollution, income, and remote place of residence.[6,12,55,56] Likewise, distal factors related to the organization and quality of health care services, costs, location, and access, as well as other social and cultural issues can mediate the relationship between ethnicity (particularly Aboriginal identity) and respiratory health status. Finally, evidence of ethnic disparities in health services is consistent across a range of diseases and health care systems.[57,58] Differences in diagnosis, quality of care and delivery of treatment can overall lead to consistently poorer health outcomes for Aboriginal peoples.

Factors pertaining to the characteristics of the individual studies affect the interpretation of the review results: the changes in the coding rules for COPD in the ICD versions over time and across the studies can potentially contribute to differences in prevalence, mortality and measures of health services use. Likewise, the quality of reporting of outcome measures in individual studies was quite variable. Recent research initiatives such as the Global Initiative for Chronic Obstructive Lung Disease (GOLD),[4] the Burden of Lung Disease study (BOLD)[59,60] and the *Proyecto LatinoAmericano de Investigación en Obstrucción Pulmonar* (PLATINO)[61,62] have called for standardizing the reporting of epidemiological research in COPD. Standardization of epidemiological data in COPD is necessary if we want to compare indicators across studies to analyze other dimensions of inequalities affecting the respiratory health status of the Aboriginal population.

There are important caveats to this review that should be noted. This review is based on a systematic search of published and unpublished studies; however,

publication bias is always a concern in systematic reviews. Attempts were made to minimize its impact by obtaining data from several sources, including electronic databases, unpublished and grey literature, reference lists and contact with authors. Similarly, efforts were made to avoid selection bias by involving two reviewers in the stages of screening and study selection. Standardized techniques for quality appraisal of studies were used and meta-analyses were considered only when clinically and statistically appropriate. To our knowledge, this is the first comprehensive review that used reproducible and systematic methods to evaluate the differences in the burden of COPD between Aboriginal and non-Aboriginal populations.

The incorporation of an equity lens towards the evaluation of how respiratory problems affect Aboriginal communities within the existing respiratory health research capacity have powerful implications for health services policy and planning. It constitutes an important contribution to the epidemiological study of respiratory diseases and an opportunity to address the inequalities in respiratory health status that affect Aboriginal peoples in our society.

2.6. Conclusions

This review identified important gaps in our knowledge about differences in the prevalence of COPD between Aboriginal and non-Aboriginal populations living in industrialized countries. There is an urgent need for further epidemiological research evaluating the existence of COPD-related inequalities between Aboriginal and non-Aboriginal populations.

Limited evidence from the scientific literature suggests that compared to non-Aboriginal populations, certain Aboriginal peoples groups experience a high burden in mortality and health care services use for COPD; however data are still sparse. Future studies should expand the knowledge base to document these inequalities and improve the methods of reporting if meaningful comparisons between studies are to be made. It is expected that the results of this systematic review will contribute to a more robust understanding of how much we do not know about the burden of COPD among Aboriginal peoples. Results of this

review provide a rational and justification to conduct more epidemiological studies in this field.

Table 2. 1. Study eligibility criteria

Category	Criteria
Population	Aboriginal adults compared to a reference group
Condition	COPD
Study design	Observational studies (i.e., analytical cohort or cross-sectional studies)
Outcomes of interest	Prevalence, mortality rates, health services utilization outcomes (e.g., hospitalizations, hospital LOS, ED visits, spirometry testing).
Geographic regions	Australia, New Zealand, United States, Canada and other countries of the Northern Circumpolar Region (i.e., Denmark, Norway, and Sweden)
Study type	Published and unpublished studies in any language

COPD = chronic obstructive pulmonary disease; ED = emergency department; LOS = length of stay

Table 2. 2. Studies assessing COPD prevalence in adult Aboriginal and non-Aboriginal populations

Study	Characteristics of aboriginal and reference groups	COPD definition and case ascertainment method	Prevalence rate, prevalence estimate (% [95% CI])	Prevalence estimates by sex (% [95% CI])
Pleis, 2008[43] USA CSS	Native Americans (American Indian, Alaska Natives); whites Total N = 99,701; M: 48,062/F : 51,639 Aboriginals N = 776; M: 380/F: 396	Emphysema, chronic bronchitis. Have been told by a doctor or other health professional that they had emphysema or chronic bronchitis (self-report)	COPD: 1 year Aboriginals: 6.4 (4.7, 8.2) Reference: 6 (5.9, 6.1)	NR

CI = confidence interval; COPD = chronic obstructive pulmonary disease; CSS = cross-sectional study; F = females; M = males; NR = not reported; USA = United States; yr = year(s)

Table 2. 3. Studies assessing COPD mortality and health services use in adult Aboriginal and non-Aboriginal populations

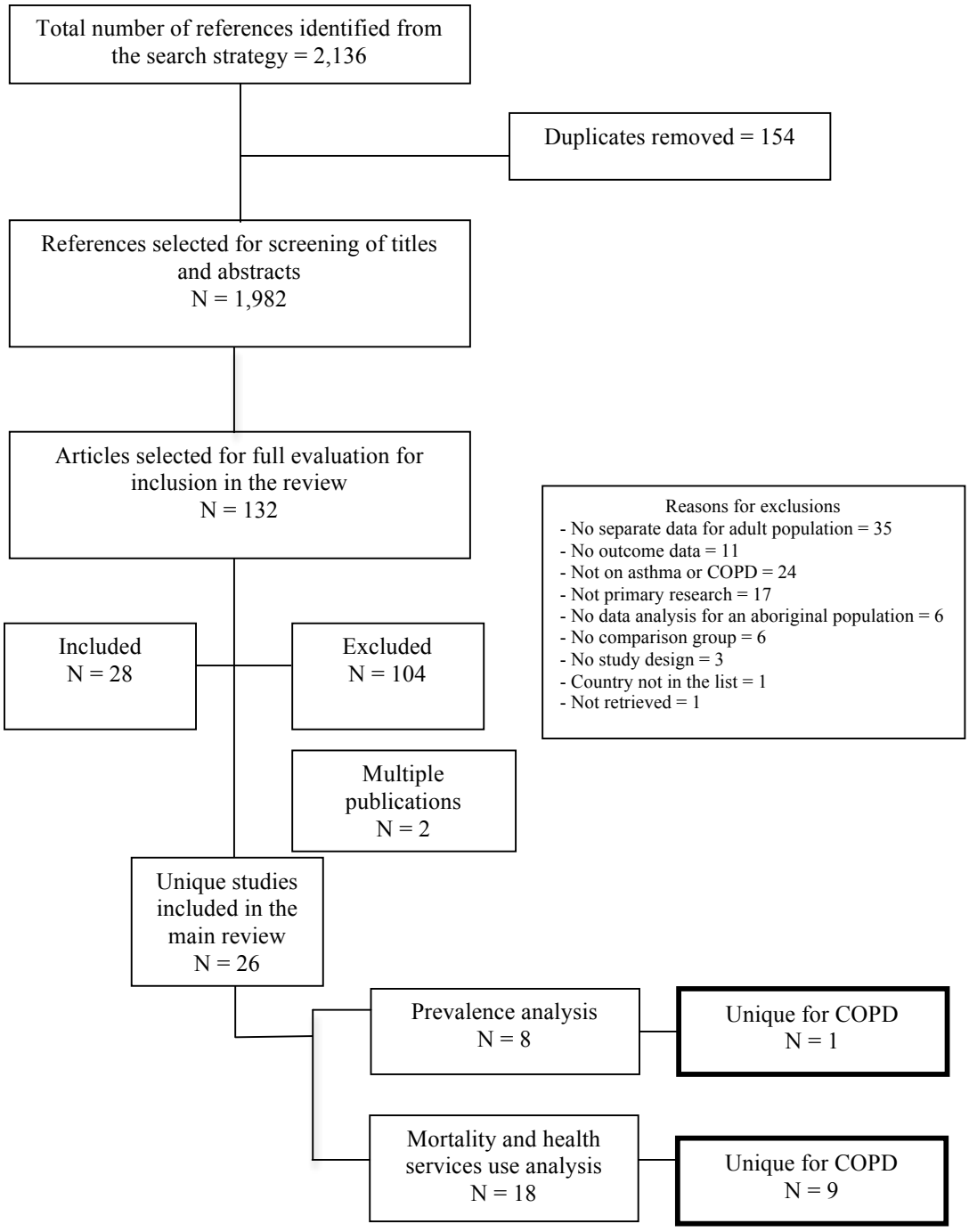
Study	Data source and dates	Comparisons	Outcomes	Results
Samet, 1980[49] USA RAC	New Mexico Bureau of Vital Statistics (1969-1977)	Native Americans (Navajos, Pueblos, Apaches); Anglo	COPD mortality	Mortality rates by sex (age-standardized) / per 100,000: <u>Males:</u> AB: 10.5 NAB: 60.5 Mortality RR = 0.17 <u>Females:</u> AB: 4.6 NAB: 12.8 Mortality RR = 0.35
Day, 2003[45] USA RAC	ABVS (1989-1998)	Alaska Natives; whites	COPD mortality	Mortality rates (age-standardized)/per100,000: AB: 34.4; NAB: 21.1 Mortality RR = 1.6 Mortality rates by sex (age-standardized)/per 100,000: <u>Males:</u> AB: 42.2; NAB: 27 Mortality RR = 1.6 <u>Females:</u> AB: 26.5; NAB: 17.2 Mortality RR = 1.5
Day, 2009[44] USA RAC	SEER (1979-2003)	Alaska Natives; whites	COPD mortality	Mortality rates (age-standardized)/per 100,000 AB: 65.1 NAB: 45.8 Mortality RR = 1.4 Mortality rates by sex (age-standardized)/per 100,000: <u>Males:</u> AB: 78.1 NAB: 56.3 Mortality RR = 1.4 <u>Females:</u> AB: 58.4 NAB: 39.6 Mortality RR = 1.5
Reeves, 1997[46] USA RAC	Wisconsin State Vital Records registry (1984-1993)	Native Americans; non-Hispanic whites	COPD mortality	Median incidence-density mortality rates per 100,000 by sex: <u>Males:</u> AB: 135.1; IQR: 83.9, 186.3 NAB: 154.8; IQR: 89, 220.6 Mortality RR = 1.4 <u>Females:</u> AB: 73.3; IQR: 51.9, 94.6 NAB: 65.8; IQR: 40.1, 91.5 Mortality RR = 2.1

Table 2.3. Studies assessing COPD mortality and health services use in adult Aboriginal and non-Aboriginal populations (continued)

Study	Data source and dates	Comparisons	Outcomes	Results
Samet, 1988[48] USA RAC	New Mexico Bureau of Vital Statistics (1958-1982)	Native Americans; (Navajos, Pueblos and Apaches); whites	COPD mortality	Median mortality rates by sex (age-standardized)/per 100,000: Males: AB: 8 (IQR: 4.2, 12.2) NAB: 31.4 (IQR: 24.8, 35.1) Median mortality RR = 0.25 Females: AB: 1.7 (IQR: 0. 8, 2.3) NAB: 5.4 (IQR: 3.7, 7.6) Median mortality RR = 0.27
Thomas, 2006[51] Australia RAC	ABS (1977-2001)	Australian Aboriginals; (Northern Territories); all other Australians	COPD mortality	Annual change in COPD mortality rate: -1.2 (95% CI: -2.2, 0.1)* Median mortality rates (age- and sex-standardized)/per 100,000 AB: 61.7 (IQR: 54.25, 71.2); NAB: 9.5 (IQR 8.5, 9.5) Median mortality RR = 6.49
Sin, 2002[50] Canada RAC	AHW administrative databases (1996-1997)	Canadian Aboriginals (First Nations peoples); non-Aboriginals (nr)	COPD/Asthma HSU (ED visits, spirometry use) combined	COPD/Asthma ED visits rates (age- and sex-standardized)/per 1000 AB: 24.1; NAB: 10.6 RR = 2.1
Williams, 1997[52] Australia RAC	Health Department of Western Australia HMDS (1988-1993)	Australian Aboriginals (Torres Strait Islander); non-Aboriginals (nr)	COPD HSU (hospitali-zations)	COPD hospitalization median rates per 1,000 AB: 4.3 (IQR 1.92, 11.64); NAB: 0.19 (IQR: 0.12, 1.38) Median RR = 8.6 (IQR 8.43, 16)
Rosychuk, 2010[47] Canada RAC	AHW administrative databases (1999-2005)	Canadian Aboriginals (First Nations peoples); registrants without subsidy	COPD HSU (ED visits)	COPD ED visit rates (age-standardized)/per 1,000* AB: 53.1; NAB: 8.9 RR = 5.96

* Data extracted from graphs; AB = Aboriginal group; ABVS = Alaska Bureau of Vital Statistics; AHW = Alberta Health and Wellness; CI = confidence interval; COPD = chronic obstructive pulmonary disease; ED = emergency department; HMDS = Hospital Morbidity Data System; HSU = health services use; IQR = interquartile range; NAB = non-Aboriginal group; nr = not reported; RAC = retrospective analytical cohort; RR = rate ratio; SEER = Surveillance Epidemiology and End Results; USA = United States

Figure 2. 1. PRISMA flow diagram for the identification of studies in the review



COPD = chronic obstructive pulmonary disease

Figure 2. 2. Summary of methodological characteristics of studies assessing mortality and health services use for COPD between Aboriginal and non-Aboriginal groups

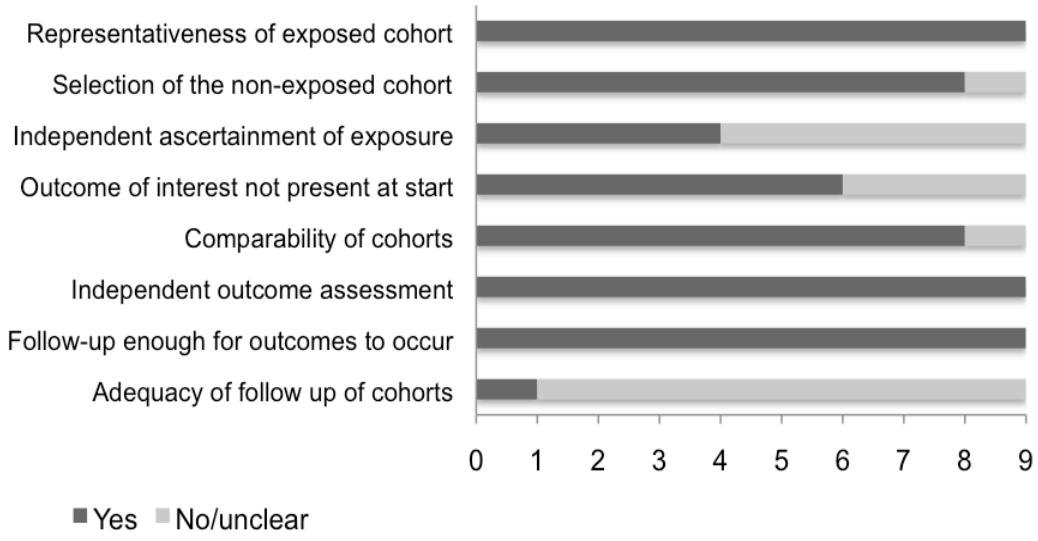
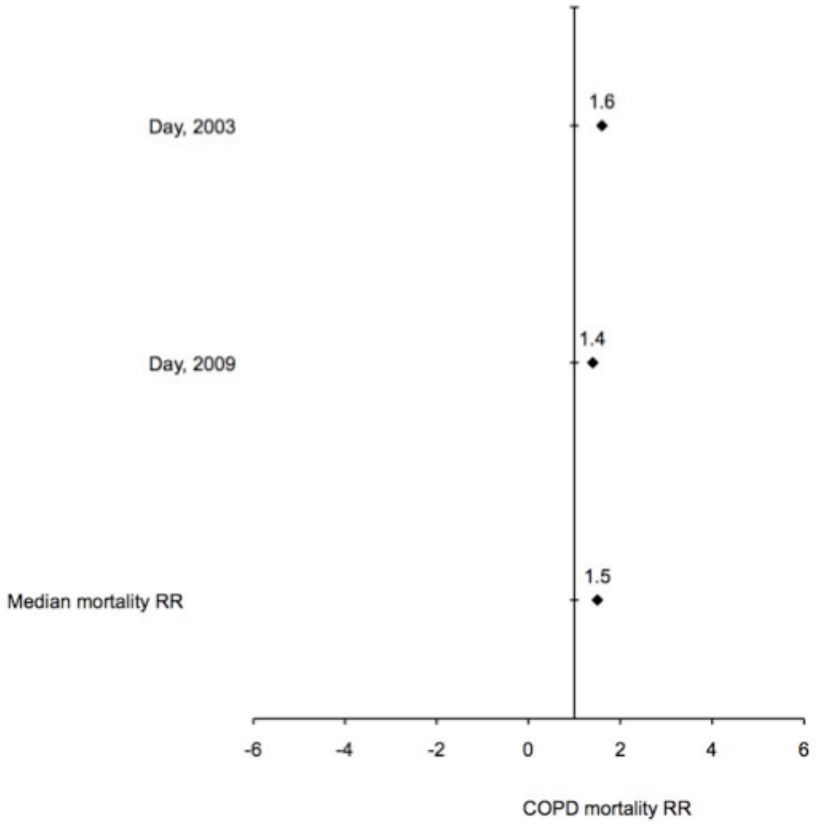


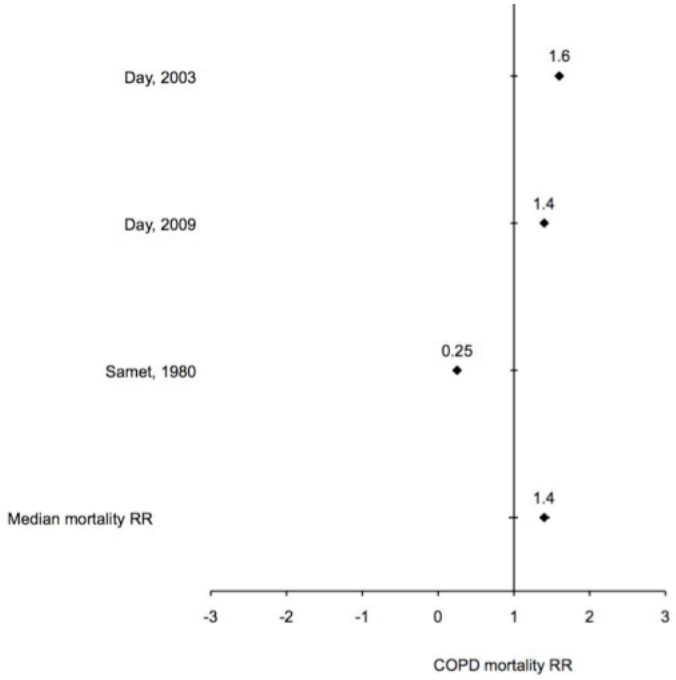
Figure 2. 3. COPD mortality rate ratios between Aboriginal and non-Aboriginal groups



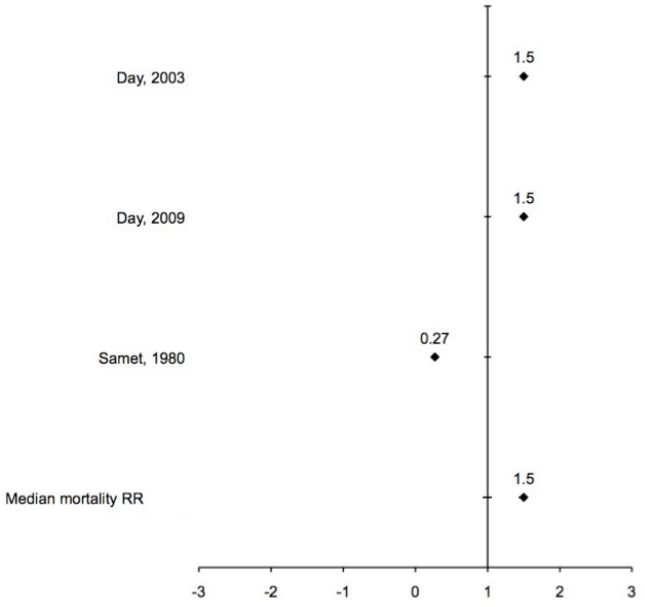
Notes: Data to calculate 95% confidence intervals were not available from the individual studies.
COPD = chronic obstructive pulmonary disease; RR = rate ratio

Figure 2. 4. COPD mortality rate ratios by sex between Aboriginal and non-Aboriginal groups

Males



Females



Notes: Data to calculate 95% confidence intervals were not available from the individual studies.

COPD = chronic obstructive pulmonary disease; RR = rate ratio

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Chapter 3

Prevalence and Incidence of Chronic Obstructive Pulmonary Disease among Aboriginal Peoples in Alberta, Canada, 2002/2003 to 2009/2010

3.1. Introduction

Chronic obstructive pulmonary disease (COPD) is a major respiratory disorder, largely caused by smoking, and characterized by progressive, not fully reversible airway obstruction, systemic manifestations, and increasing frequency and severity of exacerbations.[1] Worldwide estimates of COPD prevalence are in the range of 5% to 10%,[2] whereas COPD incidence rates have shown variations between 2 to 6 cases per 1,000 person-years, depending on the COPD case definition and the study population.[3] In Canada, approximately 4% of the general population aged 35 years and older report a diagnosis of COPD.[4] Studies using strict spirometry criteria for COPD diagnosis report prevalence estimates between 13%[5] and 16.7%;[6] measures that are 2 to 4 times higher than estimates from community surveys.

Compared to the non-Aboriginal population, Aboriginal peoples in Canada (First Nations peoples, Métis and Inuit) are especially affected by respiratory diseases. The epidemiology of their respiratory problems closely mimics that of populations in many low-and middle-income countries.[7,8] There are important gaps in our knowledge about the magnitude of disease burden for COPD in Aboriginal peoples relative to the non-Aboriginal population in Canada.[9] Results from the 2008 Canadian Community Health Survey (CCHS)[4] suggest that, compared to the non-Aboriginal population, First Nations peoples living off reserves, Métis and Inuit are twice likely to develop bronchitis or emphysema.[4]

Longitudinal studies conducted in Canada[10-13] have reported higher COPD incidence and prevalence in Canadian Aboriginal peoples compared to the non-Aboriginal population. These studies have used administrative health data spanning relatively short periods of observation and limited their scope to specific Aboriginal groups (Métis only). Others,[10,11] have restricted the analysis to health

services outcomes for COPD in Registered First Nations peoples that do not directly translate into measures of the true burden of the disease.

This retrospective cohort study assessed the prevalence and incidence of COPD in Aboriginal peoples in Alberta compared to the non-Aboriginal population at large. The objectives were to evaluate and compare the prevalence and incidence of COPD among the three Aboriginal groups of Registered First Nations peoples, Métis and Inuit relative to the non-Aboriginal population in the province, while controlling for the potential impact of sociodemographic factors on the epidemiological estimates of COPD morbidity.

3.2. Methods

3.2.1. Study design and setting

This is a retrospective cohort study based on linkage of administrative health databases in Alberta (Canada) from April 1st 2002 to March 31, 2010. Alberta is a culturally diverse province located in western Canada with a population of over 3 million residents, of which approximately 6.7% report Aboriginal ancestry.[14] The 2006 Canadian Census of Population[14] enumerated 188,365 Aboriginal peoples in Alberta. Of these Aboriginal peoples, approximately 52% were First Nations peoples, 45% were Métis and less than 1% were Inuit.

Health care in Alberta is publicly funded for all residents under the Alberta Health Care Insurance Plan (AHCIP). Virtually all Alberta residents (about 99%[15]) are covered by the AHCIP. Health premiums of Registered First Nations peoples and Inuit are paid by the federal government through the First Nations and Inuit Health Branch (FNIHB) of Health Canada. Non-registered First Nations peoples and Métis do not have coverage of the services provided through FNIHB.[16]

3.2.2. Data sources

De-identified individual-level, longitudinal data, by fiscal year, were obtained from the following administrative health databases under the custodianship of Alberta Health: the AHCIP registry, the Alberta Physician Claims Assessment

System, the Morbidity and Ambulatory Care Reporting (MACAR) system, Alberta Vital Statistics, and the Métis Nation of Alberta (MNA) identification registry. The AHCIP registry contains demographic information on all individuals in Alberta registered for health care coverage. The MACAR system records data on all hospital admissions in the province using the International Classification of Diseases, Tenth Revision; enhanced Canadian version (ICD-10-CA)[17] for diagnoses associated with acute and elective hospital utilization. The Alberta Physician Claims Assessment System records all services provided by fee-for-service physicians and "shadow-billings" for physicians paid under alternate payment plans in the province and includes information on the diagnostic fee code at each visit based on the International Classification of Diseases, Ninth Revision (ICD-9).[18] Alberta Vital Statistics captures information on deaths that occur within the province as well as the causes of death according to ICD-10-CA codes. The MNA identification registry includes citizenship information for members of the Métis Nation of Alberta. Deterministic data linkage[19] across the AHCIP, MACAR, Physician Claims and Vital Statistics databases was based on an encrypted unique personal health number (PHN). Probabilistic linkage[20] was used to obtain an encrypted PHN for persons in the MNA registry and this PHN was then directly linked to the other datasets.

3.2.3. Study population

To be eligible for the study, individuals must have been at least 28 years of age at the start of the study period (April 1, 2002), Alberta residents, and constantly registered in the AHCIP registry from fiscal years 2002/2003 through 2009/2010, including all persons who died at any point from the first day of the study period. The age limit of 28 years was chosen so that individuals in the age group 35 years and above could be considered at the beginning of each year of the 8–year study period from April 1, 2002 to March 31, 2010 and satisfy the minimum age required for the COPD case definition (35 years of age) during each year of the study).

Selection of the study cohorts. Using the MNA identification registry, all

Métis who met the eligibility criteria were identified within the AHCIP registry through probabilistic linkage. All eligible Inuit were also selected from the AHCIP registry. A random sample of eligible Registered First Nations and non-Aboriginals was assembled from the AHCIP registry for a ratio of five Registered First Nations and five non-Aboriginals for each Métis included. Because it was unlikely that cohort matching improved study efficiency,[21] no matching based on age, sex, subsidy or area of residence was considered. The flowchart for selection of the study population is described in Figure 3.1.

3.2.4. Variables of interest

Aboriginal status: The Aboriginal cohort in this study included: 1) Registered First Nations peoples, 2) Inuit (both identified in the AHCIP registry based on an alternate premium arrangement) and, 3) Métis (individuals identified as such in the MNA identification registry). If individuals were identified as both Métis and First Nations peoples, they were considered Métis. The non-Aboriginal cohort in the study refers to individuals in the AHCIP registry that do not have an alternate premium arrangement field for Registered First Nations or Inuit, and that are not included in the MNA registry. First Nations peoples without registration under the Indian Act[16] and Métis not included in the MNA registry were considered part of the non-Aboriginal cohort, as there is no reliable method to identify them within the general population.[22]

COPD case definition. The following case-finding algorithm recommended by the Canadian Chronic Disease Surveillance System-Chronic Respiratory Disease Working Group was used to identify COPD cases in the study population[23]: individuals aged 35 years and older at the time of diagnosis who have at least two physician claims with an ICD-9 code (491, 492, 496) of COPD in the first diagnostic field of the Alberta Physician Claims Assessment System in a two-year period, or one recording of an ICD-10-CA code (J41-J44) of COPD in any diagnostic field in the hospital discharge abstract ever, whichever comes first. The two physician claims must have been on different days; and, when the case definition was met by two physician claims, the date of diagnosis was the date of

the second physician claim when the case definition was met.

This algorithm has been previously validated to identify adults with COPD, showing a sensitivity of 68.4% (95% confidence interval [CI]: 59.1, 76.7), specificity of 93.5% (95% CI: 90.3, 96.0), positive predictive value of 79.2% (95% CI: 70.0, 86.6) and negative predictive value of 89.1% (95% CI: 85.4, 92.2).[24] The index date was the date of diagnosis of COPD. Once individuals were identified as having COPD, they remained part of the study population throughout the study period until they died.

Covariates. Sociodemographic information was extracted from the AHCIP registry. All study participants were coded as either male or female. Age at the beginning of each fiscal year was grouped into five 10-year intervals (35-44 years, 45-54 years, 55-64 years, 67-74 years, and 75 years and over). Area of residence (urban, rural, and remote) was based on the place of residence at the beginning of every fiscal year according to the Statistical Area Classification of census subdivision areas by Statistics Canada.[14] Health care insurance premiums in Alberta are full or partially subsidized for individuals qualifying for social assistance. The need for, and receipt of health care subsidies represents a measure of socioeconomic status within the Canadian health care system. Therefore, the subsidy level (full, partial, none) at the beginning of every fiscal year was used as a proxy measure of socioeconomic status.

Outcomes. The annual prevalence of COPD was calculated for fiscal years 2002/2003 to 2009/2010 (fiscal year: April 1st of current year to March 31st of subsequent year) for the Aboriginal and the non-Aboriginal cohorts. Since the cohorts were dynamic over time, the population at risk for every fiscal year were individuals 35 years and older alive by the beginning of each fiscal year. The numerator for the annual prevalence was the number of active (alive at the beginning of the fiscal year) COPD cases from the previous fiscal year plus the number of new COPD cases detected by the end of the current fiscal year. The denominator was the population at the beginning of the fiscal year minus ½ the total number of deaths that occurred during the fiscal year.

Historical information on COPD diagnoses was collected from April 1, 1994

onwards to allow an eight-year run-in period to identify prior prevalent cases of COPD by the start of the study period. A long prevalence period to identify pre-existing COPD was chosen because selecting a short prevalence period can substantially inflate estimates of incidence through misclassification.[25] All individuals diagnosed with COPD were included in the calculation of the prevalence estimates from the first year of diagnosis throughout the entire study period until they died. All annual prevalence estimates were expressed as percentages.

Annual incidence rates of COPD were calculated from fiscal years 2002/2003 to 2009/2010 for the Aboriginal and the non-Aboriginal cohorts. The numerator for the annual incidence rates was the number of new COPD cases per year and the denominator was the person-time of observation (the sum of the time that each person remained under risk and free from disease until COPD diagnosis, death, or end of fiscal year; whichever came first). COPD cases were deemed incident cases in the first fiscal year in which they met the case definition, and cases were considered incident only once.

Incidence density rates for Aboriginal and non-Aboriginal cohorts were calculated as the total number of new COPD cases that occurred between 2002/2003 and 2009/2010 divided by person-time of observation (the sum of the time that each person remained under risk and free from disease until COPD diagnosis, death, or end of study). Follow-up time for incidence density rates was the time between the beginning of the study (April 1, 2002) to the date of COPD diagnosis, death, or end of study (March 31, 2010), whichever occurred first. All incidence rates were expressed as COPD cases per 1,000 persons-years.

3.2.5. Statistical analysis

Aboriginal and non-Aboriginal groups were described in terms of age, sex, area of residence and subsidy level in the year of entry into the cohort.

All crude COPD prevalence and incidence estimates were age-and sex-adjusted using the direct standardization method[26] and the 1991 Canadian Census population as the standard.[27] Both crude and standardized estimates were

presented with 95% CI around the estimates. Where the 95% CI of two estimates did not overlap, it was concluded that there was a significant difference between the two estimates.

For the analysis of differences in annual COPD prevalence estimates between Aboriginal and non-Aboriginal groups, unadjusted prevalence ratios (PR) with 95% CI were obtained for each fiscal year. Using Poisson regression models fitted for eight time periods (2002-2003, 2003-2004, 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010), PRs were adjusted for age group, sex, socioeconomic status-proxy, and area of residence at baseline. All regression models included Aboriginal status as the independent variable (with the non-Aboriginal population as the reference category) and the annual COPD prevalence as the dependent variable. Similarly, crude incidence rate ratios (IRR) with 95% CI were calculated for every fiscal year and the entire study period.

Poisson regressions were conducted to adjust the IRRs by age group, sex, socioeconomic status-proxy, and area of residence at baseline, using person-time as the offset in the models. Two-sided p-values less than 0.05 represented statistical significance for all comparisons. The suitability of the regression models was assessed using Q-Q plots of the standardized deviance residuals against their estimated distribution. All statistical analyses were performed using Predictive Analysis Software Statistics for Mac® (PASW® version 18.0, IBM SPSS, Somers NY).

3.2.6. Ethics approval

The University of Alberta's Health Research Ethics Board (HREB), in Edmonton, Alberta, Canada granted ethics approval for this study (Appendix C). Additional recommendations from the former Canadian Institutes of Health Research (CIHR) Guidelines for Health Research Involving Aboriginal Peoples were followed.[28] The research proposal for this study was presented to the Public Health Surveillance Advisory Committee Meeting of the MNA in November 2009. Similarly, the research proposal was presented to an open forum under the MNA conference "Moving Forward Together: Building Strong, Healthy and Safe

Métis Communities" in March 2010. Finally, the research proposal received official endorsement from the MNA (Appendix D).

3.3. Results

A total of 79,824 individuals were followed-up over the 8-year study period. Table 1 shows the baseline characteristics of the total study population.

3.3.1. Prevalence of COPD

The number of prevalent cases of COPD in the entire study population rose from 1,921 in fiscal year 2002 to 5,293 by the end of the study period; an increase of 76.7% (95% CI: 76.6, 76.8) in the age- and sex-standardized COPD prevalence for the entire study population over eight years of observation. Both crude and age- and sex-standardized annual COPD prevalence rates were higher in the three Aboriginal groups compared to those of the non-Aboriginal group, with Registered First Nations peoples and the Inuit having the highest COPD prevalence followed by the Métis (Table 3.2 and Figure 3.2).

Table 3.3 summarizes the annual unadjusted and adjusted PRs for COPD in Aboriginal groups compared to the reference group of non-Aboriginals. For every fiscal year, unadjusted PRs of COPD indicated that Aboriginal peoples, as a whole group, had a significantly higher COPD prevalence compared to the non-Aboriginal group. Significant increases in unadjusted COPD prevalence were observed for Registered First Nations and Inuit groups but not for the Métis compared to non-Aboriginals.

After adjusting for age, sex, socioeconomic status and area of residence, the PRs were significant for all Aboriginal groups compared to the reference group of non-Aboriginals in every year of the study. Compared to the non-Aboriginal group, Registered First Nations peoples were between 2.3 and 2.4 times more likely to have COPD, followed by the Inuit (1.86 to 2.10 more likely) and the Métis (1.59 to 1.67 times more likely). There were significant differences in the prevalence of COPD among the three Aboriginal groups. Registered First Nations and Inuit showed significantly higher annual COPD prevalence estimates than the

Métis but differences between Registered First Nations peoples and Inuit in their annual COPD prevalence estimates were not significant.

3.3.2. Incidence of COPD

A total of 3,885 new cases of COPD were identified over the 8-year study period. Age- and sex standardized incidence rates of COPD for the entire study population decreased from 8.4 cases per 1,000 person-years in 2002/2003 to 6.4 cases per 1,000 person-years in 2009/2010, for an absolute percentage reduction in COPD incidence of 41.7% (95% CI: -41.2, -41.9). Crude and sex-and age standardized incidence rates of COPD at the beginning of the study period were higher in Registered First Nations peoples and Inuit compared to the non-Aboriginal population (Table 3.4). In contrast, COPD incidence rates at the beginning of the study were lower in the Métis group compared to those found in the non-Aboriginal population.

Both crude and age- and sex-standardized COPD incidence rates showed annual fluctuations over time, particularly among the Inuit and Métis groups. During fiscal years 2002/2003 to 2009/2010, the crude incidence density rate of COPD in the entire study population was 7.0 per 1,000 person-years (95% CI: 6.9, 7.1), while the age-and sex-standardized incidence density rate was 7.9 per 1,000 person-years (95% CI: 7.8, 8.1).

The crude and age-standardized COPD incidence density rates in all Aboriginal groups for the entire study period were 8.1 (95% CI: 8.0, 9.0) and 11.3 (95% CI: 11.2, 11.4) per 1,000 person-years, respectively. Both crude and age- and sex-standardized incidence density rates in the Aboriginal group were higher than those of the non-Aboriginal group (crude incidence density rate = 5.8; 95% CI: 5.7, 5.9/1,000 person-years; age- and sex-standardized incidence density rate = 5.5; 95% CI: 5.4, 5.6/1,000 person-years). When crude and age-standardized COPD incidence density rates of the three Aboriginal groups were examined, all had higher COPD incidence density rates than the non-Aboriginal group, with Registered First Nations peoples and Inuit having the highest COPD incidence density rates (Table 3.5).

Table 3.6 summarizes the unadjusted and adjusted IRRs for COPD in Aboriginal groups compared to the non-Aboriginal reference group. For every fiscal year in the study period, Aboriginal peoples, as a whole group, had significantly higher unadjusted COPD IRR compared to the non-Aboriginal group. Compared to the non-Aboriginal group, unadjusted COPD IRRs were significantly higher for the Inuit and Registered First Nations peoples only. After adjusting for age, sex, socioeconomic status and area of residence, the Aboriginal groups had significantly higher IRRs compared to the non-Aboriginal group for every year of study.

The pattern of differences relative to the non-Aboriginal groups in the COPD incidence rates over time was not equal for all the three Aboriginal groups. For example, Registered First Nations peoples had between 2 to 2.66 times more incident cases of COPD per 1,000 person-years than the non-Aboriginal group, and all annual COPD incidence rates were significantly different over the study period. The Inuit had between 1.42 to 2.22 times more incident cases of COPD per 1,000 person-years than the non-Aboriginal group; however, differences among groups were not significant for some years (2004/2005 to 2005/2006 and 2008/2009 to 2009/2010). Similarly, the Métis had between 1.2 to 1.85 times more incident cases of COPD per 1,000 person-years than the non-Aboriginal group; however, differences were not significant for the first two years of the study and for 2007/2008.

Overall, the incidence density rate ratio of COPD indicated that all Aboriginal peoples had significantly higher COPD incidence per 1,000 person-years than the non-Aboriginal group (IRR 2.1; 95% CI: 1.97, 2.27). Compared to non-Aboriginals, the number of COPD incident cases per 1,000 person-years was higher among Registered First Nations peoples (IRR = 2.37; 95% CI: 2.19, 2.56) followed by the Inuit (IRR = 1.92; 95% CI: 1.64, 2.25) and the Métis (IRR = 1.49; 95% CI: 1.32, 1.69). An examination of the 95% CI across the three Aboriginal groups (Figure 3.4) indicated that there were no significant differences between Registered First Nations peoples and the Inuit, and between the Inuit and the Métis in their IRRs compared to the non-Aboriginal group.

3.4. Discussion

This retrospective cohort study used systematically collected administrative health data to assess differences between Aboriginal and non-Aboriginal groups in Alberta with respect to the prevalence and incidence of COPD. Annual estimates of COPD prevalence were higher in the three Aboriginal groups compared to those in the non-Aboriginal group.

Using a validated diagnostic algorithm, Albertans with Registered First Nations status were between 2.3 and 2.4 times more likely to receive a COPD diagnosis than the non-Aboriginal population after adjusting for potential confounders such as sex, age group, socioeconomic status and area of residence. Similarly, the Inuit were 1.86 to 2.10 times more likely to receive a COPD diagnosis than the non-Aboriginal comparison group, whereas the Métis were 1.59 to 1.67 times more likely to receive a COPD diagnosis compared to non-Aboriginals. Within the Aboriginal peoples group, Albertans with Registered First Nations status and Inuit showed significantly higher annual estimates of COPD prevalence than those of the Métis; however, the annual COPD prevalence estimates were not significantly different between Registered First Nations and Inuit groups.

These are important findings since no other longitudinal studies using administrative health data have been published in Canada comparing the prevalence of COPD among the three Aboriginal groups relative to a non-Aboriginal reference group. This has been particularly challenging for the Métis Nation; since the definition of who is Métis has changed many times over time and they have been seldom identified as a unique population in epidemiological studies.[29]

Prevalence estimates of COPD reported in this study are consistent with those of other studies based on administrative health data involving particular Aboriginal groups. One retrospective cohort study based on probabilistic linkage between the Métis Nation of Ontario citizenship registry and Ontario administrative health datasets[13] found significant differences in the 2007-2008 prevalence of COPD between Métis (14.7%) and non-Métis groups (10.7%).

Similarly, analysis of administrative health data in Manitoba for the year 2006 showed that Métis have a higher prevalence of a cluster of respiratory conditions (including asthma, chronic or acute bronchitis, emphysema and chronic airway obstruction) compared to the general Manitoban population (13.6% versus 10.6%).[12]

Age- and sex-standardized COPD incidence rates in the study showed annual fluctuations over time, particularly among the Inuit and Métis groups. These fluctuations were likely the result of the rather small number of COPD cases reported in these two Aboriginal groups and the relatively small population size. The age- and sex-standardized COPD incidence rates in all Aboriginal groups, however, were higher than those of the non-Aboriginal group.

Analysis of the incidence density rate ratio showed that Aboriginal peoples had significantly higher COPD incident cases per 1,000 person-years than the non-Aboriginal group, with higher rates observed among First Nation peoples (~2.4 times higher) followed by the Inuit (~1.9 times higher) and the Métis (~1.5 times higher). Analysis of COPD incidence between Aboriginal and non-Aboriginal peoples conducted in other studies are scarce; however, our results are similar to those reported in another study that found that the incidence of COPD was 1.5 times higher among Métis compared to non-Métis.[13]

Because COPD is a chronic disease, the proportion of people living with COPD tends to increase over time, especially if there are improvements in treatment and early diagnosis. After standardization for age and sex, the annual prevalence of COPD for the entire study population increased by 76.7% at the end of the study period. Overall prevalence estimates of COPD in our study are consistent with other retrospective cohort studies in Canada that reported COPD prevalence estimates of 7.6% (from 2000 to 2008)[30] and 9.5% (from 1996 to 2007)[31] in the general population. Relative decreases of 41.7% in the incidence of COPD were found for the entire population; a result that is consistent with administrative-based studies of COPD overall incidence in Canada.[31]

The increased COPD prevalence and incidence among Aboriginal peoples compared to the non-Aboriginal population is likely explained through multiple

mechanisms. There is evidence[32-34] that smoking rates among Canada's Aboriginal populations are, on average, twice as high as those of non-Aboriginal Canadians. Smoking rates are highest for Inuit (~49%), followed by First Nations peoples (~40%) and Métis (~37%) compared to non-Aboriginals (~21%).[35] In Alberta, rates of current smoking among Aboriginal peoples are 43.4% for First Nations peoples, and 38.8% for Métis compared to 21.8% in non-Aboriginal Albertans (Inuit data not available).[35] If smoking is the most important etiologic factor in the development of COPD,[36,37] one could expect that epidemiological indicators of COPD would be higher in Aboriginal peoples compared to the non-Aboriginal population.

Similarly, for certain Aboriginal groups who follow a traditional lifestyle or live on reserves, exposure to environmental contaminants derived from biomass fuel burned for cooking and living in poorly ventilated areas can also increase their risk to develop COPD.[38,39]

Since the socioeconomic gradient in COPD is greater than in any other disease[40] and Aboriginal peoples in Canada have higher rates of poverty and lower income levels than non-Aboriginal Canadians.[41] it is possible that interactions between social deprivation, economic disadvantage, poverty, smoking, housing conditions, nutrition and prenatal and childhood exposures to cigarette smoking are likely to be distal mechanisms for the higher prevalence and incidence of COPD among Aboriginal peoples in the study.[42] The relationship of social determinants of Aboriginal respiratory health and the development of COPD is an important one and these hypothesis should be further tested to determine the excess risk of COPD that can be attributed to social inequalities affecting Aboriginal peoples.

To the best of our knowledge, this is one of the first studies in Canada, and the first one in Alberta that provided a comprehensive longitudinal assessment of the prevalence and incidence of COPD in the three Aboriginal groups compared to the non-Aboriginal population after adjusting for socioeconomic factors such as sex, age, socioeconomic status and area of residence. The advantage of using administrative health data to evaluate the epidemiology of COPD among

Aboriginal peoples in Alberta lies in the large number of cases available in a fixed geographical area. It is within reason to expect that the results can be generalized to Aboriginal peoples in Alberta and allow inferences that can be applied to Aboriginal populations in other Canadian provinces.

The retrospective cohort design with database linkage constituted a cost-efficient and valid method to evaluate the observed differences in the prevalence and incidence of COPD in the Aboriginal and non-Aboriginal cohorts.[43] Moreover, it involved a large number of people with wide coverage and continuity of data over a relatively long follow-up period. Additionally, the analytical methods controlled for the impact of potential confounders (i.e., age, sex, socioeconomic status, and area of residence) that may have obscured the relationship between Aboriginal status and COPD incidence and prevalence.

Another strength of the study is the comprehensive methods to identify individuals in the Aboriginal cohorts. Other studies that have assessed the health status of Aboriginal peoples in Canada,[44-47] and particularly in Alberta,[11,43,44] have restricted their analyses to individuals with Registered First Nations status only, with Inuit and Métis being systematically excluded from the analyses. Data linkage between the MNA registry and administrative health databases is likely to have reduced the impact of misclassification bias in the definition of Aboriginal status in the study.[48]

The research approach of this study, however, has some limitations that must be acknowledged. Misclassification bias affecting the status of exposure (i.e., being Aboriginal) was not entirely eliminated. Not all (perhaps as low as 30%) Métis in the province are members of the MNA and therefore, a substantial number of non-MNA Métis were not included in the study or misclassified in the non-Aboriginal group. Similarly, limitations encountered in similar studies regarding the proper identification of non-Registered Aboriginal peoples persisted.[22]

A validated algorithm for identification of COPD cases based on physicians claims and hospitalization data was used for the study. The algorithm did not specifically included emergency department (ED) diagnoses of COPD, and there

is evidence that approximately 10% of cases in clinical trials receive their first diagnosis in the ED.[49]

The algorithm for COPD case identification considered individuals 35 years and older by the time of diagnosis. This means that COPD cases diagnosed prior to this age (which may be in the earliest stages of disease progression) were missed and therefore, the true incidence and prevalence rates of COPD are likely to be underestimated. Clinical guidelines report that COPD is rarely diagnosed before age 35 years;[50] however, there is evidence that pre-clinical stages of COPD can be present at the age of 20 years and over.[51-54] For example, data from an international survey of chronic obstructive pulmonary disease in young adults according to GOLD stages[51] reported prevalence rates of 11.8% in the pre-clinical stage when airway obstruction is not yet developed (GOLD stage 0), and 2.5% and 1.1% in GOLD stages 1 and 2, respectively. Similarly, Cerveri et al.[54] reported that the prevalence of chronic cough and phlegm without coexisting asthma is high (9.5%) among young adults aged 20 years and over, but additional follow-up would be needed to establish how many of these individuals would develop COPD later in life.

Similarly, the study may have included clinically significant COPD only; excluding milder cases that may have been active COPD cases at a younger age. Since the exclusion of individuals younger than 35 years of age was equally applied to both the Aboriginal and non-Aboriginal cohorts, it is unlikely that a differential information bias affected the magnitude or direction of COPD prevalence and incidence outcomes in the comparison groups.

There are some recognized limitations inherent to the use of administrative data for research purposes, such as a lack of control over data quality and superficial clinical details. Given the many problems in obtaining adequate information on exposure and disease in retrospective cohort studies, information on key clinical and sociodemographic confounding variables (e.g., smoking status, smoking history, body mass index[55]) were not available from the administrative databases to adjust the baseline risk for COPD in the multivariate analyses.

Previous research has shown that certain Aboriginal groups (i.e., First Nations peoples and Inuit) are near two times more likely to smoke than the rest of the Canadian population.[32,33,56] Because smoking is an important etiologic agent in the development of COPD,[36,37] it is unknown whether diagnostic suspicion bias plays a role when Aboriginal peoples are diagnosed with COPD due to prior knowledge of clinicians about higher smoking rates in certain Aboriginal groups.[32,33,48]

A systematic review on health care access among Aboriginal peoples in North America, Australia and New Zealand[57] has identified important barriers to health care services that disproportionately affect Aboriginal communities compared to the general population. Access barriers to health services increase the likelihood that Aboriginal peoples with COPD contact the health care system at more severe stages of the disease compared to non-Aboriginals; being therefore, more likely to be identified. Additionally, due to past histories of abuse and discrimination toward Aboriginal peoples, mistrust towards doctors and healthcare professionals may result in Aboriginal individuals not seeking medical care until symptoms become exacerbated and potentially life threatening.[58] This may result in a potential overestimation of population disease severity at diagnosis.

3.5. Conclusions

This is the first large and comprehensive cohort study that evaluated the epidemiology of COPD in all Aboriginal groups in Alberta. Compared to the non-Aboriginal population, Aboriginal peoples have higher prevalence and incidence of COPD, with Registered First Nations peoples and Inuit having the highest rates of COPD. Differences in the magnitude of COPD across the three Aboriginal groups exist. Further evaluations of the role of smoking and other social determinants of health are needed to elucidate the mechanisms responsible for the increased prevalence and incidence of COPD in the three Aboriginal groups.

Results of this research provide a comprehensive picture of how often COPD problems affect Aboriginal peoples in Alberta. They should be considered for the planning of respiratory health services delivered to Aboriginal peoples in the

province and for identifying areas for which specific prevention and disease management interventions may be tailored for each Aboriginal group to improve their respiratory health status and outcomes.

Table 3. 1. Characteristics of the study population of Aboriginal and non-Aboriginal groups in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	2002	2003	2004	2005	2006	2007	2008	2009
Total population at baseline	63,274	65,606	67,968	70,503	72,903	75,265	77,548	79,824
Aboriginal groups (%)	48.7	49.3	49.8	50.4	50.9	51.5	51.9	52.3
Registered First Nations (%)	36.9	37.5	38.1	38.8	39.4	40.1	40.6	41.1
Métis (%)	9.4	9.4	9.4	9.3	9.3	9.2	9.2	9.1
Inuit (%)	2.4	2.4	2.3	2.3	2.2	2.2	2.1	2.1
Non-Aboriginal (%)	51.3	50.7	50.2	49.6	49.1	48.5	48.1	47.7
Male (%)	49.2	49.2	49.2	49.2	49.1	49.1	49.1	49.1
Age (yr) (± SD)	51.3 (12.7)	51.7 (12.8)	52.1 (13.0)	52.5 (13.2)	52.9 (13.4)	53.3 (13.5)	53.7 (13.7)	54.2 (13.9)
Age groups (%)								
35-44 yr	39.2	38.0	36.7	35.4	34.2	32.7	31.4	30.0
45-54 yr	28.3	28.5	28.9	29.3	29.5	29.8	29.9	29.9
55-64 yr	16.4	16.7	17.0	17.2	17.5	18.0	18.5	19.1
65-74 yr	9.9	10.0	10.1	10.4	10.5	10.6	10.8	11.0
≥ 75 yr	6.2	6.8	7.3	7.7	8.3	8.9	9.4	10.0
Area of residence (%)								
Urban	60.8	60.6	60.8	60.5	60.7	60.6	60.7	60.6
Rural	30.6	30.7	30.6	30.8	30.6	30.7	30.6	30.6
Remote	8.6	8.6	8.7	8.7	8.7	8.7	8.7	8.8
Subsidy level (%)								
Full	15.9	15.5	15.5	23.5	23.9	24.2	23.9	23.7
Partial	1.5	1.5	1.7	0.7	0.2	0.5	0.5	0.5
None	82.6	83.0	82.8	75.8	75.9	75.3	75.6	75.8
COPD prevalent cases (n)	1921	2413	2877	3357	3786	4289	4796	5293
Aboriginal groups	1150	1424	1695	1967	2221	2518	2832	3137
Registered First Nations	886	1101	1320	1521	1709	1940	2193	2426
Métis	106	192	228	271	317	361	403	453
Inuit	158	131	147	175	195	217	236	258
Non-Aboriginal	771	989	1182	1390	1565	1771	1964	2156
COPD incident cases (n)	513	491	463	479	425	501	506	497
Aboriginal groups	287	273	270	271	252	295	313	305
Registered First Nations	224	214	218	200	186	230	252	233
Métis	34	34	36	43	46	43	42	50
Inuit	29	25	16	28	20	22	19	22
Non-Aboriginal	226	218	193	208	173	206	193	192
Total person-time (yr)	60654.3	63032.0	65389.3	67895.4	70321.6	72579.5	74854.4	77118.8
Aboriginal groups	29346.0	30878.9	32394.6	34084.1	35663.4	37196.6	38681.6	40201
Registered First Nations	22195.1	23501.5	24796.1	26278.0	27645.8	28973.88	30258.2	31608.5
Métis	5736.9	5945.9	6141.8	6335.2	6521.3	6695.94	6881.4	7030.8
Inuit	1413.9	1431.5	1456.7	1470.9	1496.3	1526.78	1542.02	1561.7
Non-Aboriginal	31308.3	32153.1	32994.7	33811.3	34658.2	35382.9	36172.8	36917.8

COPD = chronic obstructive pulmonary disease; SD = standard deviation; yr = year(s)

Table 3. 2. Annual crude, and age- and sex-standardized COPD prevalence in Aboriginal and non-Aboriginal groups in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

Fiscal year	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	Percentage change in COPD prevalence from 2002/2003 to 2009/2010 (%, 95% CI)
Crude prevalence (%) (95% CI)									
Overall	3.0 (2.9, 3.2)	3.5 (3.4, 3.7)	4.1 (3.9, 4.2)	4.6 (4.4, 4.7)	5.0 (4.8, 5.1)	5.4 (5.3, 5.6)	5.9 (5.8, 6.1)	6.4 (6.2, 6.6)	113.3 (113.2, 113.4)
Aboriginal groups	3.7 (3.5, 4.0)	4.2 (4.1, 4.5)	4.9 (4.6, 5.1)	5.4 (5.1, 5.6)	5.8 (5.6, 6.0)	6.3 (6.0, 6.5)	6.8 (6.5, 7.0)	7.2 (7.0, 7.5)	94.5 (94.4, 94.6)
Registered First Nations	3.8 (3.6, 4.1)	4.3 (4.1, 4.5)	4.9 (4.6, 5.2)	5.3 (5.1, 5.6)	5.7 (5.5, 6.0)	6.2 (5.9, 6.5)	6.7 (6.4, 7.0)	7.1 (6.8, 7.4)	86.8 (86.7, 86.9)
Métis	2.6 (2.2, 3.1)	3.1 (2.7, 3.6)	3.6 (3.1, 4.0)	4.1 (3.7, 4.6)	4.7 (4.2, 5.2)	5.1 (4.6, 5.6)	5.5 (5.0, 6.0)	6.1 (5.5, 6.6)	134.6 (134.4, 134.8)
Inuit	6.9 (5.7, 8.2)	7.9 (6.6, 9.4)	9.1 (7.7, 10.5)	10.7 (9.2, 12.3)	11.7 (10.2, 13.3)	13.0 (11.3, 14.6)	14.0 (12.3, 15.6)	14.7 (13.0, 16.4)	113.0 (112.8, 113.2)
Non-Aboriginal	2.3 (2.2, 2.6)	2.7 (2.6, 2.9)	3.3 (3.1, 3.5)	3.8 (3.6, 4.0)	4.1 (3.9, 4.2)	4.5 (4.3, 4.8)	5.0 (4.8, 5.2)	5.5 (5.2, 5.7)	139.1 (139.0, 139.2)
Age- and sex-standardized prevalence (%) (95% CI)									
Overall	4.3 (3.9, 4.7)	4.2 (3.8, 4.6)	5.5 (5.0, 5.9)	6.0 (5.6, 6.5)	6.4 (6.0, 6.9)	6.8 (6.3, 7.3)	7.2 (6.8, 7.7)	7.6 (7.1, 8.0)	76.7 (76.6, 76.8)
Aboriginal groups	6.9 (5.8, 8.0)	7.7 (6.6, 8.7)	8.5 (7.5, 9.6)	9.1 (8.1, 10.1)	9.7 (8.7, 10.7)	10.2 (9.2, 11.1)	10.6 (9.6, 11.5)	10.9 (10.0, 11.8)	57.9 (57.7, 58.0)
Registered First Nations	7.4 (6.1, 8.7)	8.2 (7.0, 9.5)	9.2 (7.9, 10.4)	9.7 (8.5, 11.0)	10.3 (9.1, 11.6)	10.8 (9.7, 12.0)	11.4 (10.2, 12.5)	11.8 (10.7, 12.9)	59.5 (59.4, 59.7)
Métis	4.6 (1.53, 7.6)	6.3 (3.3, 9.4)	6.5 (3.9, 9.1)	7.0 (4.6, 9.4)	7.4 (5.1, 9.7)	7.9 (5.7, 10.1)	8.2 (6.2, 10.3)	8.4 (6.5, 10.3)	82.6 (82.5, 82.7)
Inuit	7.4 (1.9, 12.8)	7.4 (3.0, 11.8)	8.1 (3.9, 12.3)	9.0 (5.2, 12.8)	9.6 (5.9, 13.3)	9.9 (6.4, 13.4)	10.0 (6.6, 13.4)	9.8 (6.5, 13.1)	32.4 (32.3, 32.5)
Non-Aboriginals	2.9 (2.5, 3.3)	3.2 (2.8, 3.7)	3.7 (3.2, 4.2)	4.1 (3.6, 4.6)	4.4 (3.9, 4.8)	4.6 (4.1, 5.1)	4.9 (4.4, 5.4)	5.2 (4.7, 5.7)	79.3 (79.2, 79.4)

CI = confidence interval; COPD = chronic obstructive pulmonary disease

Table 3. 3. Annual unadjusted and adjusted prevalence ratios of COPD among Aboriginal groups in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

Fiscal year	All aboriginal groups		First Nations		Métis		Inuit	
	COPD PR (95% CI)		COPD PR (95% CI)		COPD PR (95% CI)		COPD PR (95% CI)	
	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted*
2002 - 2003	1.57 (1.43, 1.72)**	2.13 (1.92, 2.36)**	1.59 (1.45, 1.76)**	2.31 (2.06, 2.58)**	1.11 (0.94, 1.32)	1.60 (1.34, 1.91)**	2.91 (2.38, 3.57)**	2.10 (1.70, 2.59)**
2003 - 2004	1.48 (1.36, 1.60)**	2.12 (1.92, 2.33)**	1.50 (1.38, 1.64)**	2.30 (2.08, 2.54)**	1.04 (0.89, 1.22)	1.59 (1.35, 1.87)**	2.85 (2.37, 3.42)**	2.04 (1.68, 2.48)**
2004 - 2005	1.44 (1.34, 1.55)**	2.12 (1.94, 2.32)**	1.46 (1.35, 1.58)**	2.32 (2.11, 2.55)**	1.03 (0.89, 1.19)	1.61 (1.39, 1.86)**	2.70 (2.28, 3.21)**	1.98 (1.65, 2.38)**
2005 - 2006	1.39 (1.29, 1.48)**	2.15 (1.98, 2.34)**	1.39 (1.29, 1.50)**	2.40 (2.19, 2.62)**	1.03 (0.91, 1.18)	1.61 (1.41, 1.85)**	2.76 (2.36, 3.24)**	1.97 (1.66, 2.34)**
2006 – 2007	1.36 (1.28, 1.45)**	2.15 (1.98, 2.33)**	1.35 (1.26, 1.45)**	2.37 (2.17, 2.58)**	1.07 (0.95, 1.21)	1.68 (1.48, 1.91)**	2.76 (2.38, 3.21)**	1.97 (1.68, 2.32)**
2007 – 2008	1.34 (1.26, 1.42)**	2.14 (1.98, 2.31)**	1.32 (1.24, 1.41)**	2.37 (2.18, 2.57)**	1.07 (0.96, 1.20)	1.67 (1.48, 1.88)**	2.72 (2.36, 3.13)**	2.00 (1.71, 2.33)**
2008 – 2009	1.33 (1.26, 1.41)**	2.12 (1.97, 2.28)**	1.32 (1.24, 1.40)**	2.37 (2.18, 2.56)**	1.07 (0.96, 1.19)	1.63 (1.45, 1.83)**	2.69 (2.35, 3.08)**	1.95 (1.68, 2.26)**
2009 - 2010	1.32 (1.25, 1.40)**	2.07 (1.93, 2.22)**	1.30 (1.23, 1.38)**	2.31 (2.14, 2.49)**	1.1 (0.99, 1.21)	1.61 (1.44, 1.80)**	2.71 (2.38, 3.08)**	1.86 (1.61, 2.16)**

Reference group: Non-Aboriginal population;

* Adjusted for sex (male, female), age group (35-44 years, 45-54 years, 55-64 years, 65-74 years, 75 years and over), socioeconomic status proxy (full subsidy, partial subsidy, no subsidy), area of residence (urban rural, remote); ** $p<0.001$

CI = confidence interval; COPD = chronic obstructive pulmonary disease; PR = prevalence ratios

Table 3. 4. Annual crude, and age- and sex-standardized COPD incidence rates in Aboriginal and non-Aboriginal groups in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

Fiscal year	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	Percentage change in COPD incidence from 2002/2003 to 2009/2010 (%, 95% CI)
Crude incidence rate (per 1,000 person-years) (95% CI)									
Overall	8.4 (7.8, 9.3)	7.7 (7.1, 8.5)	7.0 (6.5, 7.8)	7.0 (6.5, 7.8)	6.0 (5.5, 6.6)	6.9 (6.3, 7.5)	6.7 (6.2, 7.4)	6.4 (5.9, 7.0)	-23.8 (-23.5, -24.0)
Aboriginal groups	9.7 (8.7, 11.0)	8.8 (7.8, 9.9)	8.3 (7.4, 9.3)	7.9 (7.1, 9.0)	7.0 (6.3, 8.0)	7.9 (7.0, 8.9)	8.0 (7.3, 9.0)	7.5 (6.8, 8.5)	-22.6 (-22.5, -22.7)
Registered First Nations	10.9 (8.9, 11.1)	9.1 (8.0, 10.4)	8.7 (7.7, 10.0)	7.6 (6.6, 8.7)	6.7 (5.8, 7.7)	7.9 (6.9, 9.0)	8.3 (7.3, 9.4)	7.3 (6.5, 8.4)	-33.0 (-32.9, -33.1)
Métis	5.9 (4.2, 8.2)	5.7 (4.1, 8.0)	5.8 (4.3, 8.1)	6.7 (5.1, 9.1)	7.0 (5.3, 9.4)	6.4 (4.8, 8.6)	6.1 (4.5, 8.2)	7.1 (5.4, 9.3)	20.3 (20.2, 20.4)
Inuit	20.5 (14.3, 29.3)	17.4 (11.9, 25.7)	10.9 (6.8, 17.8)	19.0 (13.2, 27.3)	13.3 (8.7, 20.6)	14.4 (9.5, 21.7)	12.3 (7.9, 19.1)	14.0 (9.3, 21.3)	-31.7 (-30.9, -32.4)
Non-Aboriginals	7.2 (6.3, 8.2)	6.7 (6.0, 7.8)	5.8 (5.0, 6.7)	6.1 (5.4, 7.1)	5.0 (4.3, 5.8)	5.8 (5.1, 6.6)	5.3 (4.6, 6.1)	5.2 (4.5, 6.0)	-27.7 (-27.2, -27.9)
Age- and sex-standardized incidence rate (per 1,000 person-years) (95% CI)									
Overall	12.7 (12.5, 13.0)	11.4 (11.2, 11.7)	9.7 (9.5, 9.9)	9.4 (9.2, 9.6)	8.0 (7.8, 8.1)	8.4 (8.3, 8.6)	8.1 (8.0, 8.3)	7.4 (7.3, 7.6)	-41.7 (-41.2, -41.9)
Aboriginal groups	19.8 (19.2, 20.5)	18.4 (17.8, 19.0)	14.8 (14.3, 15.3)	13.4 (13.0, 13.9)	12.1 (11.7, 12.5)	11.9 (11.6, 12.3)	11.8 (11.5, 12.1)	10.1 (9.8, 10.3)	-49.0 (-48.0, -49.1)
Registered First Nations	22.0 (21.3, 22.8)	19.3 (18.9, 20.3)	16.7 (16.1, 17.3)	13.9 (13.3, 14.4)	12.5 (12.0, 12.9)	12.3 (11.8, 12.7)	12.8 (12.4, 13.2)	10.6 (10.3, 11.0)	-51.8 (-51.0, -52.1)
Métis	9.3 (8.4, 10.3)	17.3 (15.2, 19.5)	9.5 (8.8, 10.3)	10.7 (9.7, 11.6)	10.5 (9.7, 11.4)	11.3 (10.4, 12.3)	10.1 (9.2, 11.0)	8.4 (7.8, 9.0)	-9.6 (-9.2, -9.8)
Inuit	22.5 (20.4, 24.5)	14.5 (13.1, 15.8)	8.8 (7.8, 9.8)	16.8 (15.2, 18.4)	11.2 (9.7, 12.7)	10.6 (9.5, 11.7)	7.7 (6.9, 8.5)	10.4 (9.4, 11.4)	-53.7 (-53.2, -53.9)
Non-Aboriginals	9.4 (9.2, 9.7)	8.3 (8.0, 8.5)	6.9 (6.7, 7.1)	6.9 (6.7, 7.1)	5.6 (5.4, 5.8)	6.4 (6.2, 6.5)	5.4 (5.3, 5.6)	5.3 (5.1, 5.5)	-43.6 (-43.3, -43.7)

CI = confidence interval; COPD = chronic obstructive pulmonary disease

Table 3. 5. Crude, and age- and sex-standardized COPD incidence density rate in Aboriginal and non-Aboriginal groups in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	Crude COPD incidence density rate (per 1,000 person-years) (95% CI)	Age- and sex-standardized COPD incidence density rate (per 1,000 person-years) (95% CI)
Overall	7.0 (6.9, 7.1)	7.9 (7.8, 8.1)
Aboriginal groups	8.1 (8.0, 9.0)	11.3 (11.2, 11.4)
Registered First Nations	8.2 (8.0, 9.0)	12.3 (12.1, 12.4)
Métis	6.4 (6.0, 7.0)	8.6 (8.3, 8.8)
Inuit	15.2 (13.0, 17.0)	10.1 (9.7, 10.5)
Non-Aboriginals	5.8 (5.7, 5.9)	5.5 (5.4, 5.6)

CI = confidence interval; COPD = chronic obstructive pulmonary disease.

Table 3. 6. Adjusted and unadjusted incidence rate ratios of COPD among Aboriginal and non-Aboriginal groups in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

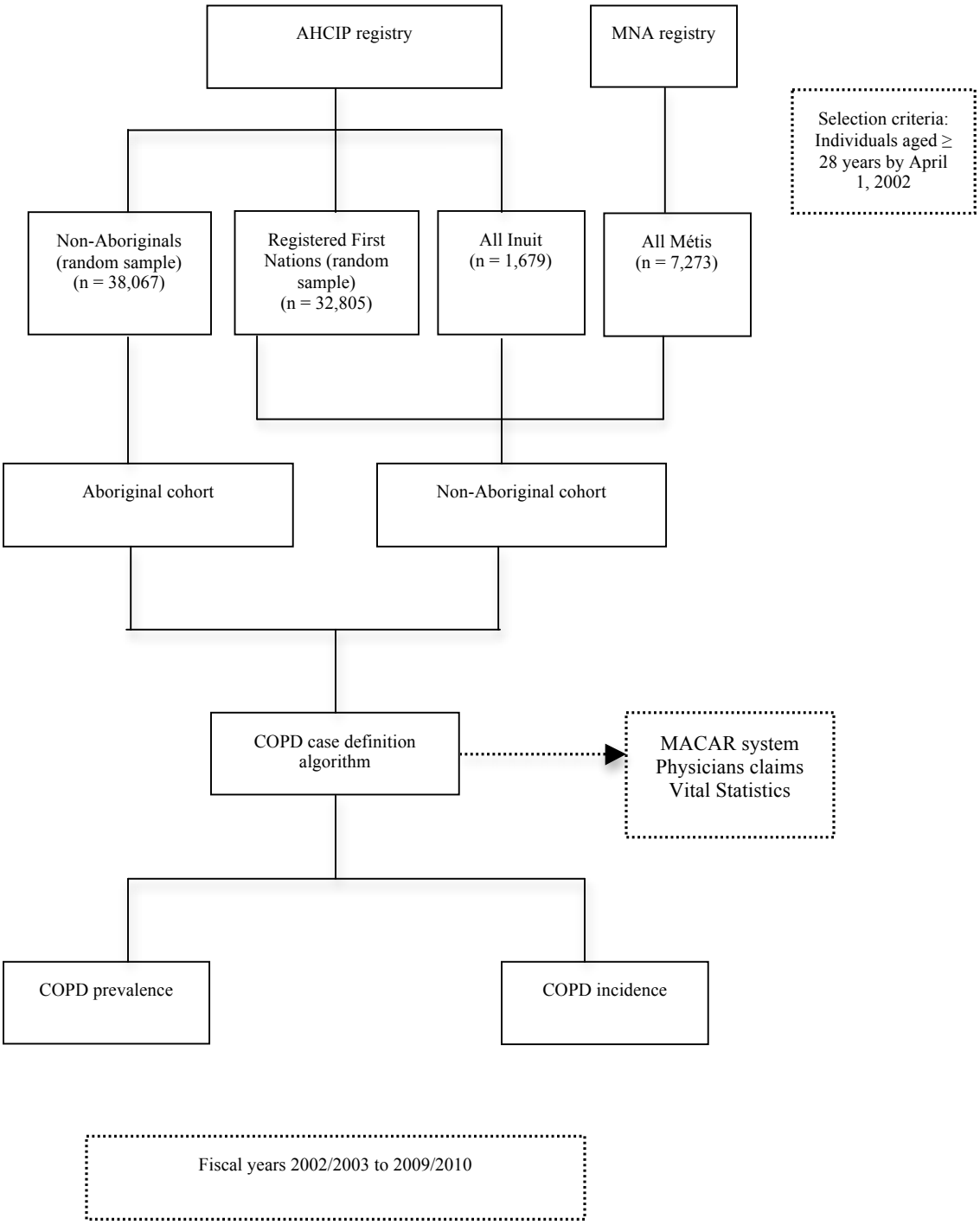
Fiscal year	All aboriginal groups		First Nations		Métis		Inuit	
	COPD IRR (95% CI)		COPD IRR (95% CI)		COPD IRR (95% CI)		COPD IRR (95% CI)	
	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted*
2002 - 2003	1.35 (1.13, 1.61)**	2.11 (1.73, 2.57)**	1.39 (1.16, 1.68)**	2.39 (1.94, 2.95)**	0.82 (0.57, 1.18)	1.24 (0.86, 1.80)	2.84 (1.93, 4.18)**	2.22 (1.49, 3.30)**
2003 - 2004	1.30 (1.09, 1.55)**	2.06 (1.68, 2.52)**	1.34 (1.11, 1.62)**	2.27 (1.83, 2.82)**	0.84 (0.58, 1.21)	1.35 (0.93, 1.96)	2.57 (1.70, 3.89)**	2.09 (1.37, 3.19)**
2004 - 2005	1.42 (1.18, 1.71)**	2.14 (1.74, 2.63)**	1.50 (1.23, 1.82)**	2.50 (2.00, 3.12)**	1.00 (0.70, 1.43)	1.44 (1.00, 2.08)**	1.87 (1.12, 3.12)**	1.42 (0.85, 2.39)
2005 - 2006	1.29 (1.07, 1.54)**	1.87 (1.53, 2.29)**	1.23 (1.01, 1.50)**	2.03 (1.62, 2.53)**	1.10 (0.79, 1.53)	1.40 (1.00, 1.96)	3.09 (2.08, 4.58)**	2.04 (1.37, 3.06)**
2006 – 2007	1.41 (1.16, 1.71)**	2.15 (1.73, 2.68)**	1.34 (1.09, 1.65)**	2.36 (1.86, 2.99)**	1.41 (1.02, 1.95)**	1.85 (1.32, 2.58)**	2.67 (1.68, 4.2)**	1.77 (1.11, 2.84)**
2007 – 2008	1.36 (1.14, 1.62)**	2.06 (1.69, 2.05)**	1.36 (1.12, 1.64)**	2.43 (1.96, 3.01)**	1.10 (0.79, 1.53)	1.36 (0.97, 1.90)	2.47 (1.59, 3.83)**	1.72 (1.10, 2.68)**
2008 – 2009	1.51 (1.26, 1.81)**	2.22 (1.82, 2.71)**	1.56 (1.29, 1.88)**	2.66 (2.15, 3.30)**	1.14 (0.82, 1.59)	1.43 (1.01, 2.00)**	2.30 (1.44, 3.69)**	1.60 (0.99, 2.58)
2009 - 2010	1.45 (1.21, 1.74)**	2.01 (1.64, 2.45)**	1.41 (1.17, 1.71)**	2.25 (1.81, 2.80)**	1.36 (1.00, 1.86)	1.53 (1.12, 2.11)**	2.70 (1.74, 4.20)**	1.76 (1.12, 2.11)**
Incidence density rate 2002 - 2010	1.48 (1.39, 1.58)**	2.11 (1.97, 2.27)**	1.52 (1.42, 1.63)**	2.37 (2.19, 2.56)**	1.08 (0.96, 1.22)	1.49 (1.32, 1.69)**	2.54 (2.18, 2.96)**	1.92 (1.64, 2.25)**

Reference group: Non-Aboriginal population

* Adjusted for sex (male, female), age group (35-44 years, 45-54 years, 55-64 years, 65-74 years, 75 years and over), socioeconomic status proxy (full subsidy, partial subsidy, none), area of residence (urban rural, remote); ** $p<0.001$

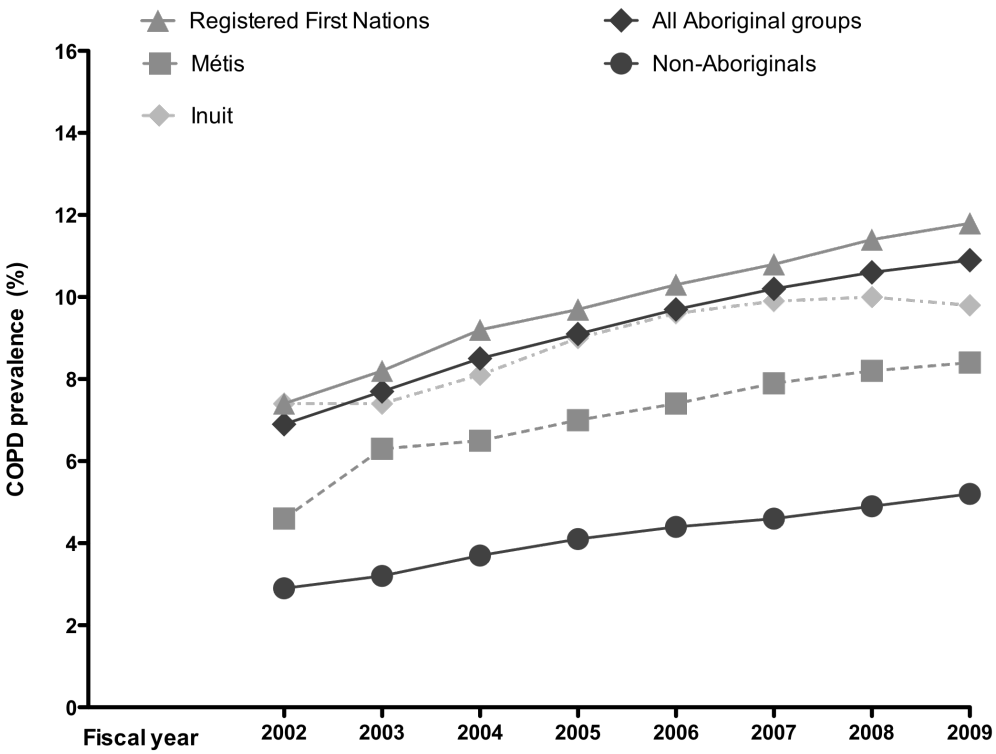
CI = confidence interval; COPD = chronic obstructive pulmonary disease; IRR = incidence rate ratios

Figure 3. 1. Flowchart of the study of prevalence and incidence of COPD among Aboriginal Peoples in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



AHCIP = Alberta Health Care Insurance Plan; COPD = chronic obstructive pulmonary disease; MACAR = Morbidity and Ambulatory Care Reporting; MNA = Métis Nation of Alberta

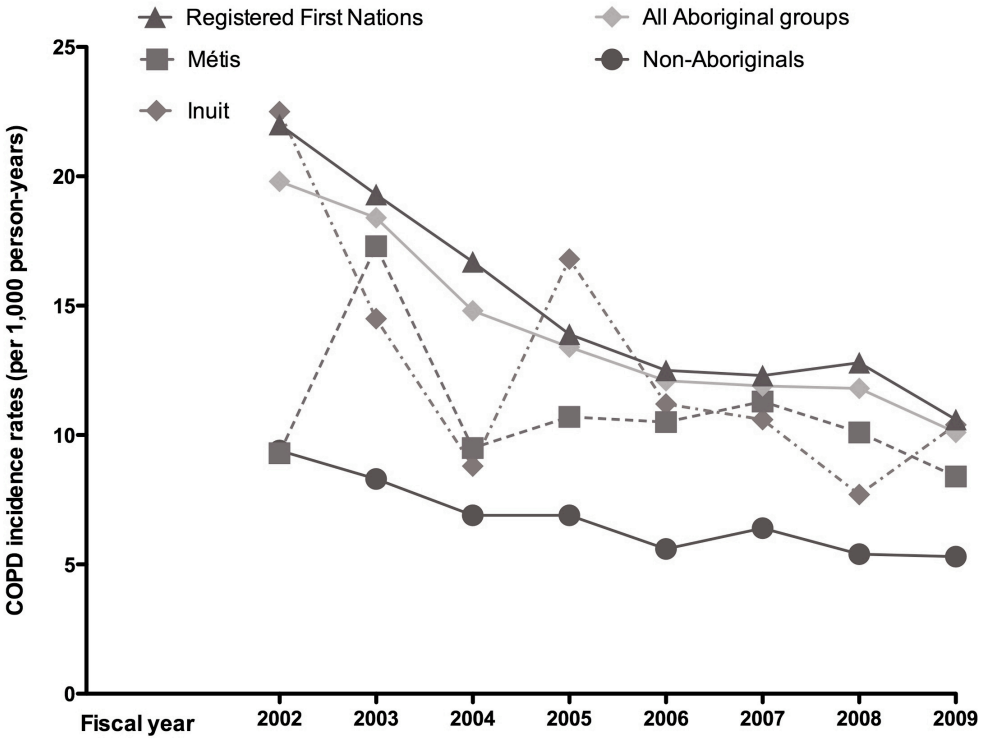
Figure 3. 2. Annual age- and sex-standardized COPD prevalence in Aboriginal peoples and the non-Aboriginal population in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



	2002	2003	2004	2005	2006	2007	2008	2009
All Aboriginal groups	6.9	7.7	8.5	9.1	9.7	10.2	10.6	10.9
Registered First Nations	7.4	8.2	9.2	9.7	10.3	10.8	11.4	11.8
Métis	4.6	6.3	6.5	7.0	7.4	7.9	8.2	8.4
Inuit	7.4	7.4	8.1	9.0	9.6	9.9	10.0	9.8
Non-Aboriginals	2.9	3.2	3.7	4.1	4.4	4.6	4.9	5.2

COPD = chronic obstructive pulmonary disease

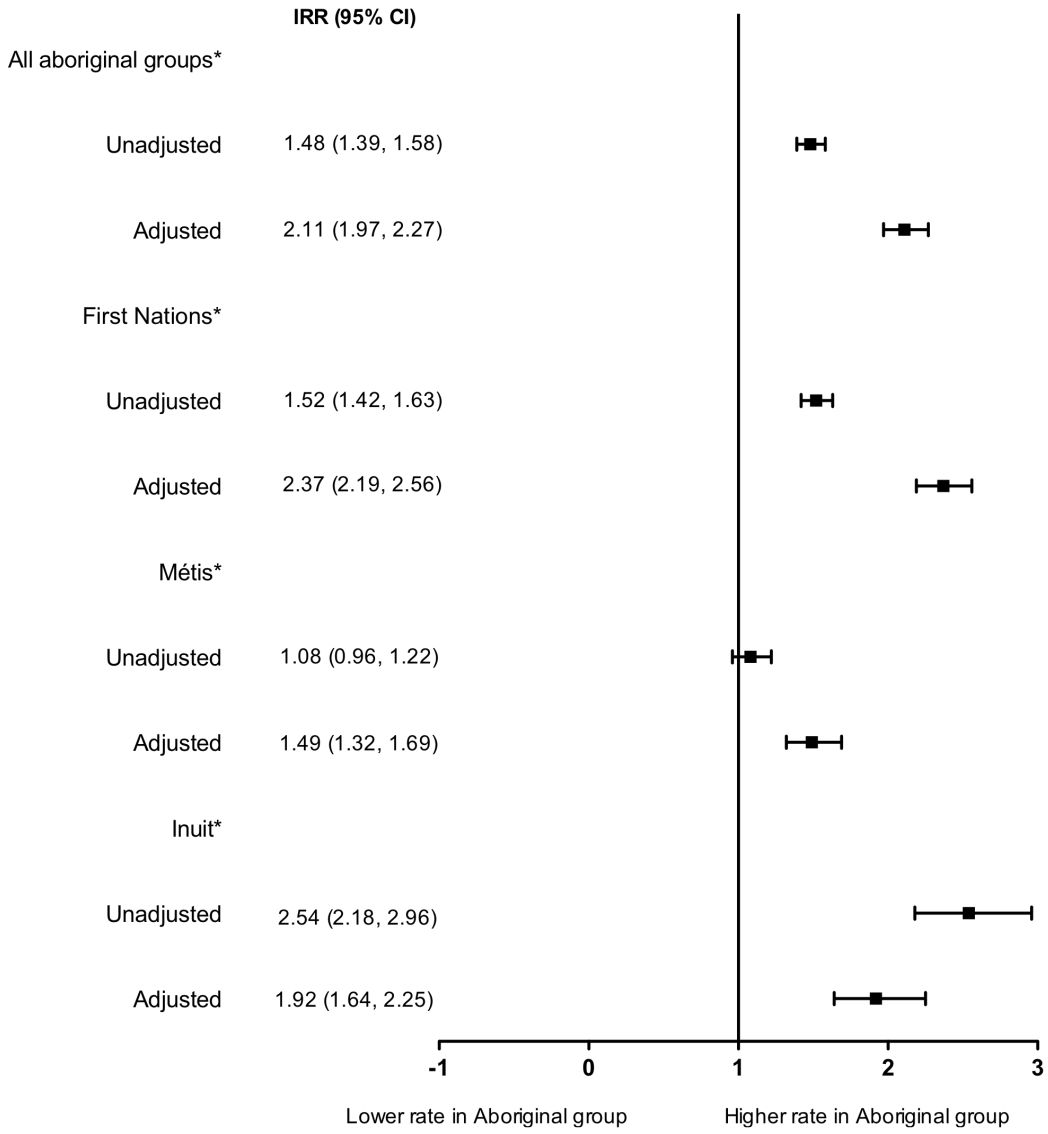
Figure 3. 3. Annual age- and sex-standardized COPD incidence rates in Aboriginal peoples and the non-Aboriginal population in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



	2002	2003	2004	2005	2006	2007	2008	2009
All Aboriginal groups	19.8	18.4	14.8	13.4	12.1	11.9	11.8	10.1
Registered First Nations	22.0	19.3	16.7	13.9	12.5	12.3	12.8	10.6
Métis	9.3	17.3	9.5	10.7	10.5	11.3	10.1	8.4
Inuit	22.5	14.5	8.8	16.8	11.2	10.6	7.7	10.4
Non-Aboriginals	9.4	8.3	6.9	6.9	5.6	6.4	5.4	5.3

COPD = chronic obstructive pulmonary disease

Figure 3. 4. Unadjusted and adjusted COPD incidence-density rate ratios for Aboriginal groups using the non-Aboriginal group as the reference



Notes: Estimates adjusted for sex (male, female), age group (35-44 years, 45-54 years, 55-64 years, 65-74 years, 75 years and over), socioeconomic status proxy (full subsidy, partial subsidy, no subsidy), and area of residence (urban rural, remote).

*Reference group: Non-Aboriginal population; CI = confidence interval; COPD = chronic obstructive pulmonary disease; IRR = incidence rate ratio.

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Chapter 4

All-cause Mortality among Aboriginal Peoples with Chronic Obstructive Pulmonary Disease in Alberta, Canada, 2005/2006 to 2009/2010

4.1. Introduction

Chronic obstructive pulmonary disease (COPD) is an important cause of mortality, accounting for approximately 3 million deaths every year in the world.[1] In 2020, COPD will be ranked as the third highest cause of death worldwide,[2] with more recent projections indicating that by 2030, COPD will become the fourth main cause of death in the world.[3] Mortality rates of COPD in the general population have ranged widely from as low a 7.2 to as high as 36.1 per 100,000 population.[4] In Canada, COPD is the fourth leading cause of death, accounting for 4% of all deaths in 2004[5] and 4.3% in 2007,[6] with sharp increases in mortality for COPD expected in the upcoming years due to changes in the aging of the population and the cumulative effects of prior exposure to tobacco smoking.[6-8]

Aboriginal peoples of Canada have significantly higher mortality rates for a variety of medical conditions compared to non-Aboriginal Canadians.[9-11] Particularly, life expectancy rates for First Nations peoples, albeit showing a trend towards improvement in the last few decades, are still trailing the rest of the non-Aboriginal Canadian population.[12] The inequality gap in mortality between the two populations is particularly accentuated for respiratory diseases; overall, they constitute the fourth leading cause of death among Aboriginal peoples in Canada.[10] A recent systematic review has indicated that mortality rates for COPD in Aboriginal peoples are significantly higher than those of non-Aboriginal groups,[13] however, the data are still sparse.

Only a few Canadian studies have conducted direct comparisons of all-cause mortality between Aboriginal and non-Aboriginal populations after being diagnosed with COPD and their results provide limited evidence applicable to specific Aboriginal groups. Analyses of administrative health data in Ontario[14] have shown that Métis individuals with COPD had lower all-cause mortality rates

compared to non-Métis in the province. The patterns of mortality among Aboriginal populations with COPD in Alberta remain poorly identified. Apart from studies that have assessed health services use for COPD in Registered First Nations peoples compared to other Albertans,[15,16] differences in mortality in individuals diagnosed with COPD across the three distinct Aboriginal groups in the province (First Nations peoples, Métis and Inuit) relative to the non-Aboriginal population are largely unknown.

This retrospective cohort study evaluated all-cause mortality in Aboriginal peoples in Alberta diagnosed with COPD compared to non-Aboriginal individuals with COPD in the province. The main objective was to evaluate and compare all-cause mortality hazards among the three Aboriginal groups of Registered First Nations peoples, Métis and Inuit relative to the non-Aboriginal population in Alberta following a diagnosis of COPD while adjusting for sociodemographic and clinical variables.

4.2. Methods

4.2.1. Study design and setting

This is a retrospective analytical cohort study of all-cause mortality data in COPD based on linkage of administrative health databases in Alberta (Canada) from April 1st 2005 to March 31, 2010. The province of Alberta is located in the western part of Canada with a population of 3 million residents,[17] with 6.7% individuals reporting Aboriginal ancestry.[17] Of the individuals with Aboriginal ancestry, 52% are First Nations peoples, 45% Métis and less than 1% are Inuit.

Medically necessary physician and hospital services are publicly funded for all Albertans under the Alberta Health Care Insurance Plan (AHCIP), which covers virtually all the eligible population in the province (99%).[18] Health coverage of First Nations peoples registered under the Indian Act[19] and the health coverage of Inuit is paid by the First Nations and Inuit Health Branch (FNIHB) of Health Canada. Non-Registered First Nations and Métis receive health coverage from the provincial government, similar to the non-Aboriginal population in Alberta.

4.2.2. Data sources

Alberta Health administrative databases used in this study were the AHCIP registry, the Alberta Physician Claims Assessment System, the Morbidity and Ambulatory Care Reporting (MACAR) system, and Alberta Vital Statistics, plus the Métis Nation of Alberta (MNA) identification registry. The AHCIP registry contains registration and demographic information of all individuals in the province with health care coverage. The MACAR system records data on all hospital admissions and diagnoses associated with acute and elective hospital utilization using the International Classification of Diseases, Tenth Revision; enhanced Canadian version (ICD-10-CA).[20] The Alberta Physician Claims Assessment System records all services provided by fee-for-service physicians and "shadow-billings" for physicians paid under alternate payment plans, with diagnostic fee codes for each visit based on the International Classification of Diseases, Ninth Revision (ICD-9).[21] Alberta Vital Statistics contains death certificate verified data of all deaths that occur within the province and the causes of death according to ICD-10-CA codes. The MNA identification registry includes citizenship information for members of the Métis Nation of Alberta who identify themselves as Métis. De-identified individual-level, longitudinal data, by fiscal year was obtained from health databases using deterministic data linkage[22] based on a unique encrypted personal health number (PHN). Probabilistic linkage[23] was used to obtain an encrypted PHN for persons in the MNA registry and this PHN was then directly linked to the other datasets.

4.2.3. Derivation of the study population

The study population included individuals newly diagnosed with COPD between the fiscal years 2005/2006 and 2009/2010. This study period was chosen because prior to 2004, the MNA registry did not include citizenship information of deceased individuals. As described in Chapter 3, COPD incident cases were identified from the MACAR and the Alberta Physician Claims Assessment databases using a validated case definition[24,25] that included individuals 35 years of age and older at the time of diagnosis who had at least two physician claims with

an ICD-9 code (491, 492, 496) of COPD in the first diagnostic field of the Alberta Physician Claims Assessment System in a two-year period, or one recording of an ICD-10-CA code (J41-J44) of COPD in any diagnostic field in the hospital file ever, whichever came first. The index date was the incidence date of diagnosis of COPD. Incident cases of COPD remained part of the study population throughout the study period with censoring occurring at time of death or end of study (March 31, 2010). The flowchart for selection of the study population is described in Figure 4.1.

4.2.4. Study variables

Aboriginal status: The Aboriginal cohort in this study included Registered First Nations peoples, Inuit (both identified in the AHCIP registry based on an alternate premium arrangement) and Métis (individuals identified as such in the MNA identification registry). If individuals were identified as both Métis and First Nations peoples, they were considered Métis. The non-Aboriginal cohort in the study refers to individuals in the AHCIP registry who do not have an alternate premium arrangement field for Registered First Nations or Inuit, and that are not included in the MNA registry. First Nations peoples without registration and Métis not included in the MNA registry were considered part of the non-Aboriginal cohort, as there is no reliable method to identify them within the general population.[26]

Outcomes: The primary outcome was all-cause mortality. All-cause mortality data (number of deaths and date of death) were obtained from the Alberta Vital Statistics database for fiscal years 2005/2006 to 2009/2010. Because COPD has been found to be underestimated as a cause of death on vital statistics records by approximately 50%,[27,28] all-cause deaths were included, whether or not COPD was listed as the cause of death. The information on deaths contained in the Vital Statistics database was verified against the hospital deaths registered in the MACAR system; where discrepancies in dates of death occurred, the hospital date of death was used.

Covariates: Sociodemographic information was extracted from the AHCIP registry. All study participants were coded as either male or female. Age at the time of COPD diagnosis was grouped in two categories (35 to 64 years, 65 years and over). Area of residence (urban, rural, and remote) was based on the place of residence at index date according to the Statistical Area Classification of census subdivision areas by Statistics Canada.[17] Health care insurance premiums in Alberta are designated as full or partially subsidized for individuals qualifying for social assistance. The need for, and receipt of health care subsidies represents a robust measure of socioeconomic status within the Canadian health care system. Therefore, the subsidy level (full/partial, none) at index date was used as a proxy measure of socioeconomic status.

Comorbidities in this study were defined as the presence of one or more distinct disorders or diseases in addition to COPD, regardless of whether the conditions are or not directly related to COPD.[29] Comorbidities such as cardiovascular diseases, diabetes mellitus (DM), hypertension, asthma, and osteoporosis are common in COPD,[30] with some of them likely to alter the risk of mortality.[29] Comorbid conditions that occurred within a three-year period preceding the index date of COPD were historically identified within the MACAR and the Alberta Physician Claims Assessment databases. Validated case algorithms were used to identify the following comorbid conditions: hypertension,[31,32] DM,[33] ischemic heart disease,[34] asthma,[35] and osteoporosis.[36] If conditions were developed after the index date of COPD diagnosis they were considered COPD complications and not comorbidities and not included in the study.

4.2.5. Statistical analysis

Descriptive analyses were used to describe the characteristics of Aboriginal and non-Aboriginal COPD cohorts in terms of sex, age, socioeconomic status, area of residence, and presence of comorbidities at time of COPD diagnosis.

Crude all-cause mortality rates for Aboriginal and non-Aboriginal COPD groups were calculated as the total number of deaths that occurred between 2005/2006 and 2009/2010 among COPD cases divided by person-time of

observation (the sum of time for each person from COPD diagnosis until death or end of study). Crude all-cause mortality rates were age-and sex-adjusted using the standardization direct method,[37] with weights derived from the 1991 Canadian Census population as reference.[38] Mortality rates were expressed as number of deaths per 1,000 person-years.

Kaplan-Meier curves were constructed to describe COPD survival in the Aboriginal and non-Aboriginal cohorts. Log-rank tests were used to assess differences in survival between the Aboriginal and non-Aboriginal cohorts.

Multivariate Cox proportional-hazard regression models were used to estimate hazard ratios (HR) for mortality after COPD diagnosis for Aboriginal peoples compared to non-Aboriginal individuals as the reference group while adjusting for the following covariates at baseline: age group (35-64 years, and 65 years and over), sex (male, female), socioeconomic status (full/partial subsidy, no subsidy), area of residence (urban, rural, remote) and presence of comorbidities (hypertension, DM, asthma, ischemic heart disease, osteoporosis).

Two separate Cox models were built: one comparing mortality HRs between the entire Aboriginal cohort and the non-Aboriginal group with COPD, and the other comparing mortality HRs of Registered First Nations, Métis and Inuit with COPD relative to the non-Aboriginal cohort with COPD as the reference group. The time variable in the models was time since COPD diagnosis. Censoring for the analysis occurred upon the date of death or March 31, 2010, whichever came first. We used plots of the Schoenfeld residuals to assess the proportional hazard assumption.

A first-order interaction term between Aboriginal status and age group at COPD diagnosis was included in the models to evaluate whether the relationship between Aboriginal status and mortality in COPD differed across age groups. Significant interaction terms ($p < 0.05$) were incorporated in the HR estimates. Log-likelihood ratio tests were used to evaluate whether adjusted Cox regression models that included interaction terms for age group at COPD diagnosis and Aboriginal status provided a significantly better fit than the main-effects Cox regression models.

All mortality outcomes were reported with 95% confidence intervals (CI) around the estimates. When the 95% CI of two estimates did not overlap, it was concluded that there was a significant difference between the two estimates. Two-sided P values less than 0.05 represented statistical significance for all comparisons. Statistical analyses were performed using Predictive Analysis Software Statistics for Mac® (PASW® version 18.0, IBM SPSS, Somers NY) and STATA® for Mac® version 12.0 (STATA Corp LP. College Station, TX).

4.2.6. Ethics approval

Ethics approval for this study was obtained from the University of Alberta Health Research Ethics Board (HREB), in Edmonton, Alberta, Canada (Appendix C). Additional recommendations from the former Canadian Institutes of Health Research (CIHR) Guidelines for Health Research Involving Aboriginal People[39] were adopted. The research proposal was presented to the Public Health Surveillance Advisory Committee Meeting of the MNA in November 2009 and to an open forum under the MNA conference "Moving Forward Together: Building Strong, Healthy and Safe Métis Communities" in March 2010. Finally, the research project received official endorsement from the MNA (Appendix D).

4.3. Results

A total of 2,415 individuals with COPD were followed over the 5-year study period. The total follow-up time was 5,111.3 person-years from the time of COPD diagnosis (2.17 years per person). Table 4.1 shows the baseline characteristics of the cohorts and the crude and age- and sex- standardized all-cause mortality rates in individuals with COPD.

There were 421 deaths that occurred during the follow-up period giving a crude all-cause mortality rate of 82.4 deaths per 1,000 person-years (95% CI: 75.1, 90.2) and an age- and sex-standardized mortality rate of 71.1 (95% CI: 69.6, 72.6) deaths per 1,000 person-years. Non-Aboriginals with COPD had higher crude all-cause mortality rates (105.8; 95% CI: 102.7, 136.4 deaths per 1,000 person-years) than those in the cohort of all Aboriginal peoples with COPD (67; 95% CI: 58.7, 76.4

deaths per 1,000 person-years). Crude all-cause mortality rates of Registered First Nations peoples with COPD (77.2; 95% CI: 67, 88.8 deaths per 1,000 person-years) where higher than those of the Métis with COPD (37.7; 95% CI: 20.6, 67.9 deaths per 1,000 person-years) and Inuit with COPD (36.6; 95% CI: 23.6, 56.5 deaths per 1,000 person-years).

The age-and sex-standardized mortality rate in non-Aboriginal individuals with COPD was 73.6 (95% CI: 71.2, 76.0) deaths per 1,000 person-years, which was higher than that of all Aboriginal groups with COPD (65.1; 95% CI: 63.3, 67.0 deaths per 1,000 person-years) but lower than the age-and sex-standardized mortality rate of Registered First Nations peoples with COPD (78.7; 95% CI: 76.4, 81.1 deaths per 1,000 person-years).

4.3.1. All-cause mortality: Aboriginal peoples versus non-Aboriginals

Five-year survival of the Aboriginal and non-Aboriginal cohorts following a diagnosis of COPD is illustrated in Figure 4.2 along with 95% CI bands around the curves. The median survival times after a COPD diagnosis could not be determined as fewer than 50% of individuals in the cohorts died by the end of the 5-year observation period.

Survival after a diagnosis of COPD was significantly higher in the Aboriginal cohort than in the non-Aboriginal cohort (log-rank test = 21.73, df = 1; $p < 0.0001$). A crude HR of 0.64 (95% CI: 0.52, 0.77) indicated that compared to non-Aboriginals, Aboriginals with COPD had significantly better survival after being diagnosed with COPD.

Table 4.2 summarizes the results of the Cox regression models of all-cause mortality after a diagnosis of COPD in the Aboriginal cohort relative to the reference group of non-Aboriginals with COPD. When the effect of independent predictors of all-cause mortality were adjusted for all the other covariates, we found that being older than 65 years of age and having comorbid ischemic heart disease were significant predictors of the hazard of death following a diagnosis of COPD in the two cohorts.

After adjusting by socioeconomic factors and comorbidities at the time of COPD diagnosis, there were no significant differences in the hazard of death between the Aboriginal and the non-Aboriginal cohorts (HR = 0.83; 95% CI: 0.68, 1.03).

A significant interaction was found between Aboriginal status and age at the time of COPD diagnosis for the outcome of death ($p = 0.013$); meaning that age at time of COPD diagnosis was an effect modifier of the relationship between Aboriginal status and all-cause mortality. The interaction terms in the Cox regression model of mortality HRs for all Aboriginal peoples relative to the non-Aboriginal group improved the overall model fit ($\chi^2 = 6.4$, df = 1; $p < 0.05$).

Results of the Cox regression model accounting for the modifying effect of age showed that Aboriginal peoples aged 65 years and older had a significantly lower hazard of death compared to their non-Aboriginal counterparts of the same age group (HR = 0.71; 95% CI: 0.55, 0.91). Among individuals aged between 35 and 64 years, there were no significant differences between Aboriginal peoples and non-Aboriginal individuals in the mortality hazard after being diagnosed with COPD (HR = 1.25; 95% CI: 0.84, 1.85). Compared to non-Aboriginals aged between 35 and 64 years, the hazard of dying after a COPD diagnosis was significantly higher in Aboriginal peoples aged 65 years and older (HR = 2.26; 95% CI: 1.41, 3.62).

4.3.2. All-cause mortality: First Nations peoples, Métis and Inuit groups versus non-Aboriginals

Figure 4.3. shows the 5-year survival of Registered First Nations, Métis and Inuit groups compared to the non-Aboriginal group after a diagnosis of COPD. The 5-year survival following a diagnosis of COPD was significantly lower in the non-Aboriginal cohort compared to Registered First Nations, Métis and Inuit (log-rank test = 21.73, df = 3; $p < 0.0001$).

Results from the Cox regression models of all-cause mortality after a diagnosis of COPD in Registered First Nations peoples, Métis and Inuit relative to the reference group of non-Aboriginals with COPD (Table 4.3) showed that being

older than 65 years of age and having comorbid ischemic heart disease were significant predictors of the hazard of death following a diagnosis of COPD in all the cohorts. In contrast, living in remote communities, and having comorbid osteoporosis were factors associated with a significantly relative lower hazard of death after a COPD diagnosis.

Unadjusted HRs showed that, compared to the non-Aboriginal group, the hazard of dying during the study period was significantly lower in Registered First Nation peoples (HR = 0.73; 95% CI: 0.60, 0.89), Métis (HR = 0.35; 95% CI: 0.26, 0.49 and Inuit (HR = 0.37; 95% CI: 0.24, 0.56) after a diagnosis of COPD. After adjusting for socioeconomic factors and the presence of comorbidities at the time of COPD diagnosis, there were no significant differences between First Nations peoples and the non-Aboriginal group in the hazard of death (HR = 1.09; 95% CI: 0.87, 1.36) whereas a significantly lower mortality hazard remained for the Métis (HR = 0.41; 95% CI: 0.25, 0.65) and the Inuit (HR = 0.37; 95% CI: 0.20, 0.71) compared to the non-Aboriginal group.

The interaction terms in the Cox regression model of mortality HRs after COPD diagnosis for Registered First Nations, Inuit and Métis relative to the non-Aboriginal group improved the overall model fit ($\chi^2 = 8.329$, df = 3; $p < 0.05$) and showed that age at COPD diagnosis modified the hazard of death.

For individuals aged between 35 and 64 years of age, there were no significant differences in the hazard of death following a COPD diagnosis among Registered First Nations (HR = 1.41; 95% CI: 0.93, 2.12), Métis (HR = 0.91; 95% CI: 0.46, 1.80) and Inuit (HR = 0.70; 95% CI: 0.21, 2.29) compared to the non-Aboriginal cohort. For individuals aged 65 years and over, the hazard of death was significantly lower for the Métis (HR = 0.24; 95% CI: 0.11, 0.49) and the Inuit (HR = 0.31; 95% CI: 0.14, 0.67) relative to the non-Aboriginal group. No significant differences in the hazard of death were identified in individuals with COPD aged 65 years and older who were Registered First Nations or non-Aboriginals (HR = 1.00; 95% CI: 0.77, 1.31).

Compared to younger non-Aboriginals (aged 35 to 64 years), Registered First Nations peoples aged 65 years and over were significantly more likely to die after a

COPD diagnosis (HR = 3.05; 95% CI: 1.87, 4.94). This difference was not significant for Métis (HR = 0.73; 95% CI: 0.32, 1.66). In contrast, Inuit aged 65 years of age and over, had a lower mortality hazard than non-Aboriginals aged 35 to 64 years (HR = 0.95; 95% CI: 0.40, 2.25).

Figure 4.4 summarizes the mortality HRs five years after a diagnosis of COPD in Aboriginal peoples compared to the non-Aboriginal group**.** In general, unadjusted mortality analyses showed that all Aboriginal groups had a lower mortality hazard than that of the non-Aboriginal group after a COPD diagnosis.

When mortality was adjusted for important socioeconomic and clinical covariates, differences between Registered First Nations peoples and non-Aboriginals were no longer significant. For Métis and Inuit, the adjusted HRs remained significant; indicating that the hazard of death in these two groups was lower than the non-Aboriginal group after a COPD diagnosis.

Among individuals aged between 35 years and 64 years, Aboriginal peoples as a whole group, and Registered First Nations peoples as a subgroup, showed mortality hazards similar to non-Aboriginal peoples of the same age group. Similarly, Métis and Inuit in the 35 years-to-64 years age group had similar risk of death as the comparison non-Aboriginal group. Finally, the hazards of death in all Aboriginal peoples, Métis and Inuit aged 65 years and over were significantly lower than that of their non-Aboriginal counterparts. Registered First Nations and non-Aboriginals aged 65 years and over did not differ in the hazard of death after being diagnosed with COPD.

4.4. Discussion

This retrospective cohort study found that there were not significant differences between Aboriginal peoples, as a whole group, and non-Aboriginal individuals in the all-cause mortality hazard after being diagnosed with COPD and after adjusting for important sociodemographic and clinical prognostic factors. When adjusted all-cause mortality hazards were examined by Aboriginal subgroups, all-cause mortality hazard in Métis and Inuit was lower compared to that of the non-Aboriginal group five years after a COPD diagnosis. No differences in all-cause

mortality hazards after COPD diagnosis were found between Registered First Nations peoples and non-Aboriginal peoples in the study.

In line with previous studies, age at time of diagnosis[40-44] and comorbid ischemic heart disease[29,44-47] were important independent predictors of all-cause mortality following a diagnosis of COPD in the two cohorts. Specifically, age was also a significantly effect modifier of the relationship between Aboriginal status and the mortality risk following a COPD diagnosis. Compared to young non-Aboriginal peoples, Aboriginal peoples diagnosed with COPD at a younger age did not differ in the all-cause mortality hazard after diagnosis. Among individuals diagnosed with COPD at an older age (i.e., 65 years and over), the hazards of death in all Aboriginal peoples, Métis and Inuit were significantly lower compared to their non-Aboriginal counterparts. In turn, Registered First Nations and non-Aboriginals diagnosed with COPD at older ages did not differ in their mortality hazards after diagnosis.

To the best of our knowledge, only one other study has examined differences in all-cause mortality between distinct Aboriginal groups and a non-Aboriginal population once a diagnosis of COPD was established.[14] A population-based study linking administrative health data and citizenship registry from the Métis Nation of Ontario (MNO) for the years 2007 and 2008[14] reported similar results and found that Métis registered in the MNO (approximately 18% of Ontario's Métis population) that were diagnosed with COPD had lower all-cause mortality rates compared to COPD cases in the non-Métis population for the years 2007 and 2008 (i.e. crude mortality rate ratios of 0.57 in 2007, and 0.59 in 2008).[14] Studies comparing all-cause mortality rates given COPD between Registered First Nations peoples and Inuit relative to the non-Aboriginal population in Canada have not been published to date.

Mortality outcomes reported in this research differ from those of previous analyses of cause-specific mortality that have shown higher mortality rates attributed to respiratory diseases (including COPD) in Métis (RR = 1.46; 95% CI: 1.07, 2.01) and Registered First Nations (RR = 1.63; 95% CI: 1.41, 1.89) compared to non-Aboriginals.[48] In contrast, this study evaluated five years of data for all-

cause mortality in a sample of individuals newly diagnosed with COPD instead of assessing COPD-specific mortality based on vital statistics records. The cause of death in the COPD study population was not established due to restricted access to information on causes of death from Alberta Vital Statistics. Therefore, it was not possible to establish which were the most frequent causes of death in the COPD population under study and whether there were differences in causes of death between Aboriginal and non-Aboriginal peoples with COPD.

A variety of factors should be considered when interpreting the results of the study. They include interactions between age at diagnosis, intensity and cumulative exposure to tobacco smoking before and after COPD diagnosis, and lifestyle effects on disease management.

Since tobacco smoking is intricately linked to the development of COPD[7] and the overall smoking rate for Aboriginal peoples in Canada (overall 39%; Inuit 49%, First Nations peoples 40% and Métis 37%[49,50]) doubles the smoking rate of non-Aboriginal Canadians (~21%),[49,51-53] one could have expected a higher hazard of death in Aboriginal peoples with COPD compared to their non-Aboriginal counterparts. Results presented in Chapter 3 suggested that a higher exposure to tobacco smoking would be an explanatory mechanism for the higher incidence of COPD in the Aboriginal population; however, a higher incidence of COPD does not immediately translates into higher all-cause mortality rates once a diagnosis of COPD is established.

Smoking prevalence rates in Canada have significantly declined over the last 10 years.[54] The reduction in smoking rates, however, has not been consistent across all age groups and among individuals with different patterns of smoking. Data from the 2006 Aboriginal Peoples Survey showed that the smoking rate in the Métis has declined by 6% since 2001,[55] with decreases in smoking prevalence rates being more sustained in older Métis populations. By 2006, 24% of Métis aged 65 years and older were daily smokers.[55] In contrast, 83% of smokers aged 65 years and older from the general population exhibit a pattern of daily smoking.[54]

In this study, age at time of COPD diagnosis was an effect modifier of the relationship between Aboriginal status and all-cause mortality: whereas Aboriginal

peoples and non-Aboriginals aged 35 to 64 years did not differ in their mortality hazards after being diagnosed with COPD, Aboriginal peoples aged 65 years and older had lower mortality hazards than non-Aboriginals of the same age group after adjusting for potential confounders. It is possible that the absence of differences in mortality hazards between Aboriginal peoples and non-Aboriginals diagnosed with COPD at young ages is explained by lack of sufficient time in the natural history of the disease to identify clear differences in disease trajectories between the two groups.

It is important to note that more individuals in the non-Aboriginal group were diagnosed with COPD at 65 years of age and over compared to those in the non-Aboriginal group (62.8% versus 34.1%). Since the risk of mortality generally increases with age, and age at diagnosis was a significant independent predictor of the hazard of death following a diagnosis of COPD, it is possible that the comparatively lower hazard of death among Aboriginal peoples aged 65 years and older may be the result of the younger age structure of the Aboriginal peoples' group.

On the other hand, physical activity has been identified as the strongest predictor of all-cause mortality in COPD.[56] Previous research has suggested that First Nations peoples living off reserve and Métis are more likely to be physically active in their leisure time than non-Aboriginals (37% and 39% versus 30%, respectively).[57] It can be hypothesized that physical activity has a protective effect among certain Aboriginal groups that is related with a reduction in all-cause mortality once COPD is diagnosed. Links between physical activity and COPD among Aboriginal peoples, particularly at older ages, warrant further investigation.

One may hypothesize that the difference in mortality hazards after a diagnosis of COPD between Aboriginal peoples and non-Aboriginals in the older age group may be due to differences in COPD severity at baseline. Since health administrative databases used for this research lack of clinical data, mortality analyses did not adjust for potential differences in COPD severity at baseline between the Aboriginal and non-Aboriginal cohorts.

Health administrative data have been widely used for researching the natural history of chronic diseases; however, one of the limitations of health administrative data is the lack of clinical detail about important prognostic factors such as smoking status, the intensity and cumulative effects of smoke exposure, and the severity of COPD in the study populations.

Another limitation of the study was the use of claims submitted by physicians as part of the COPD case identification algorithm. It has been established that the use of spirometry is low in primary care settings and approximately only 30% to 50% of newly diagnosed cases have their diagnosis confirmed by spirometry.[58] Evidence indicates that most COPD patients are not diagnosed until advanced stages of the disease and cases with early onset are often unrecognized.[58-60] Therefore, the study may have been more likely to include individuals with clinically significant COPD and miss the milder forms of this condition.

One might hypothesize that potential differences between the Aboriginal and the non-Aboriginal cohorts in COPD severity at baseline can be attributed to systematic variations in diagnostic practices. Results from the study by Sin et al.[16] suggest that Aboriginal peoples in Alberta have lower access to spirometry testing. If spirometry testing is systematically less available for Aboriginal peoples in the province, it is possible that COPD in Aboriginal peoples goes underestimated if COPD diagnosis and severity are based on spirometry results. However, misdiagnosis of COPD can also operate in the opposite direction: diagnostic suspicion bias[37] can occur if Aboriginal peoples with respiratory symptoms are readily diagnosed as COPD cases based on the physician's prior knowledge of higher rates of smoking among Aboriginal peoples without confirmation by spirometry. In contrast, it may be possible that better conditions to access spirometry testing for non-Aboriginal individuals allows for a more accurate differential diagnosis from other conditions (i.e., asthma). If true, the COPD non-Aboriginal cohort in the study would be constituted by more accurately diagnosed cases, perhaps more severe cases, in individuals that were systematically older than those in the Aboriginal peoples cohorts. All these factors can have an additive role in the overall probability of identifying more deaths among non-Aboriginal

individuals with COPD. The hypotheses outlined above warrant further research to better understand why certain groups of Aboriginal peoples with COPD, despite being diagnosed more frequently, have a lower all-cause mortality hazard compared to non-Aboriginals after a diagnosis of COPD.

Finally, caution should be exerted when applying the results of this study to Métis populations in Alberta. Not all (perhaps as low as 30%) Métis in the province are members of the MNA and therefore, a substantial number of non-MNA Métis were left out from the study or misclassified in the non-Aboriginal group. Métis individuals that are registered citizens under the MNA registry may be different (in demographic or clinical terms) than the non-registered Métis and therefore, results of this research may not be representative of the entire Métis population with COPD in the province.

4.5. Conclusions

The study findings suggest that once diagnosed with COPD, Aboriginal and non-Aboriginal peoples have similar all-cause mortality hazards. All-cause mortality hazards following a COPD diagnosis did not differ between Aboriginal and non-Aboriginal peoples aged 35 years to 64 years. Compared to non-Aboriginal peoples aged 65 years and over, lower mortality hazards were identified among Métis and Inuit of similar age. No significant differences in the hazard of death were identified in individuals with COPD aged 65 years and older who were Registered First Nations or non-Aboriginals.

Future research should focus on the identification of clinical factors that differentiate younger and older Aboriginal populations with COPD. These results should enable health care providers and policy makers to prepare for the increasing burden of COPD at older ages, to plan prevention strategies specific for different age and Aboriginal groups and to support the positive effects that COPD prevention and management strategies, and lifestyle modifications may have on Aboriginal peoples with COPD.

Table 4. 1. Baseline characteristics of Aboriginal and non-Aboriginal populations diagnosed with COPD in Alberta, Canada; fiscal years 2005/2006 to 2009/2010

	Total population	All Aboriginal peoples	Registered First Nations	Métis	Inuit	Non-Aboriginals
N	2,415	1,441	1,105	225	111	974
Male (%)	50%	46.5%	44.4%	60.4%	49.8%	55.1%
Age groups (%)						
35-54 yr	54.3	65.9	70.0	59.1	39.6	37.2
≥ 65 yr	45.7	34.1	30.0	40.9	60.4	62.8
Area of residence (%)						
Urban	53.1	42.7	39.5	52.0	55.0	68.5
Rural	34.1	38.2	39.2	38.7	27.0	28
Remote	12.8	19.2	21.3	9.3	18.0	3.5
Subsidy level (%)						
Full/Partial	54.0	41.4	34.3	60.9	73.0	72.6
None	46.0	58.6	65.7	39.1	27.0	27.4
COPD comorbidities (%)						
Hypertension	16.4	15.3	15.0	17.3	14.4	18.1
IHD	10.6	10.3	9.2	13.3	14.4	11.2
Asthma	9.2	9.9	10.9	7.6	5.4	8.2
DM	8.9	9.0	9.2	8.0	9.0	8.7
Osteoporosis	3.8	2.8	2.4	3.1	5.4	5.2
Deaths (all causes) (%, n)	17.4 (421)	14.4 (207)	16.1 (178)	8.4 (19)	9.0 (10)	22.0 (214)
Person-time (yr)	5111.3	3089.4	2305.3	518.6	265.5	2021.9
Crude mortality rate (per 1,000 person-yr) (95% CI)	82.4 (75.1, 90.2)	67.0 (58.7, 76.4)	77.2 (67.0, 88.8)	37.7 (20.6, 67.9)	36.6 (23.6, 56.5)	105.8 (102.7, 136.4)
Age-and sex-standardized mortality rate (per 1,000 person-yr) (95% CI)	71.1 (69.6, 72.6)	65.1 (63.3, 67.0)	78.7 (76.4, 81.1)	35.9 (32.4, 39.4)	33.1 (28.1, 38.2)	73.6 (71.2, 76.0)

CI = confidence interval; COPD = chronic obstructive pulmonary disease; DM = diabetes mellitus; IHD = ischemic heart disease; yr(s) = years

Table 4. 2. Cox regression analysis of all-cause mortality hazard ratios in Aboriginal and non-Aboriginal populations diagnosed with COPD in Alberta, Canada; fiscal years 2005/2006 to 2009/2010

	HR (95% CI)		
	Unadjusted	Main-effects model (no interaction)**	Model with interaction effects**
Non-Aboriginal	reference	reference	reference
Aboriginal	0.64* (0.52, 0.77)	0.83 (0.68, 1.03)	-
Age group			
35-64 years	-	reference	reference
≥ 65 years	-	2.39* (1.65, 3.47)	3.18* (2.02, 5.00)
Sex			
Male	-	reference	reference
Female	-	0.87 (0.72, 1.06)	0.86 (0.71, 1.05)
Area of residence			
Urban	-	reference	reference
Rural	-	1.03 (0.83, 1.27)	1.03 (0.84, 1.28)
Remote	-	0.73 (0.51, 1.05)	0.74 (0.52, 1.06)
Subsidy			
None	-	reference	reference
Full/partial	-	1.07 (0.72, 1.58)	1.14 (0.77, 1.71)
Hypertension			
No	-	reference	reference
Yes	-	1.00 (0.78, 1.30)	1.01 (0.78, 1.31)
Diabetes mellitus			
No	-	reference	reference
Yes	-	1.29 (0.94, 1.76)	1.30 (0.95, 1.78)
Ischemic heart disease			
No	-	reference	reference
Yes	-	1.36 (1.04, 1.77)*	1.34 (1.03, 1.75)*
Asthma			
No	-	reference	reference
Yes	-	1.07 (0.77, 1.49)	1.07 (0.77, 1.49)
Osteoporosis			
No	-	reference	reference
Yes	-	0.53 (0.29, 0.97)*	0.52 (0.29, 0.97)*
Interaction effect			
Population * Age group			
35-64 years	-	-	1.25 (0.84, 1.85)
≥ 65 years	-	-	0.71 (0.55, 0.91)*
≥ 65 years vs. 35-64 years	-	-	2.26 (1.41, 3.62)*

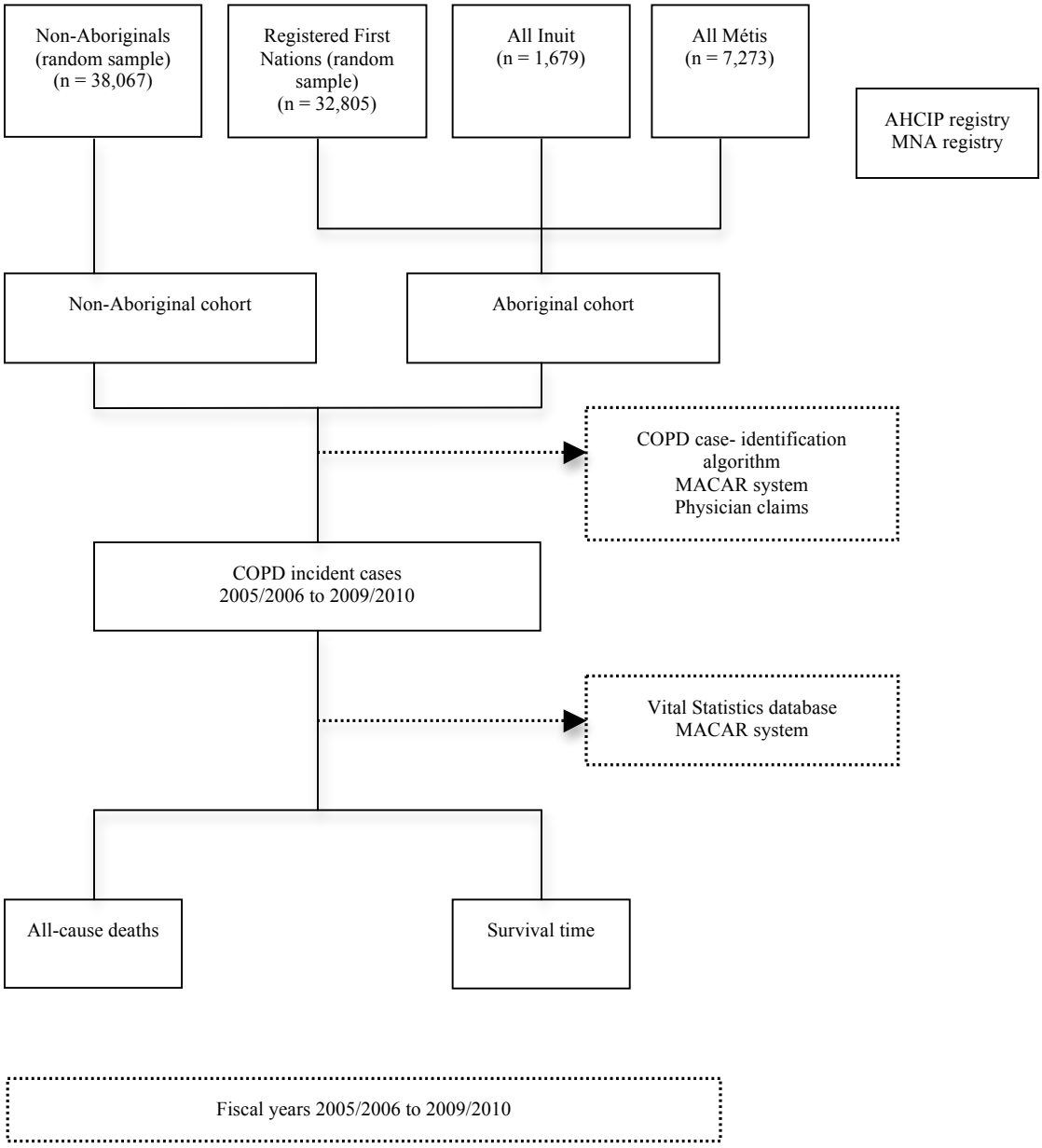
* $p<0.05$; ** Adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis). CI = confidence interval; HR = hazard ratio

Table 4. 3. Cox regression analysis of all-cause mortality hazard ratios in Registered First Nations peoples, Métis and Inuit and non-Aboriginal populations diagnosed with COPD in Alberta, Canada; fiscal years 2005/2006 to 2009/2010

	HR (95% CI)		
	Unadjusted	Main-effects model (no interaction)**	Model with interaction**
Population			
Non-Aboriginal	reference	reference	reference
First Nations	0.73 (0.60, 0.89*	1.09 (0.87, 1.36)	-
Métis	0.35 (0.26, 0.49)*	0.41 (0.25, 0.65)*	-
Inuit	0.37 (0.24, 0.56)*	0.37 (0.20, 0.71)*	-
Age group			
35-64 years	-	reference	reference
≥ 65 years	-	2.32 (1.59, 3.39)*	3.02 (1.91, 4.75)*
Sex			
Male	-	reference	reference
Female	-	0.84 (0.69, 1.02)	0.83 (0.68, 1.01)
Area of residence			
Urban	-	reference	reference
Rural	-	0.98 (0.79, 1.21)	0.99 (0.80, 1.22)
Remote	-	0.66 (0.46, 0.94)*	0.66 (0.46, 0.94)*
Subsidy			
None	-	reference	reference
Full/partial	-	1.22 (0.82, 1.83)	1.24 (0.82, 1.88)
Hypertension			
No	-	reference	reference
Yes	-	1.01 (0.78, 1.31)	1.02 (0.79, 1.32)
Diabetes mellitus			
No	-	reference	reference
Yes	-	1.25 (0.91, 1.71)	1.26 (0.92, 1.72)
Ischemic heart disease			
No	-	reference	reference
Yes	-	1.40 (1.07, 1.83)*	1.40 (1.07, 1.83)*
Asthma			
No	-	reference	reference
Yes	-	1.04 (0.75, 1.45)	1.05 (0.75, 1.46)
Osteoporosis			
No	-	reference	reference
Yes	-	0.54 (0.29, 0.99)*	0.54 (0.29, 0.99)*
Aboriginal * Age group (interaction term)	-	-	
First Nations * Age group			
35-64 years	-	-	1.41 (0.93, 2.12)
≥ 65 years	-	-	1.00 (0.77, 1.31)
≥ 65 years vs. 35-64 years	-	-	3.07 (1.87, 4.94)*
Métis			
35-64 years	-	-	0.91 (0.46, 1.80)
≥ 65 years	-	-	0.24 (0.11, 0.49)*
≥ 65 years vs. 35-64 years	-	-	0.73 (0.32, 1.66)
Inuit			
35-64 years	-	-	0.70 (0.21, 2.28)
≥ 65 years	-	-	0.31 (0.14, 0.67)*
≥ 65 years vs. 35-64 years	-	-	0.95 (0.40, 2.25)*

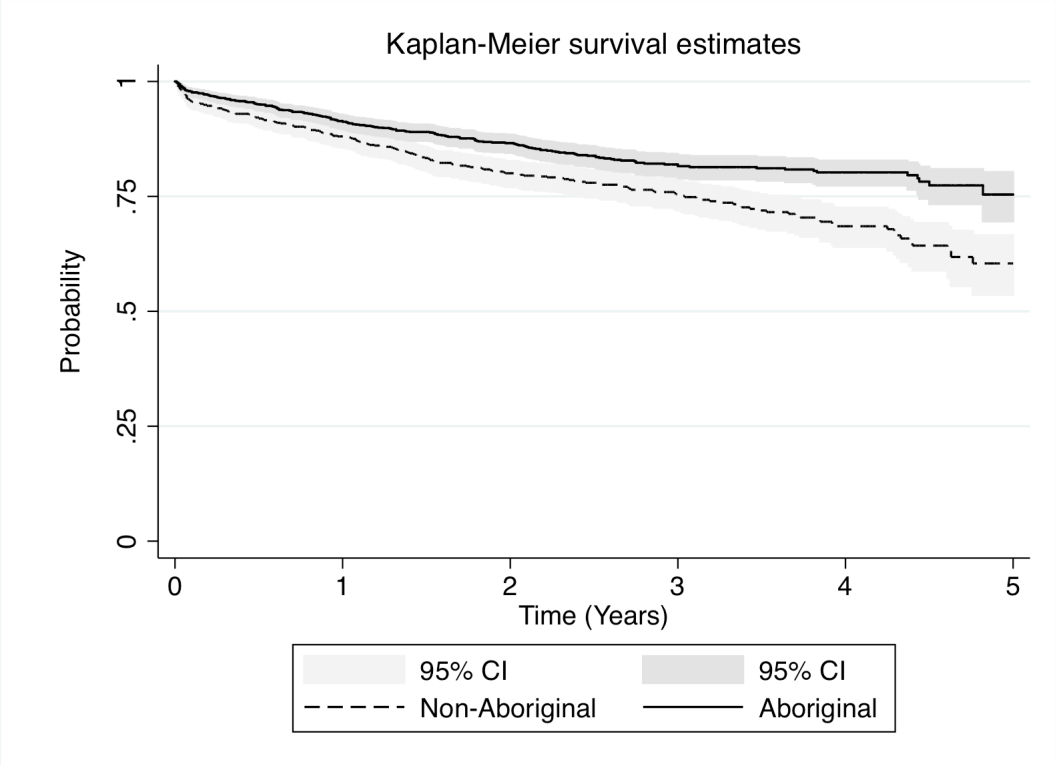
* $p<0.05$; ** Adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis). CI = confidence interval; HR = hazard ratio

Figure 4. 1. Flowchart of the study of all-cause mortality among Aboriginal Peoples with COPD in Alberta, Canada; fiscal years 2005/2006 to 2009/2010



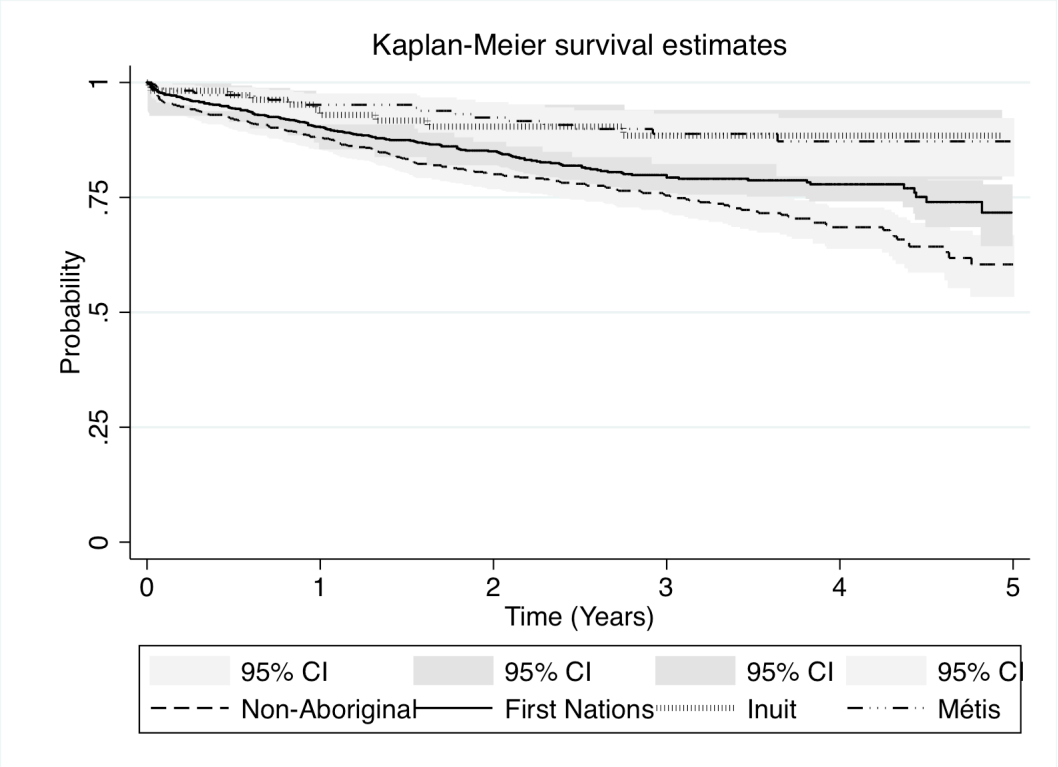
AHCIP = Alberta Health Care Insurance Plan; COPD = chronic obstructive pulmonary disease; MACAR = Morbidity and Ambulatory Care Reporting; MNA = Métis Nation of Alberta

Figure 4. 2. Five-year survival time of Aboriginal and non-Aboriginal groups diagnosed with COPD in Alberta, Canada; fiscal years 2005/2006 to 2009/2010



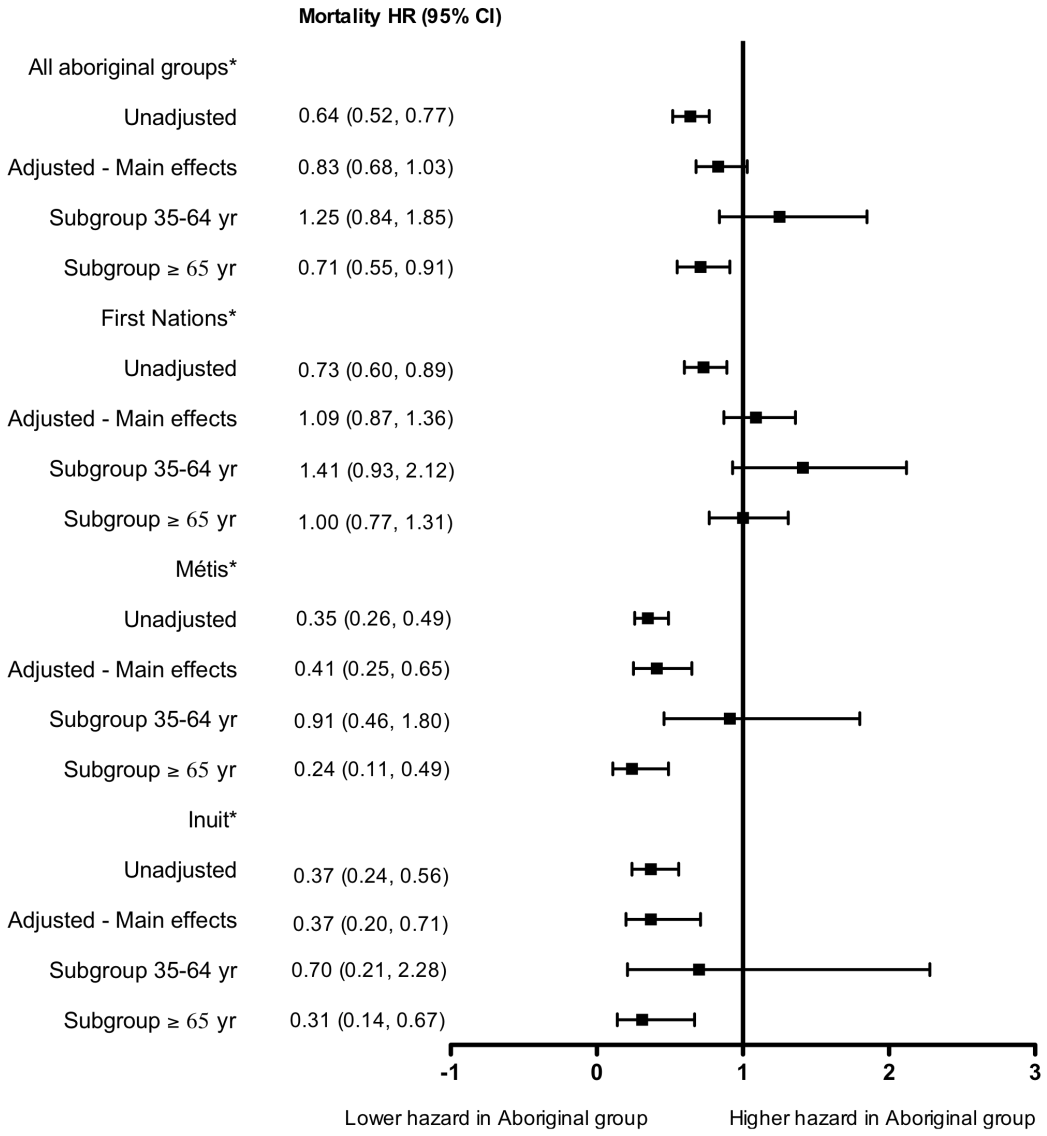
CI = confidence interval

Figure 4. 3. 5-year survival time of Registered First Nations, Métis, Inuit and non-Aboriginal groups diagnosed with COPD in Alberta, Canada; fiscal years 2005/2006 to 2009/2010



CI = confidence interval

Figure 4. 4. Mortality hazard ratios after a diagnosis of COPD in Aboriginal peoples



Notes: The main-effects model and the model with the interaction term were adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), and presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis).

*Reference group: Non-Aboriginal population; CI = confidence interval; HR = hazard ratio

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Chapter 5

Health Services Use among Aboriginal Peoples with Chronic Obstructive Pulmonary Disease in Alberta, Canada, 2002/2003 to 2009/2010

5.1. Introduction

Chronic obstructive pulmonary disease (COPD) is a major respiratory disorder characterized by chronic, persistent, not fully reversible airway obstruction, systemic manifestations, and increasing frequency and severity of exacerbations.[1] COPD is a leading cause of morbidity worldwide, with prevalence estimates in the range of 5% to 10%.[2] Being a chronic condition characterized by frequent episodes of acute exacerbations, concomitant complications, and often associated with multiple comorbidities, COPD requires frequent visits to the emergency department (ED) and hospital admissions,[3,4] representing important health care events for COPD patients, their families and the health care system.[5]

Data from the Confronting COPD survey in North America and Europe[6] revealed that approximately 30% of COPD patients were admitted in hospitals at some point in their lives, with 14% reporting at least one hospitalization over the last year and 17% reporting at least one ED visit due to symptom exacerbations in a one-year period.[6]

Individuals with COPD in Canada use large amounts of health services to treat their condition.[7] COPD accounts for the highest rate of hospital admissions among all major chronic illnesses (96 per 100,000 population); a number that is expected to double by the year 2015.[8] Research based on administrative health data in Ontario found that people with COPD accounted for one fifth to one third of all hospital and ED services in the province.[5] Hospitalization rates (562 per 1,000 population) and ED visits (641 per 1,000 population) were, respectively, 63% and 85% higher than those of the rest of the population without COPD.[5] Approximately 1.4% of all ED visits in Canada are attributed to COPD, accounting for 196,000 ED visits per year.[9] Longitudinal analyses of administrative health data in Alberta showed that ED visit rates for COPD among individuals 55 years of age and older

ranged from 25.6 per 1,000 population in 1999 to 25.1 per 1,000 population in 2005, with an average of 2.2 visits per patient per year.[10]

Aboriginal peoples in Canada (i.e., First Nations peoples, Métis and Inuit) have higher incidence and prevalence rates of COPD compared to the non-Aboriginal population.[11,12] Access to diagnosis and treatment services for COPD is an important determinant of respiratory health that has the potential to contribute to health inequalities between Aboriginal peoples and the rest of the Canadian population.[13]

Limited epidemiological studies (two of them conducted in Alberta) have informed differences in health services use for COPD between Aboriginal peoples and non-Aboriginal populations in Canada.[10,12,14] Evidence from these studies indicate that, compared to non-Aboriginal individuals with COPD, Aboriginal peoples with COPD have higher hospitalization rates for all-causes[12] and higher numbers of ED visits for COPD exacerbations.[10,14] Results from these studies are applicable to specific Aboriginal groups (i.e., Métis,[12] or Registered First Nations peoples[10,14]) and may not be generalizable to other Aboriginal peoples in Canada. Similarly, the follow-up periods in these studies were relatively short to provide a strong basis for the observed differences in the trends of hospitalizations and ED visits by Aboriginal peoples with COPD compared to their non-Aboriginal counterparts.

To date, there are no published data to inform whether there are differences in hospitalizations and ED visit rates among First Nations peoples, Métis and Inuit with COPD compared to the non-Aboriginal population with COPD in Canada. With these considerations in mind, this retrospective cohort study used administrative health data to compare hospitalizations and ED visits rates in Aboriginal peoples (Registered First Nations peoples, Métis and Inuit) with COPD compared to those of the non-Aboriginal population with COPD in Alberta, Canada while adjusting for the impact of sociodemographic and clinical factors on the health services use outcomes.

5.2. Methods

5.2.1. Study design and setting

This is a retrospective analytical cohort study of health services use for COPD based on linkage of longitudinal administrative health data in Alberta (Canada) from April 1st 2002 to March 31, 2010. Alberta is a western Canadian province with a population of over 3 million residents[15] of which approximately 6.7% report Aboriginal ancestry (52% First Nations peoples, 45% Métis and less than 1% Inuit).[15] Approximately 99% of residents in Alberta have universal health insurance under the Alberta Health Care Insurance Plan (AHCIP),[16] which pays for all medically necessary physicians and hospitals services. The First Nations and Inuit Health Branch (FNIHB) of Health Canada pay for health services of First Nations peoples registered under the Indian Act[17] and the Inuit. Non-Registered First Nations peoples and Métis have health services covered similarly to non-Aboriginal Albertans.

5.2.2. Data sources

Details of health services encounters of Albertan residents registered under the AHCIP and recorded in Alberta Health administrative databases were linked at individual level based on a unique encrypted personal health number (PHN). Individual, de-identified longitudinal data from six administrative databases were used for the analyses of individual encounters with the Alberta health care system during an 8-year follow-up period (April 1, 2002 to March 31, 2010). The AHCIP registry contains demographic information of individuals in the province registered for health care coverage; the Métis Nation of Alberta (MNA) registry contains citizenship information for members of the Métis Nation of Alberta who identify themselves as Métis. Alberta Vital Statistics contains verified and certificate data of all deaths in the province and the causes of death according to International Classification of Diseases, Tenth Revision, enhanced Canadian version (ICD-10-CA)[18] diagnosis codes. The Morbidity and Ambulatory Care Reporting (MACAR) system records data on all hospitalizations using ICD-10-CA diagnoses associated with acute and elective hospital admissions. The Alberta Ambulatory Care

Classification System (ACCS) collects information on all ED visits and services delivered within acute care institutions in Alberta using ICD-10-CA diagnosis codes to reflect the conditions that led to attendance at the ED. The Alberta Physician Claims Assessment contains information on all services provided by fee-for-service physicians and "shadow-billings" for physicians paid under alternate payment plans in the province, with diagnostic fee codes for each visit based on the International Classification of Diseases, Ninth Revision (ICD-9).[19]

5.2.3. Study population

Similar to procedures described in Chapter 4, searches in the MACAR and the Alberta Physician Claims Assessment databases allowed the identification of residents in Alberta with constant registration between the fiscal years 2002/2003 and 2009/2010 that had a new diagnosis of COPD based on a previously validated case algorithm.[20,21] The case definition allowed the selection of individuals 35 years of age and older at the time of diagnosis who had at least two physician claims with an ICD-9 code (491, 492, 496) of COPD in the first diagnostic field of the Alberta Physician Claims Assessment System in a two-year period, or one recording of an ICD-10-CA code (J41-J44) of COPD in any diagnostic field in the hospital discharge abstract ever, whichever came first. Cases of COPD remained part of the study population throughout the study period until time of death or end of study (March 31, 2010). The flowchart for selection of the study population is described in Figure 5.1.

5.2.4. Study variables

Aboriginal status: The Aboriginal cohort included Registered First Nations peoples, Inuit (both identified in the AHCIP registry based on an alternate premium arrangement) and Métis (individuals identified as such in the MNA identification registry). If individuals were identified as both Métis and First Nations peoples, they were considered Métis. The non-Aboriginal cohort were individuals in the AHCIP registry who did not have an alternate premium arrangement field for Registered First Nations or Inuit, and that are not included in the MNA registry.

First Nations peoples without registration and Métis not included in the MNA registry were considered part of the non-Aboriginal cohort as there is no reliable method to identify them from the general population.[22]

Outcomes. The primary outcomes were hospitalization and ED visits rates for all causes. All hospitalizations and ED visits that occurred after the date of COPD diagnosis were included in the analysis. For each episode of care, the index date was the date of admission until first definitive discharge from the service. Hospitalizations and ED visits for all causes in individuals with COPD, instead of just for COPD, were considered so as to not miss services use for COPD comorbidities.

Secondary outcomes were hospitalization and ED visits rates for AECOPD. To be considered an AECOPD-related event, the primary or secondary diagnosis fields for the episode of care were required to have an ICD-10-CA for COPD.

Other outcomes of interest were all-cause hospital and ED length of stay (LOS). Hospital LOS was defined as the number of days between admission date and discharge. ED LOS was defined as the difference between the end date and time and the start date and time for each ED visit. For analytical purposes, ED LOS was truncated to hours.

Covariates. Comorbidities were defined as the presence of one or more distinct disorders or diseases in addition to COPD.[23] Comorbidities such as cardiovascular diseases, diabetes mellitus (DM), hypertension, asthma, and osteoporosis are common in COPD.[24] Comorbid conditions that occurred within a three-year period preceding the index date of COPD were historically identified within the MACAR and the Alberta Physician Claims Assessment databases. Validated case algorithms were used to identify the following comorbid conditions: hypertension,[25,26] DM,[27] ischemic heart disease,[28] asthma,[29] and osteoporosis.[30] If conditions were developed after the index date of COPD diagnosis they were considered COPD complications and not included in the study.

Sociodemographic information was extracted from the AHCIP registry. All study participants were coded as either male or female. Because of small numbers, age at time of COPD diagnosis was collapsed into two categories (35-64 years, and

65 years and over). Area of residence (urban, rural, and remote) was based on the place of residence at time of COPD diagnosis according to the Statistical Area Classification of census subdivision areas by Statistics Canada.[15] Health care in Alberta is government-funded and health care insurance premiums provide partial funding. Residents with low income or receiving welfare services are eligible for subsidies for these health premiums. Therefore, the subsidy level (full/partial, none) at the time of COPD diagnosis was used as a proxy measure of socioeconomic status.

5.2.5. Statistical analysis

Aboriginal and non-Aboriginal groups were described in terms of age, sex, area of residence, subsidy level, and presence of comorbidities at the time of COPD diagnosis. Descriptive statistics were provided for the characteristics of hospitalizations and ED visits.

Annual, all-cause and AECOPD hospitalization and ED visit rates were calculated from fiscal years 2002/2003 to 2009/2010 for the Aboriginal and the non-Aboriginal cohorts with COPD. The numerator for the annual rates was the number of episodes of care per person per year. The denominator was the person-time of observation, defined as the sum of the time that each person with COPD remained under observation from beginning of the fiscal year (if the person was diagnosed in previous years) or COPD diagnosis date (if the person was diagnosed during the year) until death, or end of fiscal year; whichever came first.

All-cause and AECOPD hospitalization and ED visit rates for Aboriginal and non-Aboriginal cohorts with COPD were calculated as the total number of episodes of care that occurred between 2002/2003 and 2009/2010 divided by total person-time of observation (the sum of the time that each person remained under observation from index COPD diagnosis date until death, or end of study). All rates in the study were expressed as number of events per 1,000 person-years. All 95% confidence intervals (95% CIs) for services rates were computed under a Poisson distribution.[31] Where the 95% CI of two rates did not overlap, it was concluded that there was a significant difference between the two estimates.

Unadjusted rate ratios (RR) with 95% CI were calculated for the entire study period for all-cause and AECOPD hospitalization and ED visits using the non-Aboriginal population as the reference group. Poisson regressions were conducted to adjust the RRs by age group, sex, socioeconomic status, area of residence, and presence of comorbidities at baseline using person-time as the offset in the models.[31] Two-sided P values less than 0.05 represented statistical significance for all comparisons. The suitability of the regression models was assessed using Q-Q plots of the standardized deviance residuals against their estimated distribution. All statistical analyses were performed using Predictive Analysis Software Statistics for Mac® (PASW® version 18.0, IBM SPSS, Somers NY).

5.2.6. Ethics approval

Ethics approval to conduct this study was granted by the University of Alberta's Health Research Ethics Board, in Edmonton, Alberta, Canada (Appendix C). Additional recommendations from the former Canadian Institutes of Health Research (CIHR) Guidelines for Health Research Involving Aboriginal People[32] were followed. The research proposal was presented to the Public Health Surveillance Advisory Committee Meeting of the MNA in November 2009 and to an open forum under the MNA conference "Moving Forward Together: Building Strong, Healthy and Safe Métis Communities" in March 2010. Finally, the research project received official endorsement from the MNA (Appendix D).

5.3. Results

During the study period from 2002/2003 to 2009/2010, a total of 3,885 individuals were newly diagnosed with COPD. The characteristics of the total study population and the Aboriginal and non-Aboriginal cohorts are described in Table 5.1.

5.3.1. Hospitalizations

Over the 8-year study period, 59% of individuals newly diagnosed with COPD had at least one hospital episode of care with a mean of 3.8 (standard deviation [sd]

= 3.2) hospital admissions per individual (95% CI: 3.6, 3.9). Hospitalizations for AECOPD were made by 17.6% of the study population, with a mean of 2 (sd = 2.1) AECOPD admissions per individual (95% CI: 1.8, 2.1).

The proportion of individuals with COPD who had at least one hospital episode for any cause during the study period was similar across the cohorts, except for the Inuit, who showed a lower proportion of COPD individuals who were hospitalized (49.2%; 95% CI: 43.8%, 54.6%) relative to the non-Aboriginal group with COPD (58.5%; 95% CI: 56.0%, 60.9%). The average number of hospital episodes per individual with COPD was significantly higher for all the Aboriginal groups combined (mean = 4.4; 95% CI: 4.0, 4.7) compared to the non-Aboriginal group (mean = 3.1; 95% CI: 2.9, 3.2); however, the differences were mainly attributed to a higher number of hospital episodes per individual in Registered First Nations peoples (mean = 4.6; 95% CI: 4.2, 4.9). There were no significant differences among the groups in the proportion of individuals that had at least one AECOPD hospitalization or in the mean number of AECOPD hospitalizations per individual.

A total of 9,062 hospitalizations occurred during the study period. Table 5.2 summarizes the characteristics of all-cause hospitalizations among Aboriginal groups and the non-Aboriginal population with COPD. The median hospital LOS for the entire study population was 5 days (interquartile range [IQR]: 3,12). The median hospital LOS in the non-Aboriginal group (7 days; IQR: 3, 15) was longer than that of all Aboriginal peoples groups combined (5 days; IQR: 2, 10). The median hospital LOS of Registered First Nations peoples (5 days; IQR: 2, 10), Métis (5 days; IQR: 2, 8) and Inuit (4 days; IQR: 2, 9) were all shorter than in the non-Aboriginal group.

Table 5.3 summarizes the annual, all-cause and AECOPD hospitalization rates in the Aboriginal peoples and the non-Aboriginals groups. The annual all-cause hospitalization rates for all Aboriginal groups combined were consistently higher over time compared to those in the non-Aboriginal cohort (Figure 5.2).

When annual all-cause hospitalization rates were examined across the three Aboriginal peoples groups over time (Figure 5.3), the cohort of Registered First Nations peoples showed higher all-cause hospitalization rates, and the Métis group

showed lower all-cause hospitalization rates compared to those in the non-Aboriginal cohort. The annual all-cause hospitalization rates among the Inuit were similar to those of the non-Aboriginal cohort. All-cause hospitalization rates for the entire study period in all Aboriginal groups combined (717.3 hospitalizations per 1,000 person-years; 95% CI: 699.4, 735.5) were significantly higher than those in the non-Aboriginal group (516.9 hospitalizations per 1,000 person-years; 95% CI: 498.5, 535.0).

The pattern of hospitalization rates was not uniform across the three Aboriginal groups. Whereas Registered First Nations peoples had significantly higher all-cause hospitalization rates (803.5 hospitalizations per 1,000 person-years; 95% CI: 781.8, 825.7), the Métis showed significantly lower all-cause hospitalization rates (397.9 hospitalizations per 1,000 person-years; 95% CI: 364.7, 435.5). All-cause hospitalization rates in the Inuit (531.1 hospitalizations per 1,000 person-years; 95% CI: 479.6, 586.7) were not significantly different of those in the non-Aboriginal group.

When annual hospitalization rates for AECOPD were examined (Figure 5.4) differences between all Aboriginal groups combined and the non-Aboriginal cohort increased over time, with Aboriginal peoples having higher AECOPD hospitalization rates by the end of the study period.

Overall, AECOPD hospitalization rates in Aboriginal peoples combined (110.8 AECOPD hospitalizations per 1,000 person-years; 95% CI: 103.9, 118.1) were significantly higher than those of the non-Aboriginal cohort (86.7 AECOPD hospitalizations per 1,000 person-years; 95% CI: 79.2, 94.6) for the entire study period. Annual rates of AECOPD hospitalizations in the three Aboriginal peoples groups fluctuated over time (Figure 5.5). For the entire study period, we found that only AECOPD hospitalization rates in Registered First Nations peoples (116.6 AECOPD hospitalizations per 1,000 person-years; 95% CI: 108.5, 125.3) were significantly higher, whereas AECOPD hospitalization rates in Métis and Inuit were not significantly different of those in the non-Aboriginal cohort.

Table 5.4 summarizes the unadjusted and adjusted all-cause hospitalization RRs in Aboriginal peoples groups with COPD compared to the non-Aboriginal

reference group. The unadjusted RR indicated that Aboriginal peoples combined had significantly higher all-cause hospitalization rates (RR = 1.21; 95% CI: 1.16, 1.27) than non-Aboriginals. After adjusting for sociodemographic and clinical factors, all-cause hospitalization rates in combined Aboriginal peoples groups remained significantly higher (RR_{adj} = 1.31, 95% CI: 1.24, 1.37).

Not all Aboriginal peoples with COPD had all-cause hospitalization rates higher than non-Aboriginals (Table 5.5). All-cause hospitalization rates in Registered First Nations peoples were significantly higher (RR_{adj} = 1.60; 95% CI: 1.52, 1.69) than those of the non-Aboriginal group, whereas all-cause hospitalization rates in the Métis and the Inuit were significantly lower than those of non-Aboriginal individuals after adjusting for sociodemographic and clinical factors (RR_{adj} Métis = 0.80, 95% CI: 0.72, 0.88; RR_{adj} Inuit = 0.71; 95% CI: 0.64, 0.79). Figure 5.6 provides a graphic summary of the unadjusted and adjusted all-cause hospitalization RRs in Aboriginal peoples with COPD.

Unadjusted and adjusted RRs for AECOPD hospitalizations for all Aboriginal peoples groups combined (Table 5.6) showed that their hospitalization rates for AECOPD were significantly higher than those of non-Aboriginals (RR_{adj} = 1.22; 95% CI: 1.08, 1.38). Again, unadjusted and adjusted RRs of AECOPD hospitalizations indicated that differences in rates were not uniform across the three Aboriginal peoples groups (Table 5.7 and Figure 5.7). Registered First Nations peoples had significantly higher AECOPD hospitalization rates (RR_{adj} = 1.44; 95% CI: 1.26, 1.65) but Inuit's AECOPD hospitalization rates were significantly lower than those in the non-Aboriginal cohort (RR_{adj} = 0.67; 95% CI: 0.52, 0.86). There were not significant differences between the Métis and non-Aboriginal individuals in their hospitalization rates for AECOPD (RR_{adj} = 1.10; 95% CI: 0.89, 1.36).

5.3.2. ED visits

During the study period, 79.4% of individuals with a new diagnosis of COPD visited the ED on at least one occasion; with a mean of 11.6 ED visits (sd = 8.5) per individual (Table 5.1). Visits to the ED due to AECOPD were made by 23.9%

of the study population. On average, study participants had 2.7 ED visits (sd = 3.6) for AECOPD over the study period.

Aboriginal peoples combined, and particularly Registered First Nations peoples, had a higher proportion of individuals visiting the ED for any cause during the study period (85.7%; 95% CI: 84.1, 87.3) compared to those in the non-Aboriginal cohort (72.8%; 95% CI 70.6, 75.0). Proportions of Métis and Inuit with COPD visiting the ED were similar to those of the non-Aboriginal group.

The mean number of ED visits per individual across all Aboriginal cohorts was higher than those in non-Aboriginals (mean = 7.1; 95% CI: 6.4, 7.7). Registered First Nations peoples had on average 15.4 ED visits per individual (95% 14.1, 16.6), whereas Métis and Inuit had a mean of 9.1 (95% CI: 7.6, 10.5) and 13.2 (95% CI 9.5, 16.8) ED visits per person, respectively, over the entire study period.

Compared to the non-Aboriginal group, both Registered First Nations peoples and Inuit had a significantly higher proportion of individuals who visited the ED for AECOPD (Registered First Nations peoples = 26.6%; 95% CI: 24.5, 28.6; Inuit = 33.7%; 95% CI: 26.8, 40.6). There were no significant differences across the groups in the mean number of ED visits for AECOPD per individual during the study period.

In total, 35,951 visits to the ED occurred during the observation period among the study population. Table 5.8 summarizes the characteristics of all-cause ED visits among Aboriginal groups and the non-Aboriginal population with COPD. The median ED LOS in Registered First Nations peoples (1 hour; IQR: 0, 4), Métis (1 hour; IQR: 0, 3) and Inuit (1 hour; IQR: 0, 3) were shorter than that of the non-Aboriginal group (2 hours; IQR: 1, 5). Compared to non-Aboriginals, there was a higher proportion of ED visits in Aboriginal peoples ending in discharge from the ED (77.7% versus 71.3%) or leaving before completion of care (5.0% versus 2.4%).

Table 5.9 summarizes the annual, all-cause and AECOPD rates of ED visits in Aboriginal peoples and the non-Aboriginals group. Annual rates of all-cause ED visits in the group of all Aboriginal peoples combined were consistently higher than those in the non-Aboriginal group (Figure 5.8). Compared to the non-

Aboriginal cohort, annual all-cause ED visits rates over time where higher in the cohorts of Registered First Nations peoples and Inuit, but not in the Métis group (Figure 5.9).

For the entire study period, all-cause ED visit rates in the Aboriginal groups combined (3242.7 ED visits per 1,000 person-years; 95% CI: 3205.4, 3281.3) were significantly higher than those in the non-Aboriginal group (1460.1 ED visits per 1,000 person-years; 95% CI: 1429.2, 1492.3). The three Aboriginal peoples groups considered separately had significantly higher all-cause ED visit rates, particularly among Registered First Nations peoples (3612.5 ED visits per 1,000 person-years; 95% CI: 3566.1, 3659), followed by the Inuit (2574.4 ED visits per 1,000 person-years; 95% CI: 2460.1, 2694.0) and the Métis (1801.2 ED visits per 1,000 person-years; 95% CI: 1730.1, 1875.4).

Annual rates of ED visits for AECOPD (Figure 5.10) showed that Aboriginal peoples had higher ED visit rates for AECOPD than those in the non-Aboriginal group, particularly after the third year of follow-up. For the entire study period, ED visit rates for AECOPD in Aboriginal peoples combined (202.2 ED visits for AECOPD per 1,000 person-years; 95% CI: 192.8, 212.0) were significantly higher than those of the non-Aboriginal cohort (144.0 ED visits for AECOPD per 1,000 person-years; 95% CI: 134.4, 154.2). Annual rates of ED visits for AECOPD in the three Aboriginal peoples group fluctuated over time (Figure 5.11) but, rates of ED visits for AECOPD in Registered First Nations peoples (208.3; 95% CI: 197.3, 219.7) and the Inuit (251.8; 95% CI: 216.8, 291.0) were significantly higher than those in the non-Aboriginal cohort for the entire study period. There were not significant differences between the Métis and the non-Aboriginal cohort in their rates of ED visits for AECOPD over the study period.

Table 5.10 summarizes the unadjusted and adjusted RRs for all-cause ED visits in Aboriginal peoples groups with COPD compared to the non-Aboriginal reference group. The unadjusted RR showed that Aboriginal peoples combined had significantly higher all-cause ED visit rates (RR = 1.95; 95% CI: 1.9, 2.00) compared to non-Aboriginals. After adjusting for sociodemographic and clinical factors, all-cause ED visit rates per 1,000 person-years in Aboriginal peoples

groups combined remained significantly higher (RR_{adj} = 1.72, 95% CI: 1.67, 1.77) compared to the non-Aboriginal group. Unadjusted RR for the three Aboriginal groups relative to the non-Aboriginal cohort showed that all-cause ED visit rates of the three Aboriginal groups were higher than that of non-Aboriginals (Table 5.11). Compared to the non-Aboriginal group, all-cause ED visit rates were significantly higher in Registered First Nations peoples (RR_{adj} = 2.02; 95% CI: 1.97, 2.08) and the Inuit (RR_{adj} = 1.28; 95% CI: 1.22, 1.35), but significantly lower in the Métis group (RR_{adj} = 0.94; 95% CI: 0.90, 0.98) after adjusting for important sociodemographic and clinical factors. Figure 5.12 provides a graphic summary of these results.

Unadjusted and adjusted RRs of ED visits for AECOPD in Aboriginal peoples groups combined (Table 5.12) showed that their ED visit rates for AECOPD were significantly higher than those of non-Aboriginals (RR_{adj} = 1.33; 95% CI: 1.21, 1.45). When unadjusted RRs of ED visits for AECOPD in the three Aboriginal groups were examined, Registered First Nations peoples had significantly higher ED visits for AECOPD (RR = 1.30; 95% CI: 1.19, 1.42) relative to the non-Aboriginal group; however, Métis' and Inuit's rates of ED visits for AECOPD were not significantly different (RR for Métis = 1.16; 95% CI: 0.99, 1.36; RR for Inuit = 0.98; 95% CI: 0.84, 1.15). After adjusting for sociodemographic factors and comorbidities, both Registered First Nations peoples (RR_{adj} = 1.45, 95% CI: 1.32, 1.60) and Métis groups (RR_{adj} = 1.22; 95% CI: 1.04, 1.44) had significantly higher rates of ED visits for AECOPD compared to the non-Aboriginals group. There were not significant differences between the Inuit and non-Aboriginal individuals in their rates of ED visits for AECOPD (RR_{adj} = 0.96; 95% CI: 0.82, 1.14). Figure 5.13 displays a graphic summary of these results.

5.4. Discussion

This study examined differences in hospitalizations and ED visits rates in Aboriginal groups of Alberta relative to a non-Aboriginal population, once a diagnosis of COPD is established. After adjusting for important sociodemographic factors and comorbidities, Aboriginal peoples with COPD, as a whole group, had significantly higher rates of all-cause and AECOPD hospitalizations and ED visits compared to non-Aboriginals with COPD.

Not all Aboriginal peoples groups shared the same pattern of hospital use after being diagnosed with COPD: multivariate analyses of all-cause and AECOPD hospitalization rates showed that Registered First Nations peoples with COPD had significantly higher rates than those of the non-Aboriginal population with COPD. The same cannot be said about the Métis and Inuit with COPD, whose all-cause hospitalization rates were significantly lower than those of non-Aboriginal individuals with COPD after adjusting for socioeconomic factors and the presence of comorbidities. In contrast, AECOPD hospitalization rates for Inuit were significantly lower than those in the non-Aboriginal cohort, whereas AECOPD hospitalization rates were not significantly different between Métis and non-Aboriginal individuals.

Only one other study published in Canada has compared hospitalization rates in Aboriginal peoples and non-Aboriginal individuals diagnosed with COPD. A retrospective analysis of administrative health data from Ontario for the years 2007 and 2008 assessed the mean number of hospitalizations in individuals with COPD and other respiratory conditions in members of the Métis Nation of Ontario and the general population.[12] Results showed that the mean number of hospitalizations was approximately 1.1 times higher in Métis with COPD compared to the general population with COPD, with no differences between the groups in the mean number of COPD-specific hospitalizations.[12] In contrast, the study presented in this Chapter found a significantly higher mean number of hospitalizations per individual with COPD for all Aboriginal groups with COPD combined; however, the subgroup analysis of Métis with COPD did not confirm these results.

Differences between the two studies in the outcomes selected, observation periods and sample sizes could potentially explain the discrepancies in their findings. The demographic characteristics of both studies were similar; however, the study by Klein-Geltink et al.[12] reported the mean number of hospitalizations per person for two years of observation, whereas this study evaluated all-cause hospitalization rates for 8 years of observation while adjusting for important covariates in multivariate analyses. It can be hypothesized that the relative small sample of Métis included in the study presented here did not have enough power to detect significant differences in the mean number of hospitalizations relative to the non-Aboriginal group with COPD.

COPD is an ambulatory-care sensitive condition that could ideally be managed in outpatient settings. Hospitalizations for ambulatory-care sensitive conditions are a measure of the performance of primary health care services. Their occurrence may reflect potentially preventable complications resulting from unavailable access to, or inadequate quality of primary care.[33]

One could hypothesize that the higher rates of all-cause and AECOPD hospitalizations for all Aboriginal groups with COPD combined, particularly Registered First Nations peoples, are likely the result of inequalities in the access to primary care health services, or deficiencies in the provision of appropriate primary health care services compared to the non-Aboriginal population with COPD. The fact that these effects occur in a universal heath insurance setting with no direct financial barriers to physician and ambulatory services suggest that barriers may be beyond the health care system itself. Alternatively, cultural differences, education background, level of health literacy, and other social determinants of health are key factors associated to how Aboriginal peoples access health care services to receive treatment for COPD and other comorbidities.

Despite having higher all-cause and AECOPD hospitalization rates, Aboriginal peoples with COPD spent less time in the hospital than non-Aboriginal individuals, with the latter staying approximately five to eight days longer. Administrative health data for the study did not provide information about important predictors of hospital LOS (e.g., treatment-related factors, severity, and pulmonary function

prior to and on presentation to hospital, body mass index,[34] specialty of admission, deprivation status of place of residence, distance of place of residence from hospital).[35] Therefore, additional analyses adjusting for these and other factors such as hospital geographic location, and hospital case-mix would be needed to explore this finding further.

All-cause and AECOPD ED visits rates in the study, albeit being higher in the Aboriginal group as a whole, revealed distinct patterns across the three Aboriginal groups. After adjusting for socioeconomic factors and comorbidities, all-cause ED visit rates were significantly higher in Registered First Nations peoples and the Inuit, but lower in the Métis group compared to their non-Aboriginal counterparts with COPD. In contrast, both Registered First Nations peoples and Métis had significantly higher rates of ED visits for AECOPD than the group of non-Aboriginals. Differences between the Inuit and non-Aboriginal individuals in ED visit rates for AECOPD were not significant.

These results are somehow similar to those of studies comparing ED visit rates for COPD between Registered First Nations peoples and non-Aboriginal Canadians:[10,14] Registered First Nations peoples were more likely to visit the ED for COPD exacerbations. The results, however, differ from those of Klein-Geltink et al.[12] in which the mean number of overall ED visits among those diagnosed with COPD were 1.3 times higher among the Métis compared to the general population, while there were no differences between the two groups in the proportion of COPD-specific ED visits.[12] As mentioned earlier, the discrepancies between the study results may be related to differences in the analytical approach chosen and the periods of observation in the studies. There are no published data to compare the results regarding the hospitalizations and ED visits rates in Inuit with COPD.

Differences in ED visit rates among the Aboriginal peoples groups and non-Aboriginal individuals with COPD in this study can be attributed to a variety of factors that are determinants of quality of care in COPD. They include preferences for using the ED as a "safety net of health care" over primary care providers, particularly in socially and economically disadvantaged groups,[36,37] and higher severity of illness.[38] Similarly, poor adherence to therapeutic regimens for COPD

and its comorbidities may lead to treatment failure and disease relapse that often require emergency care.[39]

Data from the 2006 Aboriginal Peoples Survey (APS)[40,41] showed that, overall, the proportion of Aboriginal peoples who have a regular physician (81%) is significantly lower than the national average in Canada (85%). In particular, First Nations peoples living in rural and isolated communities are more likely to report difficulties accessing health providers, including regular physicians.[42] Similarly, according to the APS, Métis and Inuit adults had lower access to a regular physician compared to the general population.[40,41]

It can be hypothesized that the ED constitutes the first point of contact with the health care system for many Aboriginal peoples with COPD; either because they have frequent or more severe exacerbations of their baseline condition, or because they go to the ED rather than going to physician offices for symptoms or conditions that could be otherwise managed out of the ED.

The fact that approximately 10% of individuals are diagnosed with COPD for the first time in the ED[43] indicates that in many instances, the condition remains undetected at the primary care level. The existence of barriers affecting the access to diagnosis and treatment services for COPD, the shortage of regular family physicians, and in a broader perspective, an inadequate organization of the primary care services to address the needs of Aboriginal population with COPD could account for the differences in the use of emergency services between Aboriginal and non-Aboriginal individuals with COPD.

Results from this study showed that the mean ED LOS in the three Aboriginal peoples groups was significantly lower than that of the non-Aboriginal group. These can be good or bad news: on one hand, a shorter LOS may indicate that Aboriginal peoples are admitted and treated faster in the ED. Alternatively, it may indicate that, in some instances, their condition could have been treated in outpatient settings and that the ED visit could have been avoided if better access to physician ambulatory services were available.

Analysis of ED admissions in this study revealed that more Aboriginal peoples with COPD left the ED more frequently before completion of care compared to

their non-Aboriginal counterpart (5.0% versus 2.4%) and this could explain the shorter ED LOS. Post-hoc analyses of the data showed that compared to non-Aboriginal peoples with COPD, Aboriginal peoples with COPD culminated their ED visits because they left against medical advice (LAMA) (2.2% of all ED visits by non-Aboriginal peoples with COPD versus 3.9% of all ED visits by Aboriginal peoples with COPD) or left without being seen (LWBS) (0.2% of all ED visits by non-Aboriginal peoples with COPD versus 0.8% of all ED visits by Aboriginal peoples with COPD). Further studies are required to explore the outcomes of ED visits and other characteristics of Aboriginal peoples and non-Aboriginal peoples who are often users of ED services.

Results from this study confirm that COPD affects Aboriginal peoples differently once they receive a diagnosis, and that they require substantial health services. This study extends on previous findings by quantifying and contextualizing the impact of COPD and its comorbidities on the use of hospitalizations and ED services.

An important contribution of this study is that, albeit it shows that Aboriginal peoples with COPD, as a whole group, use almost two times the amount of hospital and ED services compared to non-Aboriginal peoples with COPD, the three Aboriginal groups have distinct patterns of hospital and ED services use. Findings from this study add important information of variations in the use of hospital and ED services for COPD among the three Aboriginal peoples groups that may reveal inequalities in access to appropriate outpatient care.

Some limitations of this study should be noted. First, accuracy and consistency of administrative health data cannot be assumed. While health care use does not necessary equate with the need for health care, it may be a function of availability of services. For example, variations of hospitalization and ED rates over time and among the study populations may be due to factors other than health status (e.g., accessibility of treatment services or medical and administrative decisions) that influence the use of health services.

Furthermore, the introduction of a new revision of the ICD can create major discontinuities in longitudinal data.[44] Hospitalization and ED visit rates for the year

2002 showed substantial variations compared to rates in subsequent years. It is important to bear in mind that starting April 1, 2002, Alberta switched from ICD-9 to ICD-10-CA to classify discharge diagnoses. Relatively little is known about the effect of coding learning curves after the introduction of a new diagnosis coding system. One study conducted in Switzerland[45] analyzed the impact of coding learning curves after the implementation of ICD-10. The study compared ICD and chart review data for the same hospital discharges over a five-year period (1999-2003) following the adoption of ICD-10 for diagnosis coding. Results of this study showed that there were differences in the level of agreement between chart and administrative data over time, indicating that the accuracy of administrative data coded with ICD-10 improved from the time it was first implemented in 1999 to the end of the study period in 2003.[45] The study authors concluded that coders' knowledge and skills in using ICD-10 coding methods and guidelines may have improved with time, contributing to an improved and more consistent adherence to coding guidelines in subsequent years. A similar study conducted in Australia showed that the validity of ICD-10 data improved over time, two years after the introduction of the ICD-10 in that country.[46]

Variations in rates of episodes of care between 2002 and the 2003-2009 period in our study may be related with the fact that in 2002, coders were still in the early portion of an ICD-10 learning curve, thus creating some discontinuity compared to health services utilization rates in subsequent years for which rules of coding and labelling of disease categories using the new taxonomy were more established.[44,45] This hypothesis is supported by data from one Canadian study[47] that examined the average number of coded diagnoses per hospital visit from 1998 to 2005 for nine Canadian provinces that switched from ICD-9 to ICD-10-CA during this period, including Alberta. The study found minimal changes in coding between the two systems; however, four provinces (Nova Scotia, New Brunswick, Ontario and Alberta) had a decrease in the average number of all diagnoses coded the year after implementation of ICD-10-CA. The authors attributed this decrease to the fact that health record coders were learning a new coding system.[47] Although ICD-10

learning curve may account for disruptions in rates over time, they do not explain the differences in rates of health services use between the study groups.

Post-hoc multivariate analyses of RRs of hospitalizations and ED services between Aboriginal peoples and the non-Aboriginal groups after excluding data from 2002 showed that RRs did not differ in magnitude or direction from those calculated for the entire study period of 2002-2009. Similarly, post-hoc analyses of hospital and ED LOS excluding the year of 2002 did not yield differences in the estimates calculated.

A potential explanation for differences in hospital and ED utilization rates between the years 2002 and 2003 onwards may be related to the provincial adoption of the National Immunization Strategy in 2003,[48,49] which may have contributed to a reduction in the number of influenza- and pneumococcal disease-associated hospitalizations and ED visits over time, particularly among high-risk populations such as seniors and Aboriginal peoples.

Baseline differences in demographic and utilization characteristics were adjusted in the Poisson regression models; however, potential confounders including COPD disease severity, smoking behaviour and smoking status were not fully controlled because this information is not captured within the administrative health databases used in this study. Another limitation of the study was the relatively low sample size of Inuit and Métis individuals with COPD in the analysis that may have obscured differences in the outcomes assessed. Finally, since this study only included a cohort of Métis citizens under the MNA, results are not generalizable to non-registered Métis with COPD, which may have different sociodemographic and clinical characteristics that the cohort included here.

Although the results presented in this study should be interpreted with the above considerations in mind, this retrospective cohort study provides a reasonably comprehensive picture of hospital admissions and ED visits by the three groups of Aboriginal peoples with COPD in Alberta compared to the non-Aboriginal population with COPD in the province.

Understanding the underlying reasons for the high rates of hospitalizations and ED visits in Aboriginal peoples with COPD and the possible remedies require

further study. For example, it would be important to explore the reasons physicians in hospitals and ED services choose to admit or not admit COPD patients at a defined degree of severity and to determine if these choices are systematically different based on the knowledge of the Aboriginal/non-Aboriginal status of the patients.

Access to health services has been widely considered an important determinant of health.[13] Several studies have examined the barriers to access health care services that contribute to health inequalities between Aboriginal peoples and the rest of the population. A systematic review on health care access among Aboriginal peoples in North America, Australia and New Zealand[50] has identified important barriers to health care services that disproportionately affect Aboriginal communities compared to the general population. They include socioeconomic position, geographic location, lack of infrastructure and staff, and language and cultural factors.[13] Results from our study suggest potential inequalities in care between Aboriginal peoples and non-Aboriginal peoples with COPD. Overall, any factor that impedes or delays the adequate access to COPD prevention, diagnosis and treatment services have the potential to create health inequalities affecting the respiratory status of Aboriginal populations. Aboriginal peoples face obstacles to access appropriate health care for their COPD condition; as a result, the degree of severity of COPD manifestations can worsen due to a lack of proper diagnosis, treatment, and prevention. The role that these potential inequalities have on the higher incidence and prevalence rates of the condition among the Aboriginal population and the subsequent burden in hospital and ED services requires further exploration of the causes and the interventions that are needed to target these inequalities.

5.5. Conclusions

Overall, Aboriginal peoples with COPD in Alberta have higher rates of hospitalizations and ED visits than the non-Aboriginal population with COPD. The patterns of hospitalizations and ED services use, however, differ among the three Aboriginal groups, with Registered First Nations peoples consistently showing

higher rates in all indicators evaluated. This study provides a comprehensive picture of the level of use of hospital and ED services for Aboriginal peoples with COPD in Alberta. More importantly, results of this research are expected to help identifying whether inequalities exist in the health status and access to health services for COPD among Albertans. The identification of the impact of COPD among the Aboriginal groups in the province constitutes an important step towards tackling potential health inequalities and identifying the areas in which specific approaches to improve their respiratory health status and access to health services for COPD are needed.

Table 5. 1. Characteristics of Aboriginal peoples groups and a non-Aboriginal population with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	Total population	All Aboriginal peoples	Registered First Nations	Métis	Inuit	Non-Aboriginals
N	3,885	2,274	1,764	329	181	1,611
Male (%)	49.6%	46%	44.0	49.2	59.1	54.7%
Age groups (%)						
35-64 yr	52.7	65.4	68.7	61.4	41.4	34.8
≥ 65 yr	47.3	34.6	31.3	38.6	58.6	65.2
Area of residence (%)						
Urban	59.2	41.3	37.9	52.9	53.0	69.2
Rural	34.4	39.1	40.8	35.9	28.7	27.8
Remote	12.7	19.6	21.3	11.2	18.2	3.0
Subsidy level (%)						
Full/Partial	50.6	39.2	33.6	56.2	62.4	66.7
None	49.4	60.8	66.4	43.8	37.6	33.3
COPD comorbidities (%)						
Hypertension	17.9	17.2	17.0	16.7	19.9	18.9
IHD	11.5	11.0	10.0	14.3	14.9	12.1
Asthma	9.9	10.4	11.0	8.8	7.7	9.1
DM	8.2	8.5	8.7	7.3	8.8	7.7
Osteoporosis	4.3	3.3	2.9	4.0	5.0	5.7
Person-time (yr)	14230.8	8511.0	6461.3	1319.1	730.5	5719.8
Individuals with at least one hospitalization (%; 95% CI)	59.9 [2329] (58.3, 61.4)	60.9 [943] (58.8, 62.9)	63.1 [1114] (60.8, 65.3)	49.2 [162] (43.8, 54.6)	60.7 [110] (53.5, 67.8)	58.5 [943] (56.0, 60.9)
Hospitalizations per person (mean, 95% CI)	3.8 (3.6, 3.9)	4.4 (4.0, 4.7)	4.6 (4.2, 4.9)	3.2 (2.7, 3.6)	3.5 (2.9, 4.0)	3.1 (2.9, 3.2)
Individuals with at least one hospitalization for AECOPD (%, 95% CI)	17.6 [687] (16.4, 18.8)	18.3 [418] (16.7, 19.8)	18.4 [326] (16.5, 20.2)	15.8 [52] (11.8, 19.7)	22.0 [40] (15.9, 28.0)	16.6 [269] (14.7, 18.42)
AECOPD hospitalization per person (mean, 95% CI)	2.0 (1.8, 2.1)	2.2 (1.9, 2.4)	2.3 (2.0, 2.5)	2.1 (1.4, 2.7)	1.9 (1.3, 2.4)	1.8 (1.6, 2.0)
Individuals with at least one ED visit (%[n]; 95% CI)	79.4 [3087] (78.2, 80.7)	84.2 [1914] (82.7, 85.7)	85.7 [1512] (84.1, 87.3)	79 [260] (74.6, 83.4)	78.5 [142] (72.5, 84.4)	72.8 [1173] (70.6, 75.0)
ED visits per person (mean, 95% CI)	11.6 (10.8, 12.3)	14.4 (13.3, 15.4)	15.4 (14.1, 16.6)	9.1 (7.6, 10.5)	13.2 (9.5, 16.8)	7.1 (6.4, 7.7)
Individuals with at least one ED visit for AECOPD (%, n)	23.9 [930] (22.6, 25.3)	26.5 [603] (24.7, 28.3)	26.6 [469] (24.5, 28.6)	22.2 [73] (17.7, 26.7)	33.7 [61] (26.8, 40.6]	20.3 [327] (18.3, 22.3)
AECOPD ED visits per person (mean, 95% CI)	2.7 (2.4, 2.9)	2.8 (2.5, 3.0)	2.8 (2.4, 3.1)	2.6 (2.0, 3.1)	3.0 (2.1, 3.9)	2.5 (2.1, 2.8)

AECOPD = acute exacerbations of chronic obstructive pulmonary disease; CI = confidence interval; COPD = chronic obstructive pulmonary disease; ED = emergency department; yr(s) = years

Table 5. 2. Characteristics of all-cause hospitalizations among Aboriginal peoples groups and a non-Aboriginal population with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

%	Total population	All Aboriginal peoples	Registered First Nations	Métis	Inuit	Non-Aboriginals
N all-cause hospitalizations	9,062	6,105	5,192	525	388	2,957
Admission type						
Elective	15.0	12.6	11.6	18.7	18.8	19.9
Urgent	85.0	87.4	88.4	81.3	81.2	80.1
Method of admission						
Direct	28.3	31.1	26.1	32.2	32.0	27.0
ED	69.4	66.8	71.8	64.4	64.9	70.7
Outpatient hospital service	2.2	2.1	2.1	3.4	3.1	2.3
Disposition status						
Discharged	73.8	75.6	74.9	82.3	75.5	70.2
Transferred to another facility	16.6	14.8	15.1	11.4	16.0	20.4
Expired	6.2	5.1	5.1	5.0	4.9	8.4
Signed out against medical advice	3.4	4.5	4.9	1.3	3.6	1.0
ED RHA						
Chinook	6.3	7.1	8.0	3.4	0.0	4.6
Palliser Health Region	1.6	0.3	0.2	1.3	0.5	4.3
Calgary Health Region	16.0	11.5	11.8	8.0	12.4	25.3
David Thompson Health Region	8.7	8.0	8.5	5.3	5.7	9.9
East Central Health	3.5	2.3	2.2	3.0	3.4	5.7
Capital Health	34.1	33.2	31.7	43.0	40.7	35.8
Aspen Regional Health Authority	14.2	17.8	17.4	19.0	22.4	6.6
Peace Country Health	9.2	11.0	10.7	12.4	12.9	5.5
Northern Lights Health Region	6.2	8.3	9.3	4.0	0.8	1.8
ACB, AMHB	0.4	0.4	0.3	0.4	1.3	0.5
Hospital LOS (median days, IQR)	5 (3, 12)	5 (2, 10)	5 (2, 10)	5 (2, 8)	4 (2, 9)	7 (3, 15)

ABC = Alberta Cancer Board; AMHB = Alberta Mental Health Board; CI = confidence interval; IQR = interquartile range; LOS = length of stay; RHA = Regional Health Authority

Table 5. 3. Annual all-cause and AECOPD hospitalization rates in Aboriginal and non-Aboriginal groups with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

Fiscal year	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2002/2003 to 2009/2010
All-cause hospitalizations rate (per 1,000 person-years) (95% CI)									
Overall	1235.8	692.8	643.5	707.0	648.1	617.4	575.1	589.8	636.7
	(1101.7, 1382.8)	(640.4, 748.3)	(600.2, 688.4)	(667.1, 748.0)	(613.3, 684.3)	(586.1, 650.0)	(546.8, 604.5)	(562.7, 618.1)	(623.7, 650.0)
Aboriginal groups	1271.1	745.7	758.9	811.2	745.5	703.9	650.7	649.3	717.3
	(1092.1, 1472.3)	(674.2, 822.8)	(698.6, 823.2)	(756.2, 869.2)	(697.4, 796.2)	(660.9, 749.1)	(612.1, 691.1)	(613.0, 687.2)	(699.4, 735.5)
Registered First Nations	1519.3	852.7	848.6	907.1	853.9	803.7	726.8	690.0	803.5
	(1299.0, 1766.0)	(766.3, 946.2)	(776.5, 925.5)	(840.6, 977.4)	(794.6, 916.6)	(750.8, 859.5)	(680.0, 776.1)	(646.9, 735.2)	(781.8, 825.7)
Métis	412.4	205.8	403.8	428.5	385.7	316.3	366.8	519.8	397.9
	(165.3, 849.9)	(112.5, 345.4)	(291.0, 545.9)	(329.3, 548.3)	(302.8, 484.2)	(247.5, 398.4)	(297.2, 448.0)	(441.7, 607.8)	(364.7, 435.5)
Inuit	237.7	582.3	485.1	623.2	480.0	559.0	509.6	536.8	531.1
	(47.7, 694.5)	(386.9, 841.7)	(327.3, 692.6)	(469.5, 811.2)	(430.3, 759.8)	(435.0, 707.1)	(397.3, 644.0)	(426.9, 666.3)	(479.6, 586.7)
Non-Aboriginals	1188.5	622.7	482.9	561.6	503.9	486.6	458.2	495.0	516.9
	(989.3, 1416.0)	(547.9, 704.9)	(426.6, 544.6)	(507.9, 619.5)	(456.1, 555.3)	(443.0, 533.4)	(418.3, 501.0)	(455.2, 537.4)	(498.5, 536.0)
AECOPD hospitalizations rate (per 1,000 person-years) (95% CI)									
Overall	93.5	87.8	112.3	115.9	108.8	100.7	94.3	93.6	101.1
	(59.2, 140.3)	(69.8, 109.0)	(94.9, 131.9)	(100.4, 133.3)	(94.8, 124.3)	(88.3, 114.5)	(83.0, 106.7)	(83.0, 105.3)	(95.9, 106.5)
Aboriginal groups	120.7	75.1	116.0	117.6	127.1	111.6	108.0	105.5	110.8
	(70.3, 193.3)	(53.6, 102.3)	(93.2, 142.8)	(97.2, 141.0)	(107.8, 149.1)	(94.9, 130.5)	(92.6, 125.2)	(91.2, 121.5)	(103.9, 118.1)
Registered First Nations	152.8	86.4	129.7	121.1	137.1	124.0	108.1	103.4	116.6
	(88.9, 244.7)	(60.6, 119.7)	(102.6, 162.0)	(97.6, 148.5)	(114.0, 163.6)	(103.8, 147.2)	(95.4, 128.1)	(87.1, 121.8)	(108.5, 125.3)
Métis	0.0	58.8	86.5	108.8	78.1	57.1	95.5	102.6	85.6
		(15.8, 150.6)	(39.5, 164.3)	(62.1, 176.8)	(43.7, 129.0)	(30.4, 97.6)	(61.8, 141.0)	(69.7, 145.7)	(71.2, 103.0)
Inuit	0.0	0.0	32.3	101.9	131.7	105.3	131.0	130.9	104.0
			(3.6, 116.8)	(46.5, 193.6)	(71.9, 221.1)	(56.0, 180.1)	(77.6, 207.1)	(79.9, 202.2)	(83.1, 130.2)
Non-Aboriginals	57.0	104.6	107.1	113.7	81.7	84.3	73.0	74.6	86.7
	(20.8, 124.2)	(75.3, 141.4)	(81.5, 138.2)	(90.3, 141.4)	(63.2, 104.0)	(67.5, 105.1)	(57.6, 93.1)	(59.7, 92.2)	(79.2, 94.6)

AECOPD = acute exacerbations of chronic obstructive pulmonary disease; CI = confidence interval; COPD = chronic obstructive pulmonary disease

Table 5. 4. Unadjusted and adjusted rate ratios for all-cause hospitalizations in Aboriginal peoples diagnosed with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	RR (95% CI)	
	Unadjusted	**Adjusted****
Non-Aboriginal	reference	reference
Aboriginal	1.21 (1.16, 1.27)*	1.31 (1.24, 1.37)*
Age group		
35-64 years	-	reference
≥ 65 years	-	0.95 (0.90, 1.00)
Sex	-	
Male		reference
Female	-	0.89 (0.86, 0.93)*
Area of residence	-	
Urban		reference
Rural	-	1.04 (1.00, 1.09)
Remote	-	1.05 (0.98, 1.12)
Subsidy		
None	-	reference
Full/partial	-	1.54 (1.47, 1.63)*
Hypertension		
No	-	reference
Yes	-	1.01 (0.96, 1.06)
Diabetes mellitus		
No	-	reference
Yes	-	1.19 (1.11, 1.28)*
Ischemic heart disease		
No	-	reference
Yes	-	1.22 (1.15, 1.29)*
Asthma		
No	-	reference
Yes	-	1.25 (1.17, 1.33)*
Osteoporosis		
No	-	reference
Yes	-	0.72 (0.64, 0.80)*

* $p<0.05$

** Poisson regression model adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis); CI = confidence interval; RR = rate ratio

Table 5. 5. Unadjusted and adjusted rate ratios for all-cause hospitalizations in Registered First Nations peoples, Métis and Inuit diagnosed with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	RR (95% CI)	
	Unadjusted	**Adjusted****
Population		
Non-Aboriginal	reference	reference
First Nations	1.36 (1.30, 1.43)*	1.60 (1.52, 1.69)*
Métis	0.77 (0.70, 0.85)*	0.80 (0.72, 0.88)*
Inuit	0.70 (0.63, 0.78)*	0.71 (0.64, 0.79)*
Age group		
35-64 years	-	reference
≥ 65 years	-	0.93 (0.88, 0.98)*
Sex		
Male	-	reference
Female	-	0.86 (0.82, 0.89)*
Area of residence		
Urban	-	reference
Rural	-	0.96 (0.92, 1.01)
Remote		0.95 (0.89, 1.02)
Subsidy	-	
None	-	reference
Full/partial		1.71 (1.62, 1.80)*
Hypertension	-	
No	-	reference
Yes		1.00 (0.95, 1.05)
Diabetes mellitus	-	
No	-	reference
Yes		1.19 (1.11, 1.28)*
Ischemic heart disease	-	
No	-	reference
Yes		1.25 (1.18, 1.33)*
Asthma	-	
No	-	reference
Yes	-	1.23 (1.16, 1.31)*
Osteoporosis		
No	-	reference
Yes	-	0.74 (0.66, 0.82)*

* $p<0.05$

** Poisson regression model adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis); CI = confidence interval; RR = rate ratio

Table 5. 6. Unadjusted and adjusted rate ratios for AECOPD hospitalizations in Aboriginal peoples diagnosed with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	RR (95% CI)	
	Unadjusted	**Adjusted****
Non-Aboriginal	reference	reference
Aboriginal	1.17 (1.05, 1.31)*	1.22 (1.08, 1.38)*
Age group		
35-64 years	-	reference
≥ 65 years	-	0.77 (0.67, 0.88)*
Sex	-	
Male		reference
Female	-	0.79 (0.71, 0.88)*
Area of residence	-	
Urban		reference
Rural	-	0.75 (0.66, 0.85)*
Remote	-	1.02 (0.86, 1.20)
Subsidy		
None	-	reference
Full/partial	-	1.66 (1.45, 1.90)*
Hypertension		
No	-	reference
Yes	-	0.91 (0.78, 1.05)
Diabetes mellitus		
No	-	reference
Yes	-	1.87 (1.52, 2.28)*
Ischemic heart disease		
No	-	reference
Yes	-	0.94 (0.80, 1.10)
Asthma		
No	-	reference
Yes	-	1.35 (1.19, 1.55)*
Osteoporosis		
No	-	reference
Yes	-	0.59 (0.45, 0.78)*

* $p<0.05$

** Poisson regression model adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis); CI = confidence interval; RR = rate ratio

Table 5. 7. Unadjusted and adjusted rate ratios for AECOPD hospitalizations in Registered First Nations peoples, Métis and Inuit diagnosed with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	RR (95% CI)	
	Unadjusted	**Adjusted****
Population		
Non-Aboriginal	reference	reference
First Nations	1.26 (1.12, 1.41)*	1.44 (1.26, 1.65)*
Métis	1.14 (0.93, 1.40)	1.10 (0.89, 1.36)
Inuit	0.71 (0.55, 0.90)*	0.67 (0.52, 0.86)*
Age group		
35-64 years	-	reference
≥ 65 years	-	0.77 (0.67, 0.89)*
Sex		
Male	-	reference
Female	-	0.74 (0.67, 0.83)*
Area of residence		
Urban	-	reference
Rural	-	0.72 (0.64, 0.81)*
Remote		0.89 (0.75, 1.06)
Subsidy	-	
None	-	reference
Full/partial		1.80 (1.57, 2.07)*
Hypertension	-	
No	-	reference
Yes		0.90 (0.78, 1.05)
Diabetes mellitus	-	
No	-	reference
Yes		1.94 (1.59, 2.38)*
Ischemic heart disease	-	
No	-	reference
Yes		0.90 (0.76, 1.06)
Asthma	-	
No	-	reference
Yes	-	1.30 (1.14, 1.49)*
Osteoporosis		
No	-	reference
Yes	-	0.60 (0.45, 0.79)*

* $p<0.05$

** Poisson regression model adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis)

CI = confidence interval; RR = rate ratio

Table 5. 8. Characteristics of all-cause ED admissions among Aboriginal peoples groups and a non-Aboriginal group with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

%	Total population	All Aboriginal peoples	Registered First Nations	Métis	Inuit	Non-Aboriginals
N all-cause ED visits	35,951	27,599	23,342	2,376	1,881	8,352
Disposition status						
Discharged	76.2	77.7	77.0	80.9	82.5	71.3
Admitted	19.2	17.2	17.6	15.7	14.2	26.0
Expired	0.2	0.1	0.2	0.1	0.0	0.3
Left before completion of care	4.4	5.0	5.3	3.3	3.3	2.4
ED RHA						
Chinook	4.3	4.5	5.0	2.4	1.3	3.5
Palliser Health Region	1.3	0.4	0.3	1.3	0.3	4.4
Calgary Health Region	10.0	7.0	7.5	2.9	5.0	20.1
David Thompson Health Region	9.4	8.4	8.6	4.9	10.0	12.8
East Central Health	3.5	2.2	2.0	3.5	3.6	7.8
Capital Health	23.6	21.4	21.0	28.2	17.2	30.8
Aspen Regional Health Authority	24.3	28.5	27.9	30.6	32.2	10.7
Peace Country Health	15.2	17.1	16.1	19.4	27.5	8.7
Northern Lights Health Region	8.4	10.5	11.5	6.8	2.9	1.2
ED LOS (median hours [n]*, IQR)	1 [34038] (1, 4)	1 [26010] (0, 4)	1 [22027] (0, 4)	1 [2231] (0, 3)	1 [1752] (0, 3)	2 [8028] (1, 5)

* n available for analysis

CI = confidence interval; ED = emergency department; IQR = interquartile range; LOS = length of stay RHA = Regional Health Authority

Table 5. 9. Annual all-cause and AECOPD ED visit rates in Aboriginal and non-Aboriginal groups with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

Fiscal year	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2002/2003 to 2009/2010
All-cause ED visits rate (per 1,000 person-years) (95% CI)									
Overall	3069.2 (2854.0, 3296.0)	2228.4 (2134.2, 2326.4)	2386.1 (2303.9, 2471.8)	2598.6 (2523.3, 2676.4)	2602.8 (2533.7, 2674.9)	2736.6 (2670.1, 2804.7)	2489.7 (2430.5, 2550.7)	2411.0 (2356.3, 2467.6)	2526.2 (2500, 2553.5)
Aboriginal groups	3848.8 (3532.4, 4187.2)	2896.4 (2754.3, 3045.4)	3090.6 (2967.5, 3218.6)	3443.8 (3330.5, 3561.1)	3373.8 (3270.5, 3480.6)	3512.8 (3416.6, 3612.7)	3175.5 (3090.0, 3263.7)	3017.4 (2939.3, 3098.1)	3242.7 (3205.4, 3281.3)
Registered First Nations	4036.6 (3672.4, 4428.4)	3257.2 (3086.3, 3435.1)	3467.6 (3320.0, 3620.1)	3852.2 (3714.4, 3994.2)	3694.5 (3570.3, 3823.1)	3974.5 (3856.2, 4096.4)	3565.1 (3460.5, 3672.2)	3327.1 (3232.3, 3425.1)	3612.5 (3566.1, 3659.0)
Métis	2592.8 (1884.7, 3481.2)	1147.0 (906.7, 1432.8)	1365.3 (1150.2, 1609.4)	1687.0 (1484.4, 1911.1)	1912.8 (1722.3, 2119.5)	1726.7 (1560.0, 1906.4)	1903.0 (1740.2, 2078.2)	2006.5 (1850.1, 2173.4)	1801.2 (1730.1, 1875.4)
Inuit	3882.7 (2872.3, 5133.4)	2246.2 (1843.7, 2712.2)	2328.5 (1964.2, 2741.6)	2855.5 (2514.1, 3231)	3303.8 (2967.5, 3668.1)	2827.7 (2539.0, 3141.3)	2111.5 (1875.5, 2369.5)	2212.7 (1983.6, 2462.8)	2574.8 (2460.1, 2694.0)
Non-Aboriginals	2025.2 (1762.3, 2316.2)	1342.6 (1232.8, 1461.0)	1405.2 (1308.2, 1508.2)	1418.1 (1332.0, 1508.3)	1462.1 (1380.4, 1548.5)	1564.5 (1485.0, 1647.1)	1429.7 (1358.2, 1504.3)	1443.4 (1375.0, 1514.3)	1460.1 (1429.2, 1492.3)
AECOPD ED visits rate (per 1,000 person-years) (95% CI)									
Overall	219.5 (164.9, 286.4)	130.6 (108.5, 156.0)	157.8 (137.1, 180.8)	174.5 (155.3, 195.6)	201.7 (182.5, 222.4)	185.8 (168.8, 204.1)	188.2 (172.2, 205.4)	172.9 (158.4, 188.6)	178.8 (172.2, 185.9)
Aboriginal groups	312.4 (227.0, 419.5)	110.8 (84.3, 143.0)	169.5 (141.6, 201.3)	198.0 (171.3, 227.7)	242.6 (215.5, 272.3)	213.4 (190.1, 238.9)	211.7 (190.0, 235.4)	192.6 (173.1, 213.8)	202.2 (192.8, 212.0)
Registered First Nations	215.7 (138.2, 321.1)	120.1 (89.1, 158.3)	188.0 (155.0, 226.1)	209.3 (178.1, 244.5)	244.1 (212.9, 278.7)	239.7 (211.2, 271.0)	212.2 (187.2, 239.6)	191.6 (169.3, 216.2)	208.3 (197.3, 219.7)
Métis	0.0	88.2 (32.2, 192.0)	67.3 (26.9, 138.7)	142.8 (88.4, 218.4)	161.5 (109.8, 229.3)	92.2 (57.1, 141.0)	175.7 (128.7, 234.5)	195.3 (148.7, 252.0)	144.7 (125.0, 166.8)
Inuit	158.7 (96.7, 244.8)	62.4 (12.5, 182.3)	161.7 (77.4, 297.4)	192.6 (112.2, 308.4)	376.5 (269.0, 512.7)	210.6 (137.6, 308.7)	276.6 (195.8, 379.8)	196.4 (132.5, 280.4)	251.8 (216.8, 291.0)
Non-Aboriginals	95.0 (45.5, 174.9)	156.9 (120.6, 200.8)	141.6 (111.9, 176.7)	141.8 (115.5, 172.3)	141.1 (116.4, 169.6)	144.0 (120.8, 170.5)	151.8 (129.2, 177.2)	141.5 (120.7, 165.0)	144.0 (134.4, 154.2)

AECOPD = acute exacerbations of chronic obstructive pulmonary disease; CI = confidence interval; COPD = chronic obstructive pulmonary disease; ED = emergency department

Table 5. 10. Unadjusted and adjusted rate ratios for all-cause ED visits in Aboriginal peoples diagnosed with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	RR (95% CI)	
	Unadjusted	**Adjusted****
Non-Aboriginal	reference	reference
Aboriginal	1.95 (1.90, 2.00)*	1.72 (1.67, 1.77)*
Age group		
35-64 years	-	reference
≥ 65 years	-	0.88 (0.86, 0.91)*
Sex	-	
Male		reference
Female	-	0.97 (0.95, 0.99)*
Area of residence	-	
Urban		reference
Rural	-	1.57 (1.53, 1.61)*
Remote	-	1.64 (1.59, 1.70)*
Subsidy		
None	-	reference
Full/partial	-	1.25 (1.22, 1.29)*
Hypertension		
No	-	reference
Yes	-	1.03 (1.00, 1.06)*
Diabetes mellitus		
No	-	reference
Yes	-	1.18 (1.14, 1.23)*
Ischemic heart disease		
No	-	reference
Yes	-	1.05 (1.02, 1.09)*
Asthma		
No	-	reference
Yes	-	1.40 (1.36, 1.45)*
Osteoporosis		
No	-	reference
Yes	-	0.91 (0.86, 0.96)*

* $p<0.05$

** Adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis)

CI = confidence interval; ED = emergency department; RR = rate ratio

Table 5. 11. Unadjusted and adjusted rate ratios for all-cause ED visits in Registered First Nations peoples, Métis and Inuit diagnosed with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	RR (95% CI)	
	Unadjusted	**Adjusted****
Population		
Non-Aboriginal	reference	reference
First Nations	2.21 (2.16, 2.27)*	2.02 (1.97, 2.08)*
Métis	1.07 (1.02, 1.12)*	0.94 (0.90, 0.98)*
Inuit	1.36 (1.29, 1.43)*	1.28 (1.22, 1.35)*
Age group		
35-64 years	-	reference
≥ 65 years	-	0.82 (0.80, 0.85)*
Sex		
Male	-	reference
Female	-	0.93 (0.91, 0.95)*
Area of residence		
Urban	-	reference
Rural	-	1.46 (1.42, 1.49)*
Remote		1.54 (1.49, 1.59)*
Subsidy	-	
None	-	reference
Full/partial		1.43 (1.39, 1.48)*
Hypertension	-	
No	-	reference
Yes		1.03 (1.00, 1.06)*
Diabetes mellitus	-	
No	-	reference
Yes		1.18 (1.14, 1.23)*
Ischemic heart disease	-	
No	-	reference
Yes		1.09 (1.05, 1.13)*
Asthma	-	
No	-	reference
Yes	-	1.40 (1.35, 1.44)*
Osteoporosis		
No	-	reference
Yes	-	0.94 (0.89, 0.99)*

* $p<0.05$

** Adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis)

CI = confidence interval; ED = emergency department; RR = rate ratio

Table 5. 12. Unadjusted and adjusted rate ratios of ED visits for AECOPD in Aboriginal peoples diagnosed with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

	RR (95% CI)	
	Unadjusted	**Adjusted****
Non-Aboriginal	reference	reference
Aboriginal	1.24 (1.14, 1.35)*	1.33 (1.21, 1.45)*
Age group		
35-64 years	-	reference
≥ 65 years	-	0.94 (0.86, 1.04)
Sex	-	
Male		reference
Female	-	0.74 (0.68, 0.81)*
Area of residence	-	
Urban		reference
Rural	-	0.92 (0.84, 1.00)
Remote	-	1.06 (0.93, 1.19)
Subsidy		
None	-	reference
Full/partial	-	1.18 (1.07, 1.30)*
Hypertension		
No	-	reference
Yes	-	0.88 (0.79, 0.98)*
Diabetes mellitus		
No	-	reference
Yes	-	1.22 (1.04, 1.42)*
Ischemic heart disease		
No	-	reference
Yes	-	1.02 (0.90, 1.16)
Asthma		
No	-	reference
Yes	-	1.38 (1.25, 1.52)*
Osteoporosis		
No	-	reference
Yes	-	0.64 (0.51, 0.81)*

* $p<0.05$

** Adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis)

CI = confidence interval; AECOPD = acute exacerbations of chronic obstructive pulmonary disease; RR = rate ratio

Table 5. 13. Unadjusted and adjusted rate ratios of ED visits for AECOPD in Registered First Nations peoples, Métis and Inuit diagnosed with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

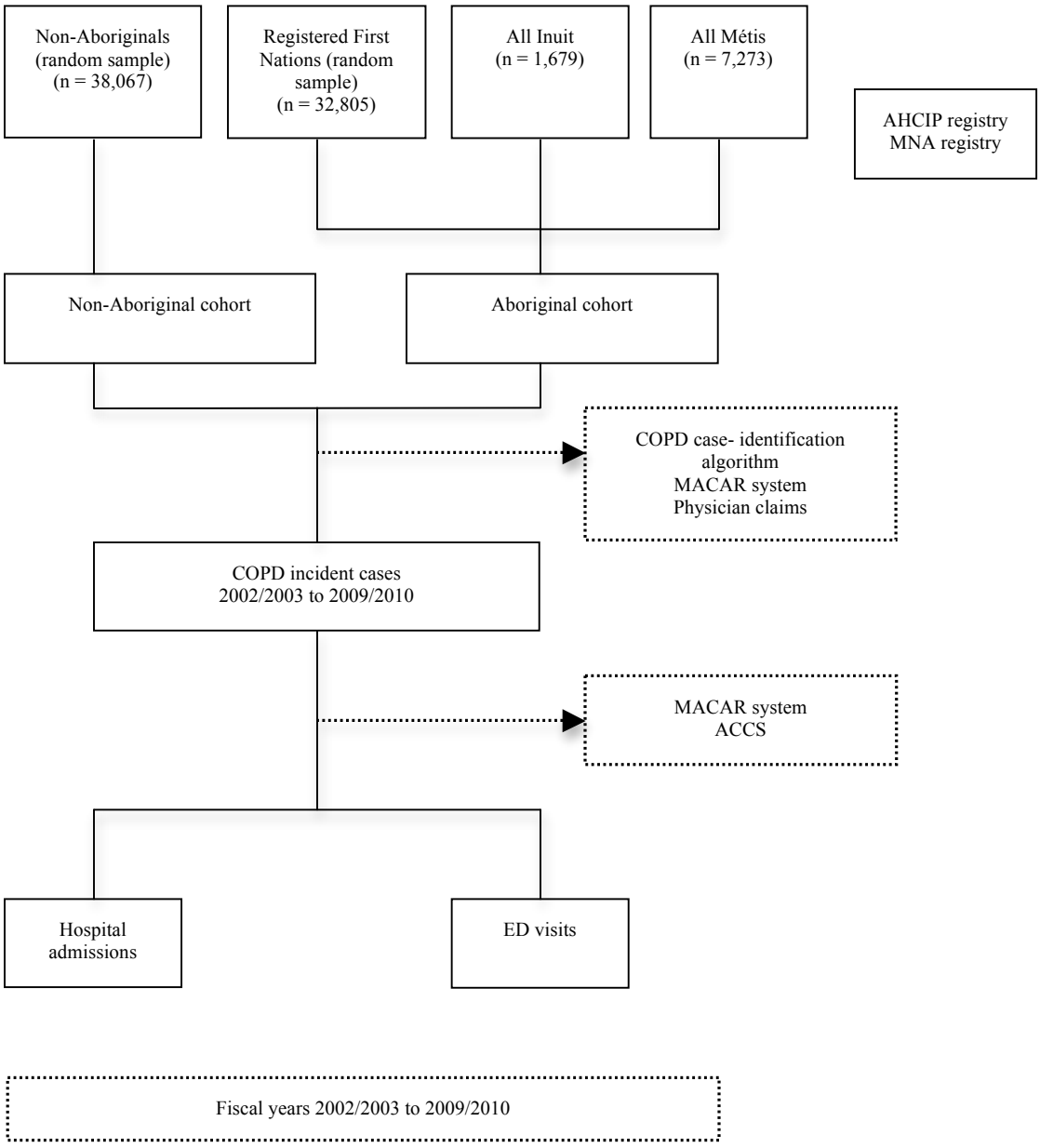
	RR (95% CI)	
	Unadjusted	**Adjusted****
Population		
Non-Aboriginal	reference	reference
First Nations	1.30 (1.19, 1.42)*	1.45 (1.32, 1.60)*
Métis	1.16 (0.99, 1.36)	1.22 (1.04, 1.44)*
Inuit	0.98 (0.84, 1.15)	0.96 (0.82, 1.14)
Age group		
35-64 years	-	reference
≥ 65 years	-	0.96 (0.87, 1.06)
Sex		
Male	-	reference
Female	-	0.72 (0.66, 0.78)*
Area of residence		
Urban	-	reference
Rural	-	0.89 (0.82, 0.97)*
Remote		1.00 (0.89, 1.14)
Subsidy	-	
None	-	reference
Full/partial		1.22 (1.11, 1.34)*
Hypertension	-	
No	-	reference
Yes		0.86 (0.77, 0.96)*
Diabetes mellitus	-	
No	-	reference
Yes		1.22 (1.04, 1.42)*
Ischemic heart disease	-	
No	-	reference
Yes		1.00 (0.88, 1.14)
Asthma	-	
No	-	reference
Yes	-	1.37 (1.24, 1.51)*
Osteoporosis		
No	-	reference
Yes	-	0.64 (0.51, 0.81)*

* $p<0.05$

** Adjusted for sex (male, female), age group (35-64 years, 65 years and over), socioeconomic status proxy (full/partial subsidy, no subsidy), area of residence (urban rural, remote), presence of comorbidities (hypertension, ischemic heart disease, asthma, diabetes mellitus, osteoporosis)

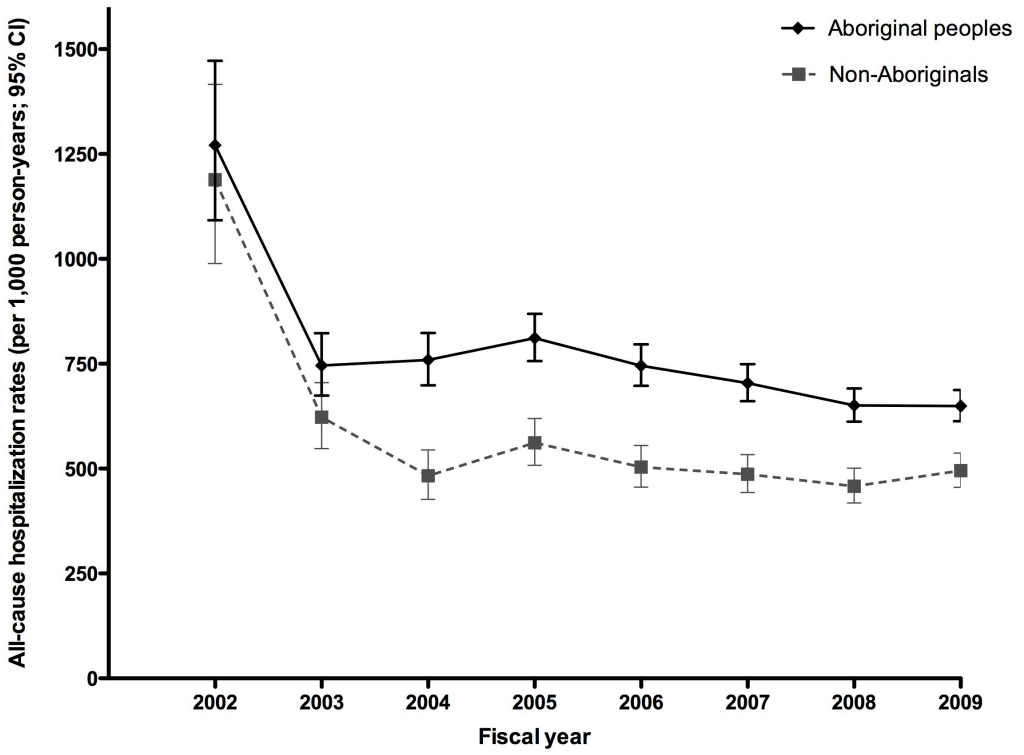
CI = confidence interval; AECOPD = acute exacerbations of chronic obstructive pulmonary disease; RR = rate ratio

Figure 5. 1. Flowchart of the study of health services use among Aboriginal Peoples with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



ACCS = Alberta Ambulatory Care Classification System; AHCIP = Alberta Health Care Insurance Plan; COPD = chronic obstructive pulmonary disease; ED = emergency department; MACAR = Morbidity and Ambulatory Care Reporting; MNA = Métis Nation of Alberta

Figure 5. 2. Annual all-cause hospitalization rates in Aboriginal and non-Aboriginal groups with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



CI = confidence interval

Figure 5. 3. Annual all-cause hospitalization rates in the three Aboriginal groups and the non-Aboriginal group with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010

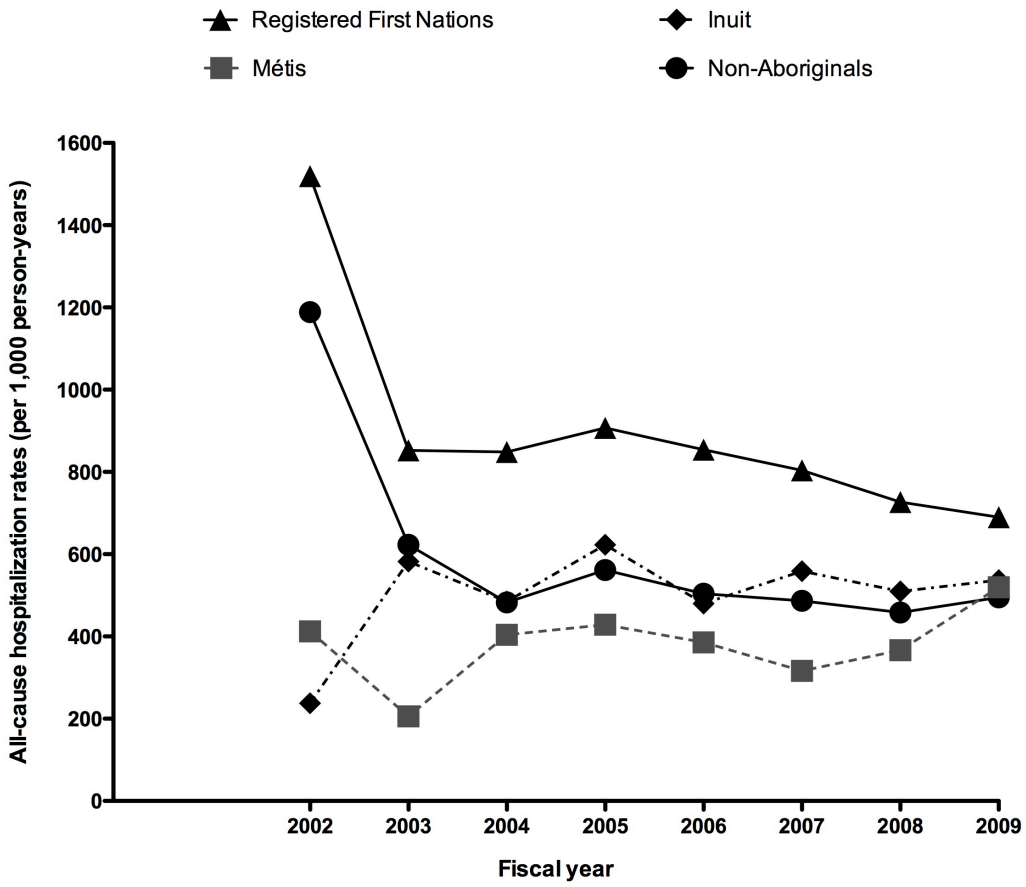
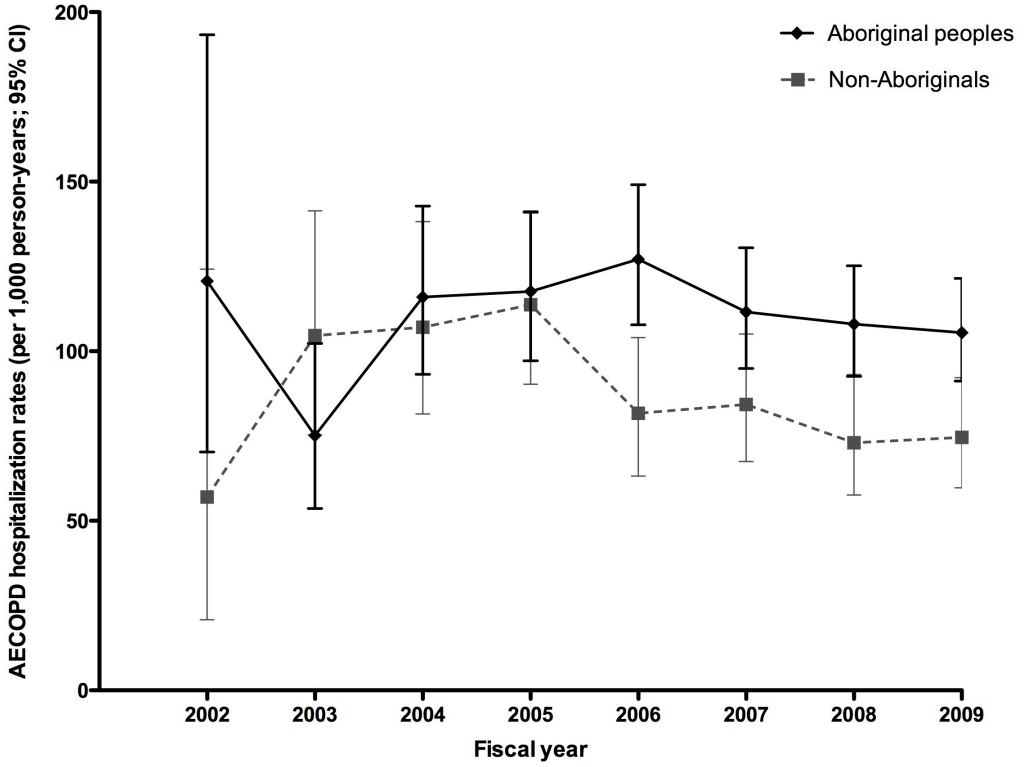
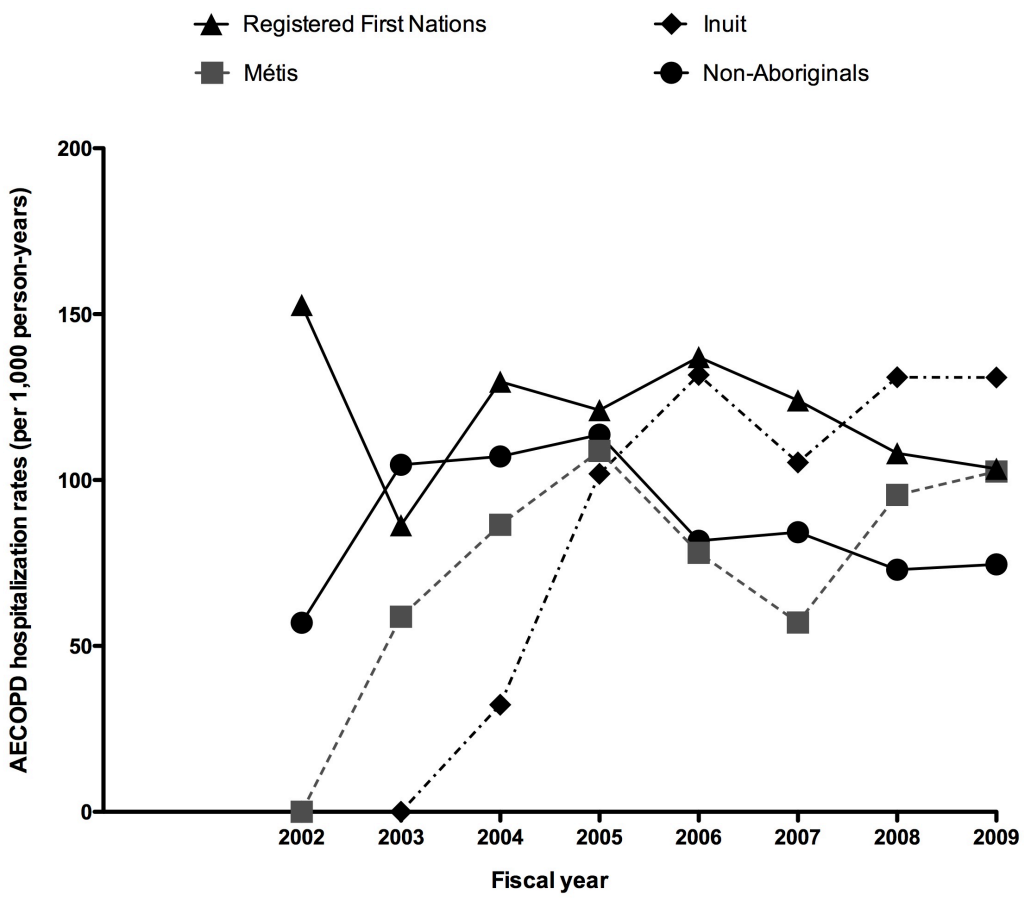


Figure 5. 4. Annual AECOPD hospitalization rates in Aboriginal and non-Aboriginal groups with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



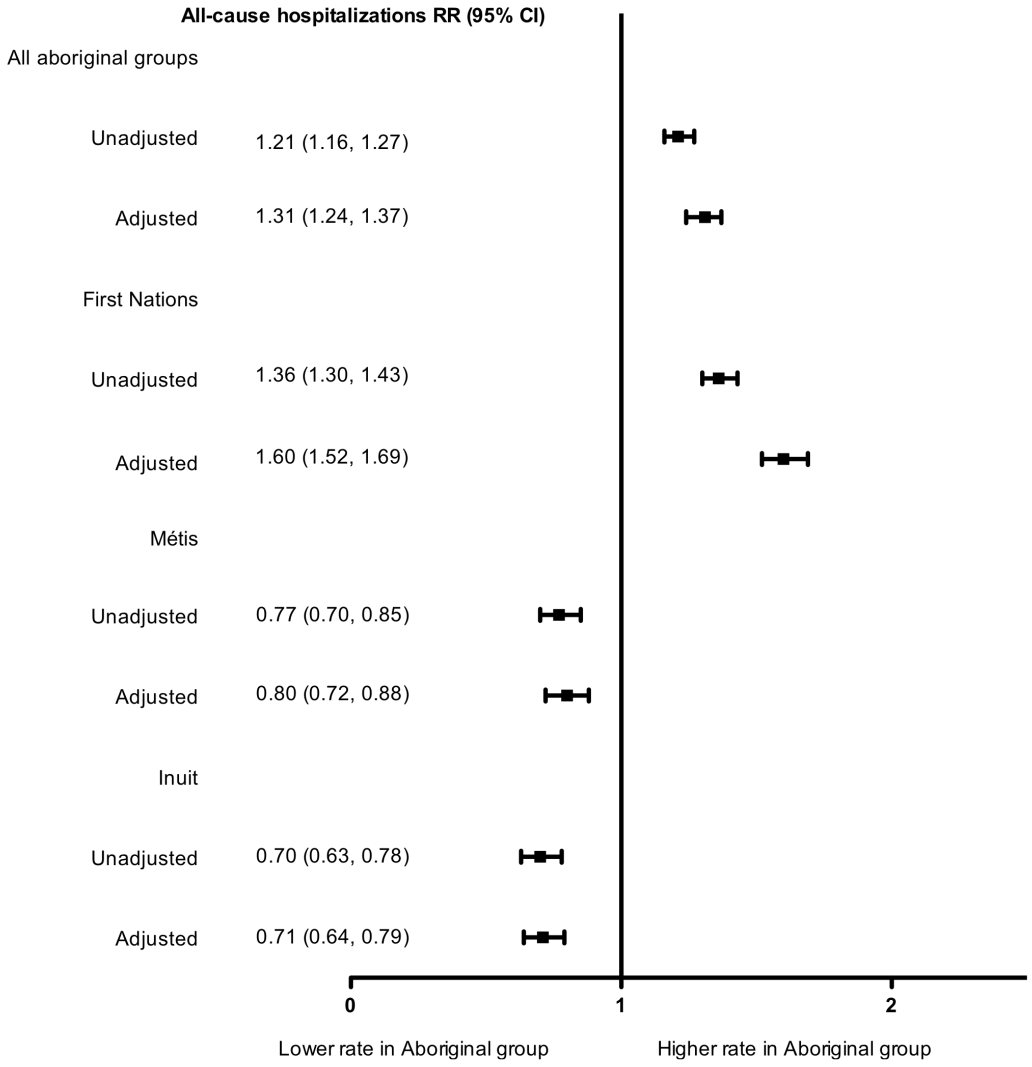
AECOPD = acute exacerbations of chronic obstructive pulmonary disease; CI = confidence interval

Figure 5. 5. Annual AECOPD hospitalization rates in the three Aboriginal groups and the non-Aboriginal group with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



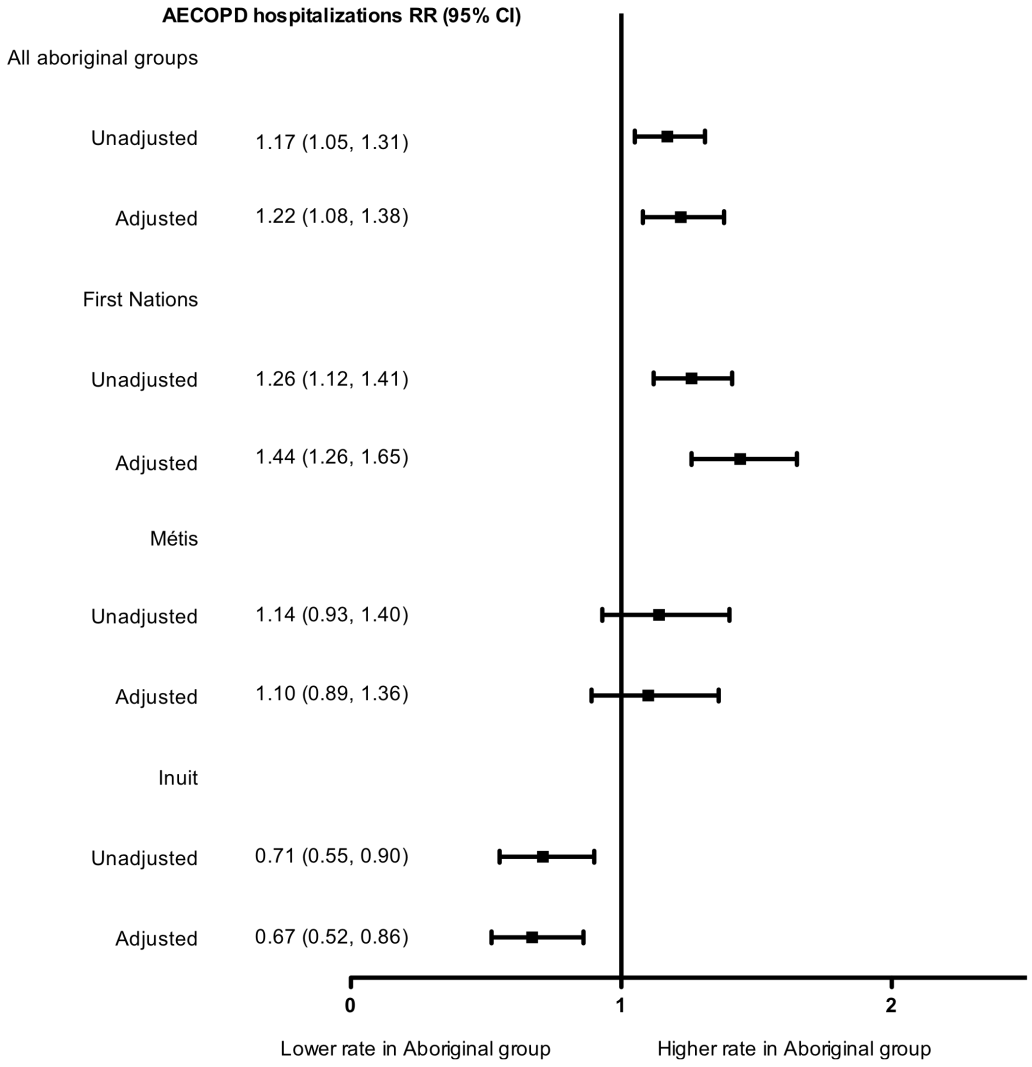
AECOPD = acute exacerbations of chronic obstructive pulmonary disease

Figure 5. 6. All-cause hospitalization rate ratios in Aboriginal peoples with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



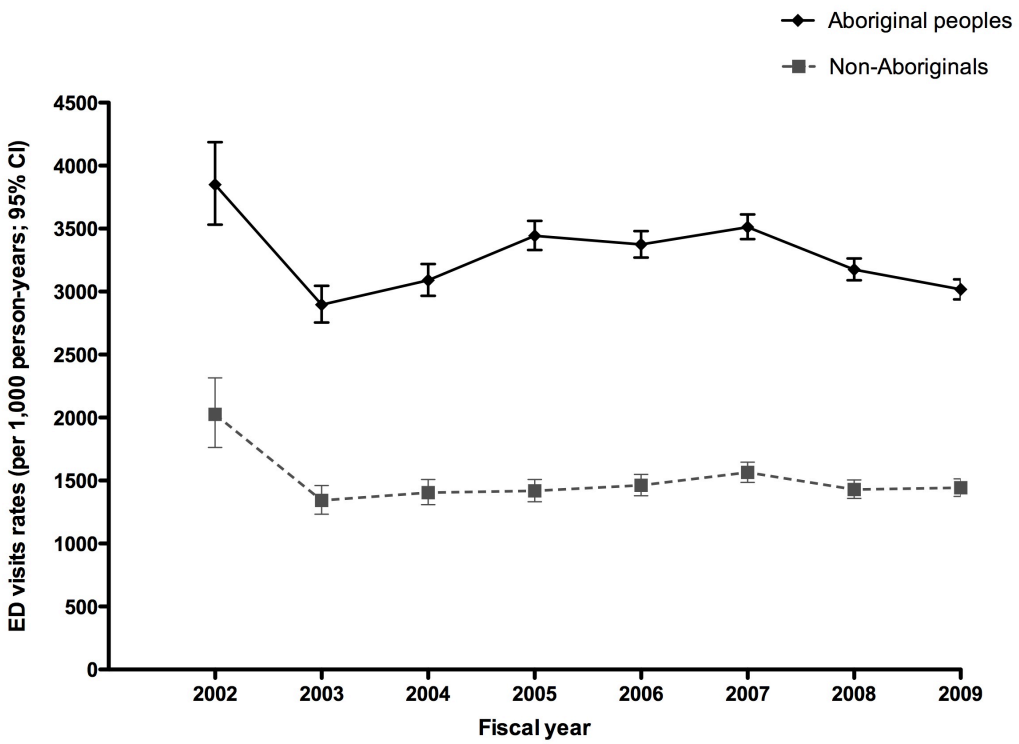
CI = confidence interval; RR = rate ratio

Figure 5. 7. AECOPD hospitalization rate ratios in Aboriginal peoples with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



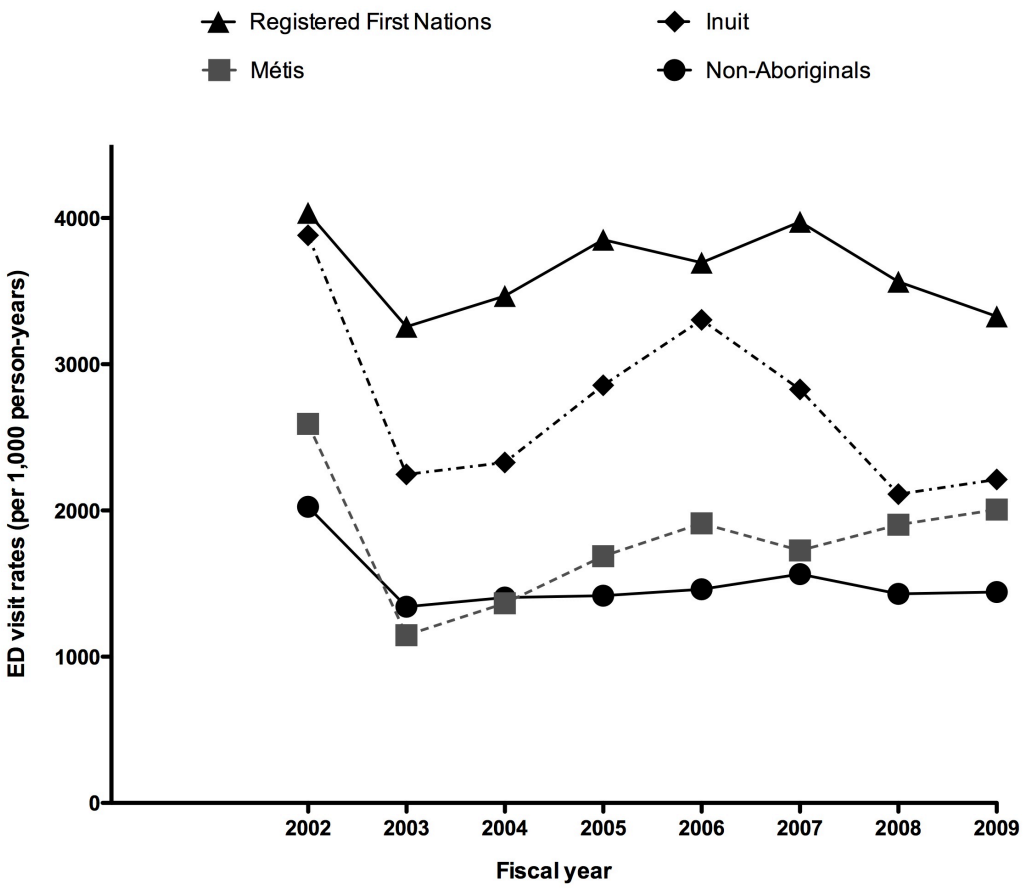
AECOPD = acute exacerbations of chronic obstructive pulmonary disease; CI = confidence interval; RR = rate ratio

Figure 5. 8. Annual rates of all-cause ED visits in Aboriginal and non-Aboriginal groups with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



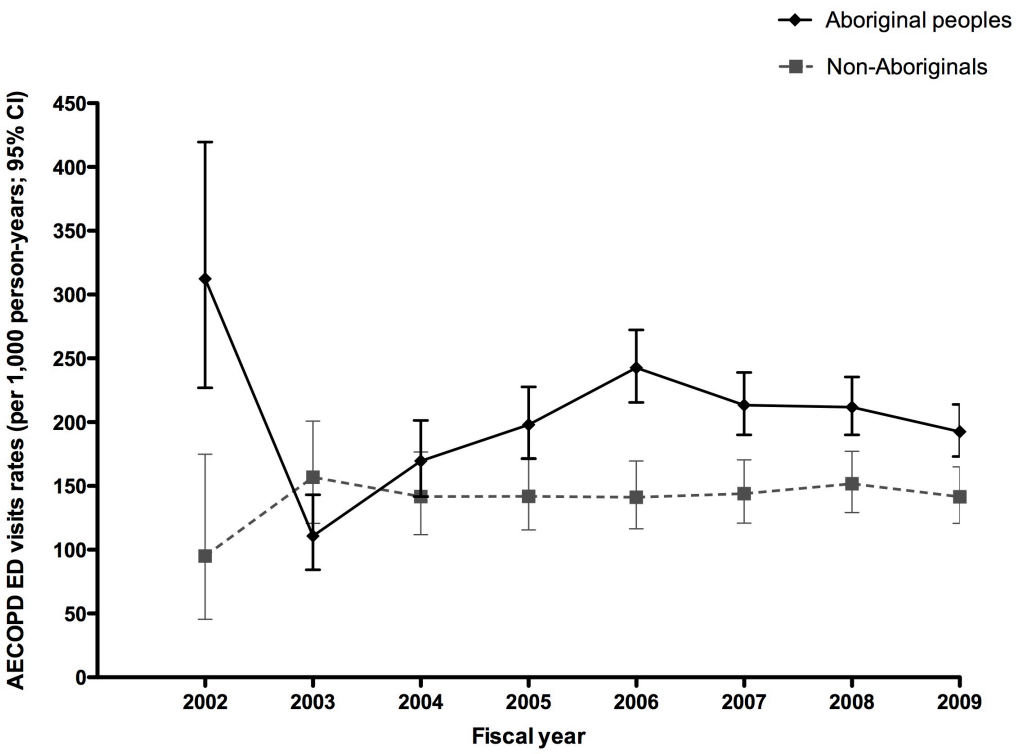
CI = confidence interval; ED = emergency department

Figure 5. 9. Annual rates of all-cause ED visits in the three Aboriginal groups and the non-Aboriginal group with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



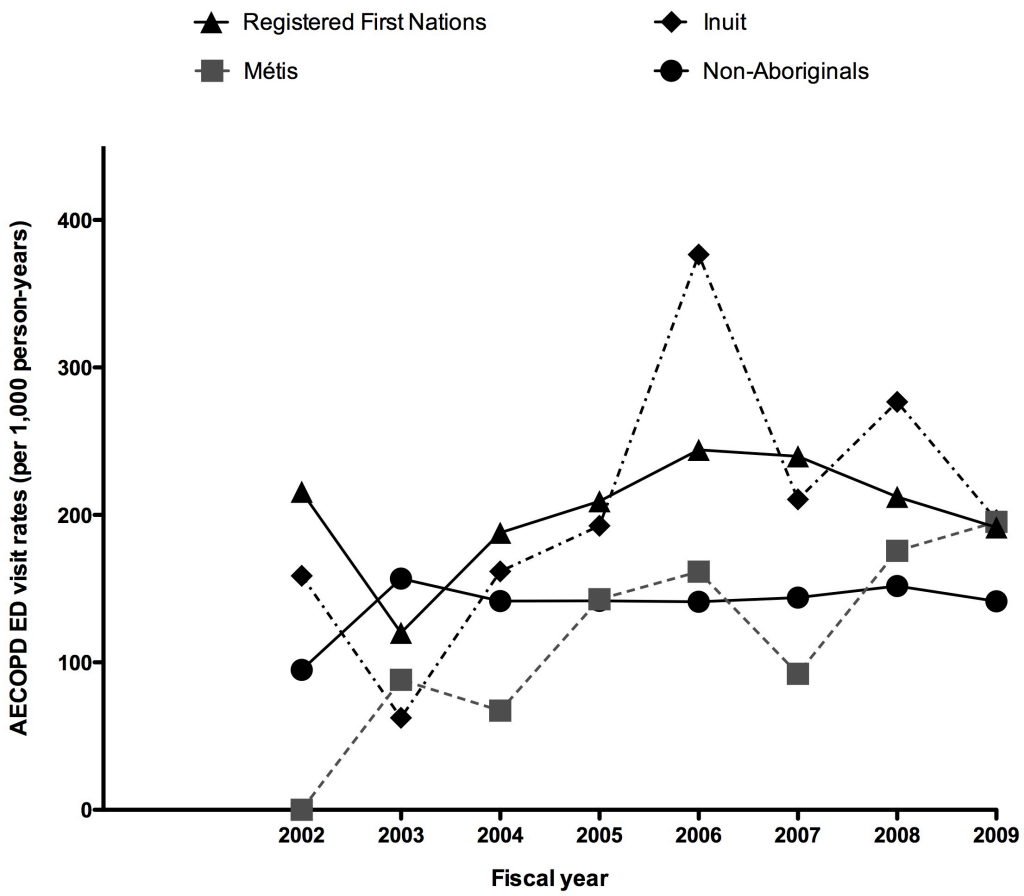
ED = emergency department

Figure 5. 10. Annual rates of AECOPD ED visits in Aboriginal and non-Aboriginal groups with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



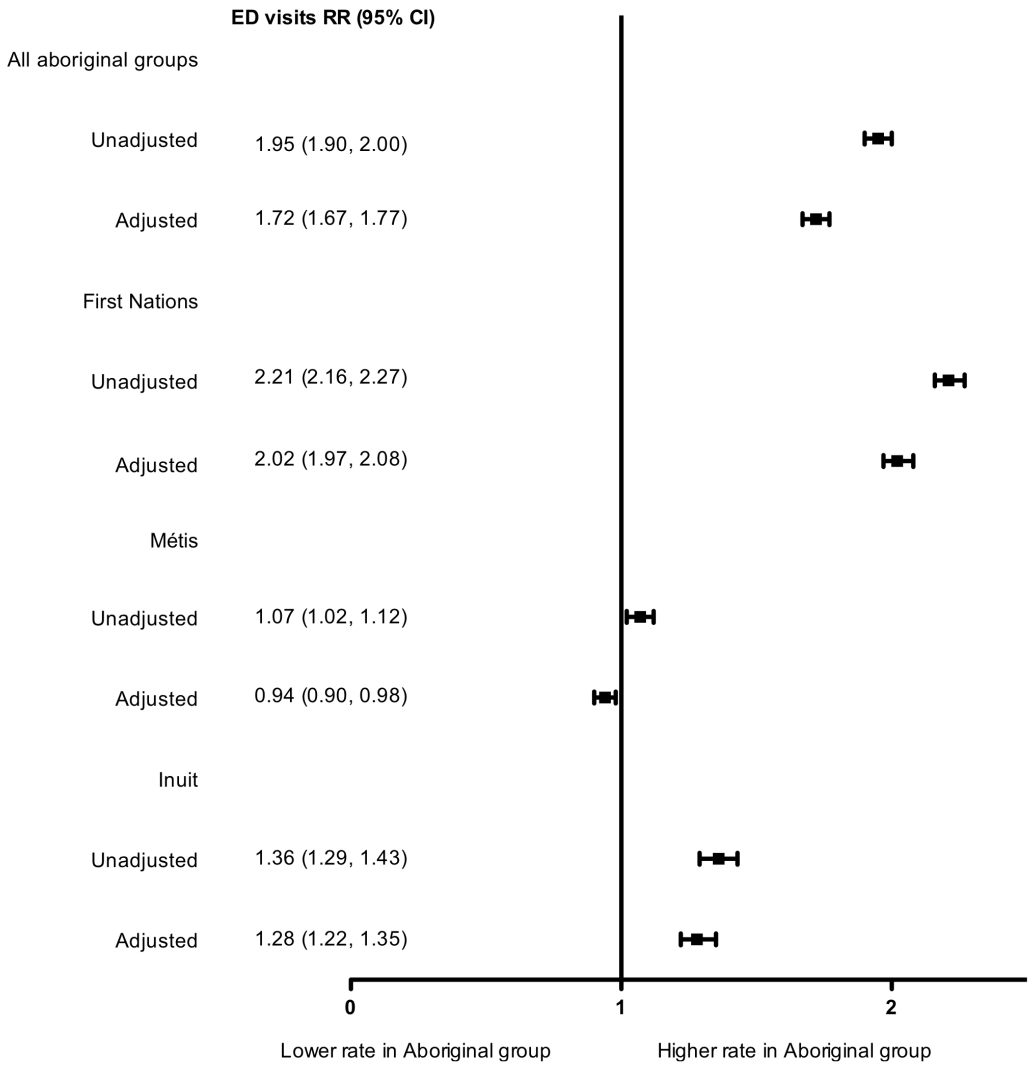
AECOPD = acute exacerbations of chronic obstructive pulmonary disease; CI = confidence interval; ED = emergency department

Figure 5. 11. Annual rates of AECOPD ED visits in the three Aboriginal groups and the non-Aboriginal group with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



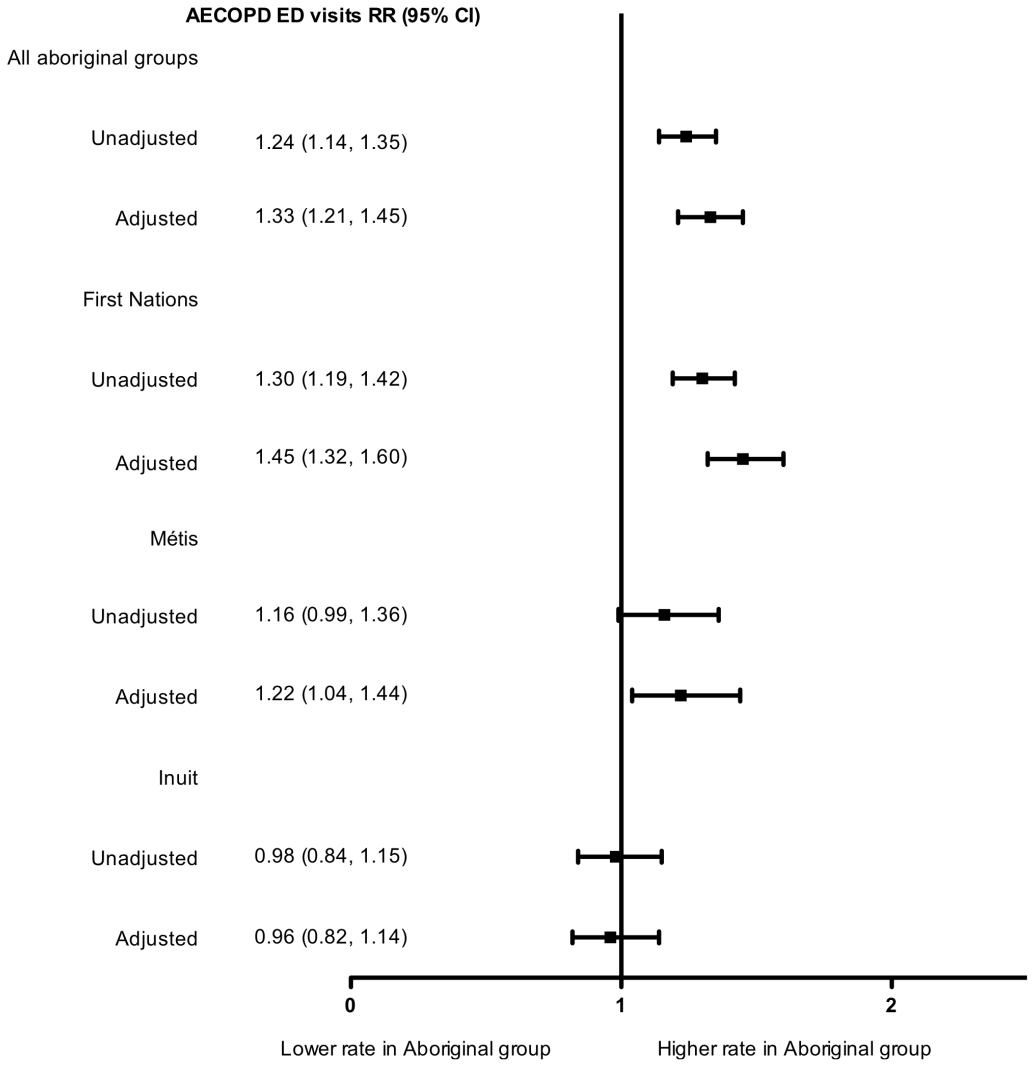
AECOPD = acute exacerbations of chronic obstructive pulmonary disease; ED = emergency department

Figure 5. 12. Rate ratios of all-cause ED visits in Aboriginal peoples with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



CI = confidence interval; COPD = chronic obstructive pulmonary disease; ED = emergency department; RR = rate ratio

Figure 5. 13. Rate ratios of ED visits for AECOPD in Aboriginal peoples with COPD in Alberta, Canada; fiscal years 2002/2003 to 2009/2010



AECOPD = acute exacerbations of chronic obstructive pulmonary disease; CI = confidence interval; ED = emergency department; RR = rate ratio

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Chapter 6
Discussion and Conclusions

6.1. Summary and Interpretation of the Results

The preceding chapters of this dissertation reviewed research on the epidemiology of chronic obstructive pulmonary disease (COPD) in Aboriginal peoples and non-Aboriginal populations in a variety of settings, and analyzed the differences between Aboriginal and non-Aboriginal groups in the prevalence, incidence, mortality and health services use (i.e., hospitalizations and emergency department [ED] visits) for COPD based on longitudinal health administrative data from Alberta.

The systematic review of the literature revealed important gaps in our knowledge about the differences in the epidemiology of COPD between Aboriginal peoples and non-Aboriginal populations of diverse backgrounds living in industrialized countries and provided a rationale and justification for conducting more epidemiological studies in this field. Results of the review emphasize the importance of developing standardized guidelines for the reporting of studies evaluating epidemiological measures of Aboriginal respiratory health if meaningful synthesis of results across studies is to be made.

The four retrospective cohort studies based on linkage of administrative health data in Alberta provide a substantial contribution to our knowledge about the differences between Aboriginal peoples and the non-Aboriginal population in the epidemiology and patterns of health services use for COPD.

6.1.1. Prevalence and incidence of COPD

The study that assessed the differences in prevalence and incidence of COPD found that, compared to the non-Aboriginal population, the three Aboriginal peoples groups in Alberta have higher prevalence and incidence of COPD, with Registered First Nations peoples and Inuit having the highest COPD estimates followed by the Métis after adjusting for sex, age group, socio-economic status and area of residence. Results of this analysis are similar to other longitudinal

studies conducted in Canada that have compared the prevalence of COPD between Métis and non-Métis populations.[1,2] Comparisons of COPD incidence between Aboriginal peoples and non-Aboriginal populations in the scientific literature, albeit scarce, have also identified a higher incidence of COPD among Métis compared to non-Métis.[2]

A variety of mechanisms are likely to explain the increased COPD prevalence and incidence in Aboriginal peoples. If it is true that the smoking rate in Aboriginal peoples is more than double the rate of the rest of the Canadian population,[3] it can be expected that epidemiological indicators of COPD would be higher in Aboriginal peoples compared to the non-Aboriginal population.

Although COPD incidence rates in all study groups have decreased over time, the gap between Aboriginal peoples and non-Aboriginal individuals in COPD remains. This finding may be associated with a relative lack of success of the implementation of smoking cessation programs in Aboriginal communities.[4,5] A recent survey conducted in British Columbia and Saskatchewan on tobacco cessation among Canada's Aboriginal peoples[6] found that Aboriginal peoples were less likely to seek physician services for quit smoking and that the requirement for a physician prescription for using drug therapy for smoking cessation was perceived as a barrier.

Since the socioeconomic gradient in COPD is greater than in any other disease[7] and Aboriginal peoples in Canada have higher rates of poverty and lower income levels than non-Aboriginal Canadians,[8] interactions between smoking and other social determinants of health (e.g., housing conditions and crowding, nutrition, economic and social disadvantage and geographic location of residence) are likely to contribute to the excess risk of COPD in Aboriginal peoples.

6.1.2. All-cause mortality after being diagnosed with COPD

The study that compared all-cause mortality following a diagnosis of COPD in Registered First Nations peoples, Métis and Inuit relative to the non-Aboriginal population in Alberta found that there were not significant differences between Aboriginal peoples, as a whole group, and non-Aboriginal individuals in their all-

cause mortality hazards after being diagnosed with COPD and after adjusting for important sociodemographic and clinical prognostic factors. All-cause mortality in Métis and Inuit was lower compared to the non-Aboriginal group, whereas no differences in mortality were found between Registered First Nations peoples and non-Aboriginal peoples with COPD.

In line with previous studies,[9-11] age at time of COPD diagnosis was an important independent predictor of all-cause mortality. Specifically, age was a significant effect modifier of the relationship between Aboriginal status and mortality following a COPD diagnosis. While mortality hazards following a COPD diagnosis did not differ between Aboriginal and non-Aboriginal peoples at younger ages, lower mortality hazards were identified among Métis and Inuit aged 65 years and over compared to their non-Aboriginal counterparts.

Results of this study are similar to those reported in a retrospective analysis of all-cause mortality in Métis with COPD registered in the Métis Nation of Ontario in which this population had lower all-cause mortality rates compared to a non-Métis population with COPD.[2] Studies comparing all-cause mortality rates for COPD between Registered First Nations peoples and Inuit relative to non-Aboriginal populations in Canada have not been published to date.

One could have expected a higher hazard of death in Aboriginal peoples with COPD compared to their non-Aboriginal counterparts given their higher exposure rate to smoking; however, results of this study suggest that a higher incidence of COPD does not immediately translate into higher all-cause mortality rates once a diagnosis of COPD is established.

A variety of explanations for this finding can be proposed: first, it is possible that the absence of differences in mortality hazards between Aboriginal peoples and non-Aboriginals diagnosed with COPD at young ages is explained by lack of sufficient time in the natural history of the disease to identify clear differences in disease trajectories between the two groups. Alternatively, since the risk of mortality increases with age, and age at diagnosis was a significant independent predictor of the hazard of death following a diagnosis of COPD, it is possible that the comparatively lower hazard of death among Aboriginal peoples aged 65 years

and older may be the result of the younger age structure of the Aboriginal peoples' group. Other potentially explanatory factors include differences between the groups in COPD severity at baseline,[12] or differences in their levels of physical activity, considering that it constitutes the strongest predictor of all-cause mortality in COPD.[13]

6.1.3. Hospitalizations and ED visits following a diagnosis of COPD

Differences between the three distinct Aboriginal groups in Alberta relative to a non-Aboriginal population in the rates of hospitalizations and ED visits after a COPD diagnosis were examined. The study found that Aboriginal peoples with COPD, as a whole group, had significantly higher rates of hospitalizations and ED visits for all causes and for acute exacerbations of COPD (AECOPD) compared to non-Aboriginals with COPD after adjusting for important sociodemographic factors and comorbidities. The pattern of health services use in individuals with COPD was not uniform across the three Aboriginal peoples hen compared to a non-Aboriginal cohort with COPD:

- All-cause hospitalizations: significantly higher in Registered First Nations peoples; significantly lower in Métis and Inuit;
- AECOPD hospitalizations: significantly higher in Registered First Nations peoples; significantly lower in Inuit, not significant different in Métis;
- All-cause ED visits: significantly higher in Registered First Nations peoples and Inuit; significantly lower in Métis; and
- AECOPD ED visits: significantly higher in Registered First Nations peoples and Métis; not significant different in Inuit.

These results contrast with those of the only other retrospective cohort study published in Canada that compared hospitalization and ED visit rates between Métis and non-Aboriginal individuals diagnosed with COPD.[2] The study found a higher mean number of hospitalizations and ED visits among Métis diagnosed with COPD compared to the general population, with no differences in the mean number of COPD-specific episodes of care between the two groups.[2] Differences between the two studies in the outcomes selected, observation periods and sample

sizes could potentially explain the discrepancies in their findings. On the other hand, it is likely that the relative small sample of Métis and Inuit included in the study presented here did not have enough power to detect significant differences in some of the outcomes evaluated.

Results of the analysis of ED visits were similar to those of studies reporting that Registered First Nations peoples in Alberta were more likely to visit the ED for AECOPD compared to non-Aboriginal populations.[14,15] There are no published data to compare the results of hospitalizations and ED visits rates in Inuit with COPD.

Differences in hospitalizations and ED visit rates among Aboriginal peoples and non-Aboriginal individuals with COPD in this study can be attributed to a variety of factors that are determinants of quality of care in COPD. For example, if hospitalizations for ambulatory-care sensitive conditions such as COPD are a measure of the performance of primary health services, the patterns of hospitalization among certain Aboriginal groups with COPD, particularly Registered First Nations peoples, may result of inequalities in the access to primary care, or deficiencies in the provision of appropriate primary health care services for this population.[16]

Alternatively, barriers affecting the access to diagnosis and treatment services for COPD, the shortage of regular family physicians, and in a broader perspective, an inadequate organization of the primary care services to address the needs of Aboriginal population with COPD could potentially explain why Aboriginal peoples, particularly Registered First Nations peoples and Inuit use the ED as a "safety net of health care" over primary care providers.

Other potentially explanatory factors of how Aboriginal peoples access health care services to receive treatment for COPD and other comorbidities include cultural differences, perception of health services, and level of health literacy. Evidence from qualitative research have established that, as a result of past histories of abuse and discrimination and prior negative experiences with the health care system, Aboriginal peoples may not seek medical care at rates which would be expected of Canadians in the general population, among whom

biomedicine is understood culturally as the primary accepted mean of disease diagnosis and treatment.[17,18]

Finally, poor adherence to therapeutic regimens for COPD and its comorbidities may lead to treatment failure and disease relapses that often require repeated hospitalizations and emergency care.

In summary, the studies presented in this dissertation provide evidence of a gap between Aboriginal peoples and non-Aboriginal populations in Alberta in the epidemiology of COPD and the rates of health services utilization (i.e., hospitalizations and ED visits) once they are diagnosed with COPD, with worse outcomes for Registered First Nations peoples.

Moreover, the results emphasize that, although similar in many ways, Registered First Nations peoples, Métis and Inuit have a distinct epidemiological profile indicative of how COPD differentially affects the three Aboriginal groups.

While there is an important body of literature worldwide informing that income, socio-economic status, social position, and geographic location are key determinants for a broad array of adverse COPD health outcomes,[7,19-25] more research is needed to expand our knowledge about the role of these factors to explain potential inequalities in respiratory health among Aboriginal peoples.

6.2. Strengths of this Research

The systematic review used reproducible and valid methods to evaluate the differences in the burden of COPD between Aboriginal and non-Aboriginal populations. Based on a systematic search of published and unpublished studies, attempts were made to minimize the impact of publication bias. Similarly, efforts were made to avoid selection bias by involving two reviewers in all stages of the review process and using *a priori* decisions. Standardized techniques for quality appraisal of studies were used and meta-analyses were conducted only in the absence of statistical heterogeneity.

Research presented in this dissertation is one of the first studies in Canada, and the first one in Alberta to provide a comprehensive longitudinal assessment of

the epidemiology and health services use in COPD among the three Aboriginal groups compared to the non-Aboriginal population.

The retrospective cohort design with database linkage constituted a cost-efficient and valid method to evaluate the differences in the outcomes of interest between Aboriginal and non-Aboriginal cohorts.[26] Additionally, it involved a large number of people with wide coverage and continuity of data over a relatively long follow-up period. Given the research questions and study design, multivariate analyses was the optimal way to address confounding in the study.[27]

This research used a validated algorithm to identify COPD cases in the study population. The algorithm has been previously validated to identify adults with COPD, with acceptable specificity and positive and negative predictive values.[28]

Another strength of the study is the comprehensive methods to identify individuals in the Aboriginal cohorts. A number of studies that have assessed the health status of Aboriginal peoples in Canada,[16,29-31] and particularly in Alberta,[15,26,29] have restricted their analyses to individuals with Registered First Nations status; with Inuit and Métis being systematically excluded from the analyses. By linking administrative data between the Métis Nation of Alberta (MNA) citizenship registry and Alberta health databases, this study is one of the first of its kind in Canada that identified Registered First Nations peoples, Métis and Inuit within the Aboriginal cohort, thus reducing the impact of misclassification bias related to the definition of Aboriginal status in the results.[32]

6.3. Limitations

As with all research that is observational in nature, there are a number of limitations inherent to the design and data sources, such as the quality of administrative data and underreporting of key information, potential bias in the selection of the study cohorts, and misclassification bias in the definition of COPD.

6.3.1. Quality of administrative health data and use for research purposes

The effect of potential confounders, including family history, smoking status and behaviour, exposure to second hand smoke, body mass index, treatments, and

clinical measures of lung function and COPD severity, were not fully adjusted for in the multivariate analyses because no direct information on these factors is captured in the administrative health databases that were used.[33,34]

Additionally, data captured in administrative databases did not permit to assess how distal social factors and potential health care system- and provider-related variables might account for the differences in outcomes between Aboriginal peoples and the non-Aboriginal population in our study. For example, rates of health services use may have differed between the study populations for factors that may not be related to health but to accessibility of treatment services as well as medical or administrative decisions that bear on the number and length of stay in the services. This research also falls short to acknowledge the role that traditional diagnosis and medicinal practices can play in health services outcomes in COPD.[35]

Another potential problem with the lack of detailed data in administrative databases was that, since previous research has shown that certain Aboriginal groups (i.e., First Nations peoples) are twice as likely to smoke than the rest of the Canadian population,[36-38] and smoking is an important etiologic agent in the development of COPD,[39,40] it is unknown whether diagnostic suspicion bias[32] plays a role when establishing a clinical diagnosis of COPD based on prior knowledge of the Aboriginal status and the higher smoking rates in certain Aboriginal groups.[32] Limited information in the databases did not allow to tease out a component of "cultural bias" in diagnostic labeling from a true difference in epidemiological measures of COPD.

6.3.2. Risk of misclassification of Aboriginal status

Misclassification bias affecting the status of exposure (i.e., being Aboriginal) was not entirely eliminated in the study. Limitations encountered in similar studies regarding the proper identification of non-Registered Aboriginal peoples persisted,[41] although to a lesser degree. For example, an individual who was classified in the non-Aboriginal group may have been in fact, a non-Registered First Nations person or a Métis without citizenship registration under the MNA. It

is also possible that First Nations peoples with Registered status and Métis individuals registered with the MNA may be different (in demographic or clinical terms) than non-Registered First Nations peoples and non-registered Métis in the province.

In 2011, First Nations peoples without registration status represented 25.1% of the total number of First Nations peoples in Canada.[42] Similarly, not all (perhaps as low as 30%) Métis in the province are members of the MNA and therefore, a substantial number of non-MNA Métis were left out from our study or were misclassified in the non-Aboriginal group.

Misclassification bias in the study may have led to undercounting of approximately one-third of Aboriginal peoples in the province. If anything, the magnitude of the differences in epidemiological indicators of COPD between Aboriginal peoples and the non-Aboriginal populations has likely been underestimated as a result of misclassification of non-Registered First Nations peoples and non-MNA Métis, for had we had the correct classification of all Aboriginal peoples, such differences would have been more precise.

6.3.3. Risk of misclassification of COPD status

Another consideration is the risk of misclassification of COPD (i.e., diagnostic misclassification bias).[27] Because the algorithm for COPD case definition considered individuals 35 years and older, cases diagnosed prior to this age (which may well be in the earliest stages of disease progression) were missed. Therefore, the study may have been more likely to include individuals with clinically significant COPD, excluding milder cases at a younger age. Because clinical symptoms of COPD do not usually appear at early stages of the disease process, it is likely that the age limit in the case ascertainment algorithm allowed the identification of individuals at relatively later stages in the natural history of their condition. Evidence indicates that most COPD patients are not diagnosed until advanced stages of the disease and cases with early onset are often unrecognized.[43-45] If true, the minimal level of COPD severity in the study was based on the level at which patients sought medical care; a situation that may

produce an underestimation of the true epidemiology of the disease in all groups (i.e., prevalence-incidence bias).[27]

There is also a potential of misclassification bias when determining disease status based on diagnostic codes collected in administrative databases. Trained nosologists assign ICD-10-CA COPD diagnostic codes for ED and hospitalizations based on recorded physician diagnoses at discharge; however, this is not the case for physician billing claims. Moreover, factors such as including billing and reimbursement considerations, and difficulties in establishing a proper classification of obstructive and non-obstructive respiratory disorders in certain age groups (e.g., asthma and COPD in the elderly) in the absence of information from spirometry and other pulmonary function tests can contribute to misclassifications of the true disease status.[46]

Despite the limitations outlined above, there is no reason to believe that misclassification of disease status would be differential for Aboriginal peoples and the non-Aboriginal populations evaluated in the study. If any, the non-differential misclassification would bias the results in the direction of the null and produce conservative COPD estimates in both groups. Therefore, the reported differences between the groups in the epidemiological estimates of COPD remain valid.

6.4. Study Significance and Implications for Aboriginal Peoples, Health Care Professionals, and Policy Makers

Notwithstanding the above limitations, this research is one of the first studies in Canada and the first one in Alberta that provided the most comprehensive evidence to date on the epidemiology and health services use for COPD among Aboriginal peoples.

From a broader perspective, the results support the view that Aboriginal peoples in Canada should not be regarded as a monolithic ethnic group when examining how COPD epidemiological estimates compare to those of non-Aboriginal peoples in the province. COPD-related inequalities compared to the non-Aboriginal population in the province are not homogeneous across all

Aboriginal peoples; their determinants of respiratory health status vary widely, as does reliance on traditional- versus Western-style health care practices to manage exacerbations and chronic care. Therefore, inequalities in their respiratory outcomes must be understood within the diverse contexts within which Aboriginal communities live. These factors should be taken into account when designing and implementing prevention, diagnosis and treatment programs to reduce the burden of COPD among Aboriginal groups in Alberta.

Results of this study have important implications for Aboriginal communities, health care professionals and policy makers in the province. For Aboriginal communities, it is important to acknowledge that the design, conduction and interpretation of this research are grounded in a Western paradigm of research that does not reflect Aboriginal worldviews about respiratory health and disease. By acknowledging this, I recognize the limitations inherent to the research approach and the commitment to avoid imposing non-Aboriginal values in the interpretation of the study results and the implications for Aboriginal communities in Alberta.

In light of this, Aboriginal communities should decide which elements of this research have the potential to contribute to their own decision-making process when setting priorities to suit their own health care needs. Similarly, it is expected that Aboriginal knowledge can make significant contributions to our understanding of how COPD burden the lives of Aboriginal communities and what type of Aboriginal-lead initiatives can be implemented to address the inequalities in the respiratory health status of Aboriginal peoples that were identified.

A first step in this direction would be the dissemination of this research through the Annual Aboriginal Health Forum and other events held by Aboriginal communities in the province. The objective would be to engage the Aboriginal community in a discussion of how Western knowledge on Aboriginal respiratory health (predicated through data and statistics) can interplay with Indigenous knowledge (based on narratives and experience) to improve respiratory health of Aboriginal communities.

The results of this study have several important practical implications for respiratory specialists and other health professionals who treat Aboriginal patients with COPD. Non-Aboriginal health care professionals need to understand how Aboriginal peoples interpret their illness experience of COPD and how they respond to therapeutic recommendations. It is recommended that health care professionals working on COPD evaluate whether their treatment plans, education and pulmonary rehabilitation programs are acceptable to the cultural, social and economic circumstances of their Aboriginal patients.

Similarly, health care professionals can use the study results as a means to advocate for COPD services targeting specific Aboriginal groups and promote training of Aboriginal health care professionals in both urban and rural settings. Since many Aboriginal communities live in remote locations, special focus should be given to health care professionals of rural areas and small-volume health facilities. After hospital discharge, Aboriginal peoples with COPD may lack adequate follow-up. Therefore, novel management approaches in partnership with multidisciplinary teams of Aboriginal health care professionals would ensure Aboriginal patients with COPD receive the care they require. In addition to specialized care, follow-up services should be available to refer Aboriginal peoples with COPD to multidisciplinary community-based services within their communities to improve self-management and community support for their condition.

The pivotal role of spirometry in the diagnosis of COPD faces major challenges at the primary care level, particularly when there is limited access to pulmonary function tests laboratories outside urban areas.[47,48] Results from this study identify the need to implement novel approaches to improve the methods of detection and monitoring of COPD in rural and remote communities. Evidence from two recent randomized controlled clinical trials[49,50] suggest that the use of spirometry performed via telemedicine is a promising alternative to overcome the obstacles of diagnosing and managing patients with pulmonary diseases in remote geographic areas.

The results of this study are also relevant from a policy makers' perspective. Policy makers involved in the planning of respiratory health services delivered to Aboriginal peoples in the province need to receive these results and collaboratively identify areas for which specific interventions may be tailored for each Aboriginal group to improve their respiratory health status and outcomes.

Research results from this dissertation can inform research and action plans within the strategic priorities considered in the Alberta's Health Research and Innovation Strategy. These initiatives can be better assessed and implemented through the works of the Alberta Health Services Respiratory Clinical Network.[51] The adoption of the "Two-Eyed Seeing" model advocated by the Canadian Institute of Health Research (CIHR) Institute of Aboriginal Peoples' Health (IAPH) to integrate traditional knowledge and community approaches to healing with Western scientific approaches for the evaluation and implementation of health interventions for COPD is one way of addressing this issue.[52,53]

It is important for policy makers to understand that the impact of COPD among Aboriginal peoples cannot be explained as an outcome arising exclusively from "wrong" individual health behaviours (i.e., smoking). There is a need to look beyond individual responsibility and examine the role of the social environment and the political and economic influences under which respiratory diseases such as COPD develop.

Results of this research, albeit of epidemiological nature, should be interpreted in the context of historical experiences of colonization, acculturation and trans-generational trauma as important distant factors underlying inequalities in the epidemiology and health services use for COPD between Aboriginal and non-Aboriginal peoples. Similarly, the role of government and intersectoral policies, including those at the health care system level, should be recognized as intermediate determinants of the respiratory health status of Aboriginal peoples. Attention to processes and pathways for the development of respiratory diseases like COPD in Aboriginal peoples is critical for planning and executing strategies to tackle respiratory health inequalities.

Despite the obvious burden of COPD in Alberta, there is a lack of recognition of the condition as a health priority. While there are existing approaches for prevention, detection and management of COPD, they are not entirely coordinated and integrated across the health system. The development of a COPD strategy for Alberta, similar to that implemented in Ontario[54] would be an important step to implement a system-wide approach to improve health care processes and results in the areas of health promotion and prevention, diagnosis, management, palliative care, providers education, surveillance and evaluation and knowledge translation, with particular emphasis in increasing the benefits of the approach towards the more vulnerable and underserved populations in the province.

6.5. Future Research Directions

The present study highlights multiple opportunities for future research. Several lines of research from this dissertation include:

1. To further assess the validity of COPD diagnoses recorded in administrative health databases in Alberta. In such a study, a random sample of medical charts of patients with a discharge diagnosis of COPD from administrative databases would be reviewed and independently adjudicated by two respiratory specialists using clinical history (including smoking status and smoking history) and results from pulmonary function tests (i.e., spirometry) obtained through linkage with laboratory test data from Alberta Health Services. The primary outcome of such a study would be the positive predictive value of the COPD diagnosis from the administrative databases given a "true" COPD diagnosis corroborated by pulmonary function test and clinical history. Similarly, a sensitivity analysis of the validity of COPD diagnoses recorded in hospitalization versus ED administrative files can be further conducted.
2. To assess the quality of Aboriginal status information in administrative health datasets in Alberta. In such a study, a random sample of hospital and ED patients would be interviewed with regard to their Aboriginal status and this information compared against the already recorded

Aboriginal status of the same patients in the Alberta Health Care Insurance Plan and MNA databases. The primary outcome of such a study would be the level of agreement between Aboriginal status as recorded in administrative databases and patients' reporting of their Aboriginal status.

3. To evaluate whether there are differences between Aboriginal peoples and non-Aboriginal populations in Alberta in access to primary care (i.e., ambulatory visits, spirometry for diagnosis) and specialized care services (i.e., pulmonary rehabilitation) for COPD. Such a study would use a cohort design based on linkage of administrative databases similar to those used in this dissertation.
4. To evaluate differences in quality of care between Aboriginal and non-Aboriginal patients with COPD admitted in urban versus rural health services facilities.
5. To assess whether there are inequalities in drug prescription for COPD between Aboriginal peoples and the non-Aboriginal population in Alberta. For such a study, administrative health data describing all filled prescriptions in individuals with a diagnosis of COPD would be examined to measure differences between the groups in the likelihood of filling prescriptions by drug class (i.e., bronchodilators, corticosteroids, antibiotics, influenza and pneumonia vaccines, etc.). Similarly, the study can further assess whether patterns of appropriateness of prescription for COPD differ systematically between Aboriginal peoples and non-Aboriginal peoples according to recommendations of the Canadian Respiratory Guidelines.[55]
6. Individual and context-specific factors that may account for the between-group differences in the epidemiology and health services use for COPD can be further assessed by linking longitudinal administrative health data with longitudinal survey data (such as those collected in the Canadian Community Health Survey and the Canadian Health Measures Survey). Conceptually, combining the survey and health administrative information might provide a richer, more complete, and more accurate assessment of

the role of known proximal (i.e., smoking history, smoking behaviour) and intermediate (i.e., occupation, education, income, housing, social position and physical environments) factors implicated in the poor respiratory outcomes of Aboriginal peoples. Additionally, survey data could provide more accurate information on the identification of Aboriginal status of study participants. This hypothesis can be further assessed.

7. Future epidemiological studies should improve our understanding of how Aboriginal status intersect with other social determinants (i.e., geographic location, socioeconomic status) to create inequitable conditions that may be associated with a higher incidence and prevalence of COPD. Based on both survey and administrative data, such studies can assess disparities related to socioeconomic position in the use of COPD services between Aboriginal peoples and non-Aboriginals by using measures of disparities such as Concentration Curves and Concentration Index.[56]
8. Future research should focus on the identification of clinical factors that differentiate younger and older Aboriginal populations with COPD. These results should enable health care providers and policy makers to prepare for the increasing burden of COPD at older ages, to plan prevention strategies targeting different age and Aboriginal groups and to support the positive effects that COPD prevention and management strategies may have on Aboriginal peoples with COPD.
9. Research on the respiratory health status of Aboriginal peoples has traditionally focused on disease and dysfunction. Over the last decade, research in Aboriginal peoples' health, particularly in the areas of suicide, tuberculosis, diabetes/obesity and oral health, has switched the focus towards factors that have positive effects on Aboriginal peoples' health.[57] They include diverse sources of resilience, such as spirituality, family values, teaching from Elders, ceremonial rituals, oral traditions, restoration and promotion of Aboriginal identity, self-governance, and the support of community networks. An area of future research can focus on the potential positive aspects of Aboriginal respiratory health; for example, to explore

the factors that confer a survival advantage to certain Aboriginal groups following a diagnosis of COPD compared to non-Aboriginal populations.

10. Qualitative research approaches can be used to explore how Aboriginal individuals manage their COPD symptoms, what are they preferences for health care services for AECOPD and how well they adhere to treatment recommendations. Similarly, qualitative research can be used to assess Aboriginal peoples' level of health literacy and perceptions about the noxious effect of smoking on their health status.

6.6. Final Considerations

In order to develop a critical paradigm for the study of respiratory health inequalities in Aboriginal peoples, three transformations are needed: first, there is a need to work on theoretical models to understand the relationship between proximal, intermediate and distant factors and the pathways that lead to the development of inequalities in respiratory health among Aboriginal peoples. The adoption of theoretical models, such as the ecosocial model[58-61] allows the integration of political, social and individual determinants of health, with respiratory health outcomes in Aboriginal peoples as the biologic expression, or "embodiment"[17,62] of living conditions, social relations and power structures over the life course and across generations.

Explicit conceptual frameworks help to understand how health inequalities are reproduced through the interplay of historical, political, institutional, social, cultural and individual factors.[63] Figure 6.1 provides a proposal that I have developed for a conceptual framework of the causal pathways that lead to respiratory health inequalities affecting Aboriginal peoples in Canada. The framework considers broader aspects of historical experiences of colonization, acculturation and trans-generational trauma as important distant factors underlying health inequalities. Similarly, it emphasizes the role of government and intersectoral policies, including those at the health care system level as intermediate determinants of the respiratory health status of the population.

Attention to processes and pathways for the development of respiratory diseases in Aboriginal peoples is critical for planning and executing strategies to address them. The choice of methods to collect and interpret data to inform respiratory health inequalities needs to be sensitive to the particular historical, social, cultural and economic experiences of Aboriginal peoples in Canada.

Second, it is necessary to innovate the methods of studying respiratory health and health inequalities in Aboriginal peoples by incorporating mixed methods research approaches.[64,65] Alternatives include having two or more theory models to compare expected outcomes under the intended research design; using qualitative and participatory techniques to obtain Aboriginal peoples perceptions on determinants of respiratory health; concept mapping; and applying multilevel epidemiological approaches[66,67] to understand the interaction between population-level and individual-level factors on health outcomes.

Finally, it is necessary to transform the relationships among the research partners by increasing the engagement and contribution of Aboriginal communities in the research process; from elaboration of the research question to planning and participation in knowledge translation. By linking epidemiological evidence that highlights key risk factors to evidence on the economic, political and social context of risk, it is theoretically possible to identify policy interventions that could improve the respiratory health status of Aboriginal peoples. Addressing persistent Aboriginal respiratory health inequalities requires consideration of both the context in which inequalities exist by using broad and complex research approaches as well as innovative and culturally appropriate means of investigating those inequalities.

In summary, there is a need to expand the theoretical and methodological scope of the study of respiratory inequalities affecting Aboriginal peoples towards an evaluation of the role of distal determinants of health in the production of respiratory health inequalities; how these factors operate on multiple levels, in both interdependent and independent ways; and how they influence biological (i.e., embodiment) mechanisms through which social inequalities are manifested in respiratory outcomes. The adoption of an ecosocial model to address the roots

of health inequalities affecting Aboriginal peoples and the use of broader and complex research strategies that include multilevel and mixed methods analytical approaches are steps in the right direction. Finally, the planning of frameworks and strategies for conducting research in respiratory health inequalities should move towards concrete and explicit initiatives to enhance Aboriginal peoples' participation, the centre of inquiry, not only as study participants but as dominant research partners and decision makers to tackle respiratory health inequalities.

The incorporation of an equity lens towards the evaluation of how respiratory problems affect Aboriginal communities within the existing respiratory health research capacity have powerful implications for health services policy and planning. It constitutes an important contribution to the epidemiological study of respiratory diseases and an opportunity to address the inequalities in respiratory health status that affect Aboriginal peoples in our society.

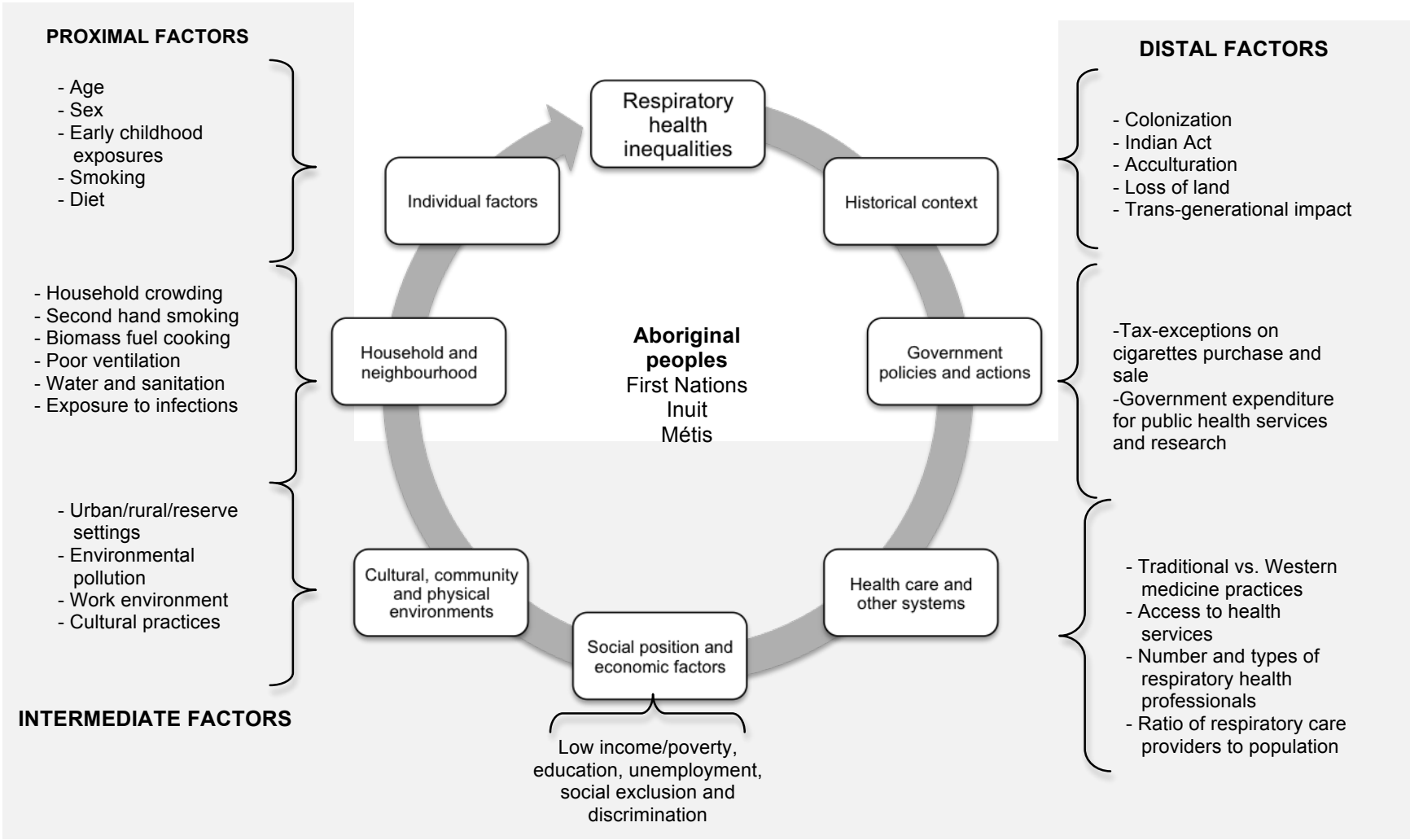
6.7. Conclusions

Aboriginal peoples in Alberta, as a whole, have a higher burden of COPD than the non-Aboriginal population, but the condition affects differently the three Aboriginal groups. The retrospective cohort studies found that all Aboriginal peoples groups in Alberta have a higher prevalence and incidence of COPD than the non-Aboriginal cohort, with Registered First Nations peoples and Inuit having the highest rates of COPD. Aboriginal peoples, as a whole group, did not differ from non-Aboriginal individuals in their mortality hazard five years after being diagnosed with COPD. Métis and Inuit with COPD had a lower mortality hazard, whereas no differences in mortality were found between Registered First Nations peoples and non-Aboriginal individuals in the study. Given a diagnosis of COPD, Aboriginal peoples had higher hospitalizations and ED visits rates than non-Aboriginals; however, Aboriginal peoples with COPD did not share a unique pattern of health services use, as Registered First Nations peoples had the highest utilization rates among the three Aboriginal groups. Reasons for the differences in the epidemiology and health services use for COPD between Aboriginal peoples and the non-Aboriginal population in Alberta should be further explored within a

framework of social determinants of health to effectively influence modifiable risk factors in the three Aboriginal groups.

The research presented in this dissertation provides a comprehensive picture of how COPD affects Aboriginal peoples in Alberta. The results constitute an important step towards tackling potential health inequalities and identifying the areas in which specific approaches are needed to improve respiratory health status and access to health services for COPD in Aboriginal peoples.

Figure 6. 1. Proposed theoretical framework to illustrate the relationship between proximal, intermediate and distant determinants of inequalities in Aboriginal respiratory health



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APPENDIX A. Letters of Copyright Permission

A.1. Reproduction of Map of Indian Treaty Areas

Egmont Lee <elee@ucalgary.ca> 10 May, 2013 7:47 AM
To: Maria Ospina
Re: Fwd: Permission to Use Copyrighted Material in a Doctoral's Thesis

Dear Ms Ospina,

please feel free to make use of the material in question under the terms outlined in your request.

Best wishes for success in your work,

Egmont Lee

Egmont Lee
Professor of History (Emeritus)
University of Calgary

On 09-May-13 15:46, Maria Ospina wrote:

> Dear Dr. Lee,
>
> My name is Maria Ospina and I am completing my PhD at the University of Alberta School of Public Health. I contacted the Department of History to request permission to use copyright material published in the U of C Applied History Research Group (a map of the Indian Treaty areas). They advised me to contact you for this permission. You will find my original request attached to this message.
>
> I appreciate your consideration and will look forward to hearing from you.
>
> Sincerely,
>
> Maria Ospina
>
> Maria B. Ospina, BSc (Psych); MSc
> PhD candidate - School of Public Health
> University of Alberta

A.2. Reproduction of Treaty map and First Nations communities in Alberta

Droitdauteur - Copyright <droitdauteur.copyright@tpsgc-pwgsc.gc.ca> 23 May, 2013 1:53 PM
To: "'mospina@ualberta.ca'" <mospina@ualberta.ca>
2013-36819 Online Application for Copyright Clearance - CCL130516-1753-43415 (copy)

1 Attachment, 79 KB

Good afternoon,

In response to your request in which you wish to be granted permission to reproduce Government of Canada material, Crown Copyright and Licensing (CCL) is pleased to inform you that permission to reproduce Government of Canada (GC) information for personal or public non-commercial purposes, as well as for cost-recovery purposes, is no longer a requirement, unless otherwise specified in the information you wish to reproduce. We only ask that you comply with the conditions set forth hereunder:

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You may share this important message with any of your team members that may use our services.

Should you have any questions, or require additional clarification in this regard, please do not hesitate to contact us. Our contact information has been provided below. Our offices are open Monday through Friday 8 a.m. to 5 p.m. ET.

Thank you,

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K1A 0S5
droitdauteur.copyright@tpsgc-pwgsc.gc.ca
Téléphone | Telephone 613-996-6886
Télécopieur | Facsimile 613-998-1450
Gouvernement du Canada | Government of Canada

APPENDIX B. Search Strategies for the Systematic Review

Databases searched for relevant studies

Database	Years/issues	Date of search
Circumpolar Health Bibliographic Database (CHBD)	1928 – 2010	28 Oct, 2011
EMBASE	1988 – 2010	28 Oct, 2011
MEDLINE®	1966 – 2010	28 Oct, 2011
Native Health Database – University of New Mexico	1966 - 2010	28 Oct, 2011

MEDLINE® – Ovid Version and EMBASE – Ovid Version

Years/issue searched: 1966 to October 2011
Search date: 28 October, 2011

exp respiratory tract diseases/
exp Pulmonary Disease, Chronic Obstructive/
exp lung diseases, obstructive/
exp respiratory function tests/
exp asthma/
exp bronchoconstriction/
6 or 4 or 1 or 3 or 2 or 5
(Aborigine$ or Aborigi$ or Aboriginal$ or Indigenous people$ or Indigenous population$ or Maori$).ab. or (Aborigine$ or Aboriginal$ or Indigenous people$ or Indigenous population$ or Maori$).ti.
(Inuit$ or Eskimo$ or Aleut$).ab. or (Inuit$ or Eskimo$ or Aleut$).ti.
(Native American or Native Americans or Native Canadian or Native Canadians or Native Alaskan or Native Alaskans or American Native$ or Alaskan Native$ or Canadian Native$ or American Indian$ or Canadian Indian$ or Amerind$).ab. or (Native American or Native Americans or Native Canadian or Native Canadians or Native Alaskan or Native Alaskans or American Native$ or Alaskan Native$ or Canadian Native$ or American Indian$ or Canadian Indian$ or Amerind$).ti.
(Inuit or Inupiats or Inupiat or Eskimos or Eskimo or Kalaallits or Kalaallit or Aleuts or Aleut or (Tribes or Natives or Indigenous or American Native or First Nations or Metis)).mp. [mp=title, original title, abstract, name of substance word, subject heading word]
8 or 11 or 10 or 9
7 and 12

Native Health Database – University of New Mexico
Years/issue searched: 1966 to October 2011
Search date: 28 October, 2011

incidence or prevalence or burden
respiratory disorders or respiratory diseases
1 and 2

Circumpolar Health Bibliographic Database
Years/issue searched: 1966 to October 2011
Search date: 28 October, 2011

WO incidence or prevalence or burden
SU Respiratory disorders or respiratory diseases
1 and 2

APPENDIX C. Ethics Approval for the Study and Extensions

Health Research Ethics Board

308 Campus Tower
University of Alberta, Edmonton, AB T6G 1K8
p. 780.492.9724 (Biomedical Panel)
p. 780.492.0302 (Health Panel)
p. 780.492.0459
p. 780.492.0839
f. 780.492.7808

APPROVAL FORM - DELEGATED REVIEW

Date:	November 26, 2009
Principal Investigator:	Donald Voaklander
Study ID:	Pro00010415
Study Title:	Epidemiology, Burden of Disease and Health Care Utilization for Chronic Obstructive Pulmonary Disease (COPD) among Aboriginal People in Alberta: Insights into Aboriginal Respiratory Health
Approval Expiry Date:	November 25, 2010
Sponsor/Funding Agency:	Alberta Health & Wellness AH

Thank you for submitting the above study to the Health Research Ethics Board (Health Panel). Your application, along with revisions submitted November 26, 2009, has been reviewed and approved on behalf of the committee.

The Research Ethics Board assessed all matters required by section 50(1)(a) of the Health Information Act. The REB Panel determined that the research described in the ethics application is a retrospective chart review for which subject consent for access to personally identifiable health information would not be reasonable, feasible or practical. Subject consent therefore is not required for access to the personally identifiable health information described in the ethics application.

In order to comply with the Health Information Act, a copy of the approval form is being sent to the Office of the Information and Privacy Commissioner.

A renewal report must be submitted next year prior to the expiry of this approval if your study still requires ethics approval. If you do not renew on or before the renewal expiry date, you will have to re-submit an ethics application.

Approval by the Health Research Ethics Board does not encompass authorization to access the patients, staff or resources of Alberta Health Services or other local health care institutions for the purposes of the research. Enquiries regarding Alberta Health Services administrative approval, and operational approval for areas impacted by the research, should be directed to the Alberta Health Services Regional Research Administration office, #1800 College Plaza, phone (780) 407-6041.

Sincerely,

Glenn Griener, Ph.D.
Chair, Health Research Ethics Board (Health Panel)

Note: This correspondence includes an electronic signature (validation and approval via an online system).

UNIVERSITY OF ALBERTA Alberta Health Services Covenant Health

Health Research Ethics Board

308 Campus Tower
University of Alberta, Edmonton, AB T6G 1K8
p. 780.492.9724 (Biomedical Panel)
p. 780.492.0302 (Health Panel)
p. 780.492.0459
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f. 780.492.9429

Re-Approval Form

Date:	October 14, 2010	
Amendment/Renewal ID:	Pro00010415_REN1	
Study ID:	MS2_Pro00010415	
Study Title:	Epidemiology, Burden of Disease and Health Care Utilization for Chronic Obstructive Pulmonary Disease (COPD) among Aboriginal People in Alberta: Insights into Aboriginal Respiratory Health	
Principal Investigator:	Donald Voaklander	
Sponsor/Funding Agency:	Alberta Health & Wellness	AH
Approval Expiry Date:	November 24, 2011	

The Health Research Ethics Board - Health Panel has reviewed the renewal request and file for this project and found it to be acceptable within the limitations of human research.

The re-approval for the study as presented is valid for one year. It may be extended following completion of the annual renewal request before the approval expires. Beginning at 45 days prior to expiration, you will receive notices that the study is about to expire. Once the study has expired, you will have to resubmit. Any proposed changes to the study must be submitted to the Health REB for approval prior to implementation.

For studies where investigators must obtain informed consent, signed copies of the consent forms must be retained, as should all study related documents, so as to be available to the Health REB upon request. They should be kept for the duration of the project and for at least five (5) years following study completion.

Sincerely,

Beverley O'Brien, DNSc.
Chair, Health Research Ethics Board - Health Panel

Note: This correspondence includes an electronic signature (validation and approval via an online system).

Health Research Ethics Board

308 Campus Tower
University of Alberta, Edmonton, AB T6G 1K8
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Re-Approval Form

Date:	November 21, 2011
Amendment ID:	Pro00010415_REN2
Principal Investigator:	Donald Voaklander
Study ID:	MS3_Pro00010415
Study Title:	Epidemiology, Burden of Disease and Health Care Utilization for Chronic Obstructive Pulmonary Disease (COPD) among Aboriginal People in Alberta: Insights into Aboriginal Respiratory Health
Sponsor/Funding Agency:	Alberta Health & Wellness AH
Approval Expiry Date:	November 23, 2012

The Health Research Ethics Board - Health Panel has reviewed the renewal request and file for this project and found it to be acceptable within the limitations of human research.

The re-approval for the study as presented is valid for another year. It may be extended following completion of the annual renewal request before the approval expires. Beginning at 30 days prior to expiration, you will receive notices that the study is about to expire. If you do not renew on or before the renewal expiry date, you will have to re-submit an ethics application.

All study related documents should be retained so as to be available to the Health REB upon request. They should be kept for the duration of the project and for at least 5 years following study completion.

Sincerely,

Dr. Jana Rieger
Chair, Health Research Ethics Board - Health Panel

Note: This correspondence includes an electronic signature (validation and approval via an online system).

Health Research Ethics Board

308 Campus Tower
University of Alberta, Edmonton, AB T6G 1K8
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p. 780.492.0839
f. 780.492.9429

Notification of Approval (Renewal)

Date:	November 26, 2012
Amendment ID:	Pro00010415_REN3
Principal Investigator:	Donald Voaklander
Study ID:	MS4_Pro00010415
Study Title:	Epidemiology, Burden of Disease and Health Care Utilization for Chronic Obstructive Pulmonary Disease (COPD) among Aboriginal People in Alberta: Insights into Aboriginal Respiratory Health
Sponsor/Funding Agency:	Alberta Health & Wellness AH
Approval Expiry Date:	November 22, 2013

Thank you for submitting this renewal application. Your application has been reviewed and approved.

This re-approval is valid for another year. If your study continues past the expiration date as noted above, you will be required to complete another renewal request. Beginning at 30 days prior to the expiration date, you will receive notices that the study is about to expire. If you do not renew on or before the renewal expiry date, you will have to re-submit an ethics application.

All study related documents should be retained so as to be available to the Health REB upon request. They should be kept for the duration of the project and for at least 5 years following study completion.

Sincerely,

Dr. Glen J. Pearson, BSc, BScPhm, PharmD, FCSHP
Associate Chair, Health Research Ethics Board - Health Panel

Note: This correspondence includes an electronic signature (validation and approval via an online system).

APPENDIX D. Letter of Support to the Research from the Métis Nation of Alberta

Métis Nation Of Alberta

Métis Health and Wellness
100 Delia Gray Building
11738 Kingsway Avenue
Edmonton, AB T5G 0X5
Phone: (780) 455 2200
Fax: (780) 732 3385
Toll Free: 1 800 252 7553
Public Health Surveillance Inquiry Line (Toll free): 1 855 732 3326

Dr. Don Voaklander
Professor and Director
Alberta Centre for Injury and Disease Control and Research
School of Public Health
University of Alberta
4075 RTF, 8308-114 Street
EDMONTON AB T6G 2E1

January 10, 2013

Dear Dr. Voaklander:

RE: ***Epidemiology and Health Services Utilization for Chronic Obtrusive Pulmonary Disease (COPD) among Aboriginal Peoples in Alberta*** research proposal.

On behalf of the Métis Nation, I am pleased to advise that we support the work of your research team as outlined in "*Epidemiology and Health Services Utilization for Chronic Obtrusive Pulmonary Disease (COPD) among Aboriginal Peoples in Alberta*".

The Métis Nation of Alberta has made a strong commitment to promote the overall health and wellbeing of our community. This includes pursing enhanced research and surveillance activities that facilitate and support evidence-informed solutions. We welcome the opportunity to be consulted on research findings at any point throughout your work, and are willing to work collaboratively with you and your team to disseminate report findings to our community.

As such, we are proud to work together with you and your research team to produce a compelling, evidence-based document that can be used to support further research, and policy and program options relative to Métis respiratory health.

Kind Regards,

Marlene Lanz
Minister of Health and Wellness
Metis Nation of Alberta

cc: Audrey Poitras, President, Metis Nation of Alberta, Edmonton, Alberta
Toby Racette, Vice President, Metis Nation of Alberta, Edmonton, Alberta