The Extent of Tobacco Consumption in the Indigenous Population in Association with Pulmonary Diseases in Canada

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

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List of Abbreviations

- APS – Aboriginal People Survey
- C.I – Confidence Interval
- COPD – Coronary Obstructive Pulmonary Disease
- DALY- Daily Adjusted Life Years
- FCTC - Framework Convention on Tobacco Control
- NCD- Non-Communicable Diseases
- SDOH- Social Determinants of Health
- WHO- World Health Organization

Abstract

Objectives: (1) To explore the prevalence of and characteristics associated with tobacco consumption in the overall Indigenous population and within specific demographic groups (e.g. age, sex, etc.). (2) To explore the association between tobacco consumption and COPD and asthma, in the Indigenous population, through the lens of the Integrated Life Course and Social Determinants Model of Aboriginal People's Health framework.

Methods: This cross-sectional study utilizes data from the Aboriginal People's Survey (2017), with a sample of 20,849 self-identified Indigenous people living off-reserves across Canada aged 15 or older.

Results: The overall prevalence of smoking was 34.7%. The highest prevalence of smoking was seen in groups of people who drank 3+ drinks/week or every day (37.9%), had 3+ chronic diseases (37.3%). Individuals between 25-34 years old were 2.37 times more likely to be smokers (95%C.I 2.04- 2.75), those who experienced in-home smoking were 5.01 times more likely to smoke (95%, C.I 4.59- 5.47), people who feel a sense of belonging were 2.38 times more likely to smoke (95% C.I 2.18- 2.60), and individuals who consume alcoholic beverages three or more times a week or drink every day had a 23% higher likelihood of smoking (95% C.I 1.07- 1.41).

Overall, 13.2% of the study population reported having asthma, and 5.0% reported having COPD. Most of the participants with COPD were 55 years or older (11.4%) more individuals experienced in-home smoking (8.2%), 6.9% of smokers reported having COPD, and 22.6% had 3+ diseases. Smokers had a 52% higher likelihood of having COPD (95% CI: 1.31-

1.76), participants 55+ years were 13 times more likely to have COPD (95% C.I: 7.94 -22.31), being female was associated with a 25% higher likelihood (95% C.I: 1.08-1.42), and in-home smoking was associated with a 59% higher likelihood (95% C.I: 1.36-1.9).

Fifteen percent (15%) of the participants who reported having asthma were female (15.2%), with 14% between the ages of 15-18, and 15% experiencing in-home smoking. Thirteen percent (13%) of people who reported asthma were smokers, and 14% reported three or more chronic conditions. Females had 49% higher likelihood of having asthma (95% C.I. 1.37-1.63), in-home smoking had a prevalence of asthma 25% higher (95% C.I: 1.11- 1.41), those who started smoking prior to 11 years old had a 50% higher prevalence of asthma (95% C.I: 1.06-3.95).

Conclusions: This study found age and sex to have a significant relationship with smoking habits; women and people aged 25-44 years were more likely to partake in smoking. This highlights the need for a more targeted tobacco cessation program in this group to mitigate the impact of smoking-related adverse health effects for this group. In-home smoking very consistently has a significant association with the likelihood of individuals smoking themselves, as well as the likelihood of individuals having asthma or COPD. This emphasizes the need for policies targeting smoke-free homes to reduce the risk of diseases, particularly for young children within the Indigenous population.

Chapter 1: Introduction

The National Cancer Institute defines pulmonary disease as any disease that impacts the lungs or parts of the respiratory system (1). These diseases can occur due to infection, tobacco consumption (either primary or second-hand), or pollutants such as asbestos (1). Chronic obstructive pulmonary disease (COPD) and asthma are among the most prevalent examples of pulmonary diseases.

COPD is when individuals experience difficulty breathing due to restricted airflow in the lungs (2). The WHO ranks COPD as the seventh leading cause of illness globally and the third leading cause of mortality, with 3.23 million deaths in 2019 attributed to COPD (3). In Canada, as of 2012, COPD affected 2 million people, but Canadians with COPD are living longer and managing it better (4). Although the national prevalence rate is 9.5% (4), there are large variations by province and territory. British Columbia, Saskatchewan, Alberta, Quebec, and Prince Edward Island have the lowest rates below the national average, with prevalence rates of 9.0%, 9.1%, 9.2%, 8.9%, and 8.8%, respectively (4). On the other hand, Newfoundland and Labrador, Ontario, Manitoba, New Brunswick, Nova Scotia, and the Northwest Territories all have prevalence rates equal to or higher than the national average, with prevalence rates of 9.5%, 9.6%, 10.4%, 11.0%, 12.1%, and 13.1%, respectively (4). However, Nunavut reports an astounding prevalence of 22.1%, more than double the national rate, in a province with a population of only 36,858 (5), and there is no data reported for Yukon (4).

Asthma is another prevalent pulmonary disease characterized primarily by inflammation and narrowing of the lungs (2,6). As of 2019, the WHO reported 262 million individuals with Asthma across the globe and 455,000 deaths (6). Similar to COPD, Canada has a lower incidence of asthma but a higher prevalence, contributing to the 3.8 million Canadians living with the

illness (2). The Canadian national average of asthma prevalence as of 2012 was 10.78% (7), with the lowest rates of 3.75%, 6.93%, and 7.53% reported in Nunavut, Yukon, and Northwest Territories, respectively (7). Three provinces, Manitoba (10.82%), Nova Scotia (11.77%), and Ontario (12.08%), reported prevalence rates higher than the national average (7).

The Indigenous community of Canada experiences both COPD and asthma at higher rates than the general Canadian population, and this is evidenced in various reports (8,9). Between 2007-2010, the Indigenous community experienced asthma at 15% compared to 10% in the general population, despite consisting of only 4.9% of the Canadian population (10–13). In 2008, the rate of COPD in the Indigenous community was 6.8% and is projected to be increasing due to higher exposure to risk factors (14). In Canada, it was 7% in 2001 and declined to only 4% in 2008(2).

COPD and asthma have a common risk factor, which is tobacco, a leading risk factor for morbidity and disability in Canada (15–17). Tobacco consumption can lead to health inequalities and can exacerbate the consequences of pulmonary diseases (15–17). People who smoke between 1-50 packs/ year have a 3.58 increased risk of developing COPD as well as a 3015.68/100,000 rate of mortality (15,18). In comparison, individuals who were former smokers had a mortality risk of 1676.2/100,000 due to smoking and 1247.93/100,000 in people who never smoked (18). Likewise, individuals who smoke 1-26 cigarettes/day have a 1.52 increased risk of developing asthma (15). Additionally, adolescents have an incidence risk ratio of 2.56 for developing asthma due to consuming tobacco themselves compared to those who do not smoke, and an incidence risk ratio of 2 for developing asthma from exposure to environmental tobacco (19). Tobacco consumption is found at a significantly higher rate in the Indigenous population compared to the general Canadian population due to misuse of tobacco recreationally outside of

traditional ceremonies (20,21). Statistics Canada reports tobacco consumption is 1.7 times higher in the Metis population, 1.9 times in the First Nations community, and 2.4 times in the Inuit community (20). Current tobacco measures in Canada are based on the World Health Organization's Framework Convention on Tobacco Control and are implemented at a population level (Canada-wide) (16). This can create an oversight or underestimation of tobacco prevalence in specific groups, which may hinder proper assessment of the impact of the intervention in Indigenous communities.

In order to address this potential oversight or underestimation in the Indigenous community, it's important to use an integrative framework such as The Integrated Life Course and Social Determinants Model of Aboriginal People's Health, which breaks down the three levels of social determinants of health from a culturally appropriate lens, relevant to the Indigenous communities of Canada (22,23). Further, the framework provides a guideline on addressing risk factors of disease from a proximal (e.g., age, sex, and race), intermediary (e.g., housing), and distal level (e.g., colonialism) to ensure a holistic approach to health (24). More so, using this framework can provide a guideline to address tobacco consumption and its impact on pulmonary diseases in the Indigenous community in a culturally appropriate manner. Therefore, addressing tobacco consumption in a culturally appropriate manner can reduce the risk of pulmonary diseases that can be attributed to tobacco consumption. In an effort to address the gap in tobacco consumption and COPD and asthma in the Indigenous community, this study aims to answer the following questions: (1) What is the prevalence of and characteristics associated with tobacco consumption in the overall Indigenous population and within specific demographic groups? (2) What is the association between tobacco consumption and COPD and asthma in the Indigenous population?

Chapter 2: Literature Review

A literature review was conducted to understand the burden of pulmonary diseases, namely COPD and asthma, Indigenous health and tobacco consumption. This was carried out by first searching health databases such as PubMed, ProQuest, and Web of Science using the following keywords:

(lung diseases"[MeSH Terms] OR ("lung" [All Fields] AND "diseases"[All Fields]) OR "lung diseases"[All Fields] OR ("pulmonary"[All Fields] AND "diseases" [All Fields]) OR "pulmonary disease"[All Fields] OR ("asthma" [MeSH Terms] OR "asthma" [All Fields] OR "asthmas" [All Fields] OR "asthma" [All Fields] OR ("pulmonary disease, chronic obstructive" [MeSH Terms] OR ("pulmonary" [All Fields] AND "disease" [All Fields] AND "chronic" [All Fields] AND "obstructive" [All Fields]) OR "chronic obstructive pulmonary disease" [All Fields] OR "copd" [All Fields]))

(((("indigene" [All Fields] OR "indigeneity" [All Fields] OR "Indigenous" [All Fields] OR "indigenes" [All Fields] OR "indigenization "[All Fields] OR "indigenous" [All Fields]) AND ("Canada" [MeSH Terms] OR "Canada" [All Fields] OR "Canada" [All Fields] OR "Canada" [All Field]))) OR ("aboriginal"[All Fields] OR "aboriginality" [All Fields] OR "aboriginals" [All Fields] OR "aborigine" [All Fields] OR "aborigines" [All Fields]) OR ("first" [All Fields] AND "nations" [All Fields] OR "first nations" [All Fields]) OR "Metis" [All Fields] OR ("Inuit"[MeSH Terms] OR "Inuit" [All Fields] OR "Inuit" [All Fields])).

The search was conducted between January and August of 2023, and results were restricted to papers written in English within the last 20 years. Through the MeSH terms mentioned earlier, literature pertaining to pulmonary diseases, asthma, COPD, and Indigenous health was separately obtained. Further, the search string for pulmonary diseases and Indigenous

MeSH terms was combined, which produced results that focused on COPD and asthma within the Indigenous community. Results that were produced and primarily focused on either COVID-19, and Indigenous people outside of Canada or looked at other health outcomes in Indigenous Canadians, such as diabetes or cancer, were excluded. Additional literature was obtained by looking at relevant articles cited within the original sources. Further searches were conducted on search engines to fill in detailed information that was missing or not explored in detail within the literature.

Figure 1: PRISMA Diagram of the literature identified

Based on the literature review, the following section will summarize information and insight into the epidemiology and burden of chronic respiratory diseases, the burden of COPD and asthma within Indigenous people, the health of Indigenous people, and factors associated with chronic diseases.

2.1 Epidemiology and burden of Respiratory Diseases

2.1.1 Global burden of respiratory disease

Chronic respiratory diseases are an umbrella of diseases that impact any breathing component, including the lungs, airways, thorax, and chest wall (2). In 2017, approximately 545 million people were living with at least one chronic respiratory disease worldwide, making this group of diseases the third leading burden of disease globally, after cardiovascular diseases and neoplasms (25). Examples of common respiratory diseases include sleep apnea, lung cancer, pneumonia, pulmonary hypertension, Chronic Obstructive Pulmonary Disease (COPD), asthma, and Tuberculosis (TB) (26). COPD, pneumonia, lung cancer, asthma, and TB are the top five leading global burdens of respiratory diseases in that order (26). In Canada, COPD is the 5th

leading burden of disease and mortality as of 2019 (15). These key respiratory diseases, namely COPD, asthma, and TB are grouped as pulmonary diseases, i.e., diseases that impact the lungs (1).

2.1.1.1 COPD

COPD is a non-communicable disease (NCD) characterized by the inability to breathe well due to blocked or narrowed airways (3). As a result, patients present with fatigue, chronic coughing, and coughing up phlegm in addition to difficulty breathing. COPD is primarily seen in people over 65 years and is the third leading cause of death worldwide, responsible for approximately 4 million deaths a year (3,4). As the most prevalent NCD, COPD has a global prevalence rate of 2638.2/ 100,000, affecting 212 million people, and a mortality rate of 42.5/100,000 (27). Of those affected, males have a higher prevalence rate (2828.1/100,00) than women (2487.1/ 100, 000) (27). The global burden of COPD is unequally distributed across the globe, seen at higher prevalence rates and higher age-standardized Daily Adjusted Life Years (DALY) rates in Sub-Saharan Africa and Asia (27). Countries in the Global North, parts of South America, Australia and North Africa all fall into the age-standardized DALY of 222.9 – <590.9/ 100,000, whereas the Global South has rates ranging from 1318.9/100,000 to 3649.5/100,000 (27). Canada's adjusted DALY rate is on the lower end, falling into the range of 410.5 – 517.9/ 100, 000 (27). While COPD is mainly seen in older adults, pneumonia and asthma are common among children, though pneumonia can also occur in adults over 65 years (26).

2.1.1.2 Asthma

Asthma affects 262 million people globally, both children and adults, but it is the most common chronic disease seen in children (6). This NCD is characterized by the airways in the lungs becoming inflamed and narrowed, leading to tightness in the chest, coughing, and

wheezing (6). Globally, asthma has a prevalence rate of 3,415.5/ 100,000 and a mortality rate of 5.8/100,000 (6,28). Females have a higher prevalence rate (3,488.5/100,000) compared to males (3,332.8/100,000), however, the mortality due to asthma is slightly higher in males (5.9/100, 000) compared to females (5.2/100, 000) (28). Countries in the Global South have higher rates of age-standardized DALY up to 1,795.1/100, 000 (28) whereas countries in the Global North have lower age-adjusted DALYs of less than 243.7/ 100, 000 (28). Canada's age-adjusted DALY rates are low, ranging between 196.7/ 100, 000 -243.7/ 100, 000 (28).

2.1.1.3 Other key pulmonary diseases

Lung cancer and tuberculosis are two respiratory diseases that contribute to a heavy burden of diseases globally. Since 1985, lung cancer has persisted as the leading type of cancer worldwide, both in terms of incidence and mortality rates (29,30). On average, lung cancer makes up 12.4% of all new cancers annually, as well as 17.6% of all deaths due to cancer in a year (29). In 2020, there were 2.2 million new cases of lung cancer and 1.8 million deaths, with a survival rate of only 10-20% (30,31). Higher mortality rates are reported in males compared to females, and yet amongst smokers, the mortality rate is the same in males and females (18). Globally, there has been a 51% increase in lung cancer prevalence since 1985 (44% in males and 76% in females) (29). In Canada, lung cancer is the second leading cause of death since 2009 (15), with a 5-year survival rate of 19% in males and 26% in females (32).

Lastly, TB is the deadliest infectious disease, second to COVID-19 (26). TB is a communicable disease resulting from infection by the *Mycobacterium Tuberculosis* bacteria through aerosol transmission, affecting the airways and the lungs (33). Although not everyone infected becomes ill, those who become ill develop symptoms such as fever, night sweats, chest

pain, fatigue, and excessive coughing, including coughing up blood (34). TB is a preventable and curable disease, but despite that, it remains the leading cause of mortality from infectious diseases, second only to COVID-19 rates between 2019-2022 (34). In 2019, an estimated 1.830 million people were living with TB (35). An additional 10.6 million people were infected with TB in 2021 alone, and it is estimated that a quarter of the world's population has the infection (34). In 2019, TB's global prevalence rate was 23,085.1/100,000, and the mortality rate was recorded at 14.6/100,000 (35).

Similar to COPD and asthma, the burden of TB is unequally distributed, with a larger burden falling onto countries with lower Social Development Index values. Countries in Western Europe and North America have an age-standardized DALY rate ranging from <6.9 - 21.8/100,000 (35). Conversely, countries in Sub-Saharan Africa, America, Eastern Europe, and Asia all fall into the mid to high range between 52.0 -10, 170.9/ 100,000 (35). Canada's age-standardized DALY rate is less than 6.9/100,000 (35).

2.1.2 Burden in Canada, overall and among Indigenous people

2.1.2.1 COPD

There were approximately 2 million Canadians over the age of 35 who were living with COPD in 2013, an 82% increase from 1.1 million cases in the early 2000s (4). In 2000, the age-standardized prevalence rate of COPD in Canada was 7.1%, which increased to 9.5% in 2012 (2). The impact of COPD is more pronounced in males than in females, with an age-standardized prevalence rate of 6.4 % for females in 2000 (lower than the national value), compared to 8.1% in males (2). However, the difference between the two groups narrowed in 2012, with an age-standardized prevalence of 9.2% among females compared to 10.0% in males (2). The higher prevalence among males persists within each age group. For example, males in the 85+ age

group have a prevalence rate of 31.5% compared to their female counterparts, who report a prevalence rate of 23.6% (2). Although the rates of COPD are generally higher starting at age 35 years, there remains an increase within each age category. In males 34-39 years old, the incidence rate in 2011-2012 was 326.9/100, 000 compared to those 85+ (2961.0/100,000) (4).

COPD is the third leading cause of death in Canada and the leading cause of illness among all respiratory diseases (2,36). This poses a significant burden on the Canadian healthcare system in terms of labour, economic, and clinical burdens. Patients with COPD are recorded to visit the emergency room up to four times a year, have 0.3-1.5 hospital visits each year, and see a physician up to 5 times a year (36). The cost to care for each COPD patient is between $2,444-$6,693 CAD, and the costs increase as the severity of their disease progresses (36). The burden of disease that COPD poses on the Canadian healthcare system increases as the population ages and is even higher among the indigenous population (36).

As of 2018, Bird and colleagues reported a prevalence of only 4% for COPD in the Canadian population (8,37). However, during that same year, the rate of COPD in the Indigenous community was higher than in the general population, at 6.8 % (8). Within the Indigenous community, people of Metis ancestry reported the highest prevalence of COPD (7.93%), followed by First Nation (6.61%) and the Inuit (3.21%) (8). Contrary to trends seen in the general Canadian population, COPD is more pronounced in Indigenous women (7.75%) compared to males (5.67%) (8). In 2008, the cost of providing healthcare to Indigenous patients with COPD was estimated to be approximately $1.23B (8). A report published by the Canadian government in 2010 on the economic burden of an extensive list of illnesses, including COPD, stratified the impact by gender, age, and province; however, it did not capture the economic

impact it has on the Indigenous community as a whole, as well as amongst Indigenous groups (38).

The higher prevalence of COPD in the Indigenous community may be related to the increased prevalence of risk factors such as smoking, thus the relevance to investigate such relationship specifically in the Indigenous community.

2. 1.2.2 Asthma

Asthma prevalence makes up 80% of all chronic respiratory diseases' prevalence in Canada (11). Approximately 8% of Canadians aged 12+ have been diagnosed with asthma, a number that has been steadily increasing over the last two decades (10,11). In 2012, the age-adjusted prevalence rate was 10.8%, an increase from 6.5% in 2000 (7). Females are reported to have higher age-adjusted prevalence rates compared to males. In 2000, the age-adjusted rate in males was 5.95 % compared to 7.0% in females, a trend which remained consistent over the years, with males reporting an age-adjusted prevalence rate of 10.2% in 2012, compared to 11.3% in females (2). When stratified by age, the youngest group of 1-4 years old has the lowest rate of 6.2%, which increases until it peaks at age 10-15 years old with a prevalence rate of 22% (2). The rates decrease for individuals 16 years and older. Males have higher rates of asthma than females for ages 1-24, but starting at age 25, the opposite trend emerges, where females have higher rates of asthma than males (2).

Asthma is the number one cause of hospital admission in Canada and, as a result, creates a clinical, humanistic, and economic burden on the healthcare system and Canadian society (11). The increasing prevalence of asthma makes it the number one reason children miss school and the third leading cause for adults to miss work (11,39). One hundred forty-six thousand (146,000) emergency visits are recorded annually due to asthma, costing an average of $366-

$647 per person, totalling $141 million in Ontario alone (37). This burden of asthma is a public health concern as this chronic condition impacts individuals' quality of life (11,39).

Historically, asthma was not a common disease reported amongst the Indigenous community of Canada. However, the rates have been increasing in the last several decades, particularly in Indigenous children and older adults between 35-64 years old (40). The 2001 Aboriginal People Survey reported a 12.1% prevalence rate of asthma among Indigenous children and 11.6% among Indigenous youth and adults. In 2012, children who were of North American Indian ancestry had a 14.2% prevalence of asthma (40). In comparison, Metis children had a 15.1% prevalence, and Inuit children had a 5.8% prevalence of asthma (40). Statistics Canada reports that Indigenous children are two times more likely to be hospitalized for respiratory diseases such as asthma than non-Indigenous children (9). A study looking at children from Alberta and Saskatchewan shows that as the prevalence increases, emergency visits also increase among this population, surpassing the prevalence in the non-Indigenous community (40). Trends in asthma prevalence in the Indigenous community are under-explored but are increasing and need to be addressed along with contributing risk factors like tobacco, to improve the overall health of the Indigenous population.

2. 1. 2. 3 Other key pulmonary disease (Tuberculosis (TB))

The rate of Tuberculosis in Canada was approximately 5/100, 000 with a cumulative prevalence of 1,904 cases in 2021 (41). Males have a higher prevalence rate of 5.5/100, 000 compared to females with 4.5/100,000 (41). The most affected age groups are ages 25-34, with a rate of 6.8/ 100,000, and 65+ years, with a rate of 6.3/100,000 (41). The prevalence rates of TB in Canada can be categorized into four groups based on the provinces and territories. Ontario, Quebec, Yukon, and the Atlantic provinces have prevalence rates lower than the country average

of 5/100,000 (41), while Alberta, British Columbia, and the Northwest Territories have prevalence rates between 5-9/100,000, and Saskatchewan and Manitoba report higher prevalence rates of 10-14/100,000 (41). Nunavut reports the highest prevalence rates in all of Canada, with 15+/100,000 (41).

Although the prevalence of TB in Canada is relatively low at only 5/100, 000 (41), in comparison to the global prevalence of 134 /100,000 (42), some population groups experience higher rates than the national rate. Individuals born outside of Canada constitute only 18% of the population but make up 65% of all TB cases in Canada, with a prevalence rate of 13.4/ 100,000 (33,41). The risk of foreign-born individuals developing TB upon arrival increases with each year that passes, and 10% develop TB in their first year in Canada (33). This increases to 17% of immigrants after being in Canada for two years and 35% after 5 years (33).

Within the Indigenous population, the risk of developing TB is higher than that of non-Indigenous persons in Canada (14). The Indigenous population makes up 4% of the Canadian population, yet contributes to 19% of TB cases in Canada (14). When stratified by Indigenous status, the rates also vary greatly within these communities. The Inuit community continues to carry the highest burden of TB at a rate of 135.1/ 100,000 in 2021, which is a large increase from 72.2/100,000 in 2020 (41,43). The First Nations community is reported to have TB at a rate of 16.1/ 100,000 in 2021, an increase from 13.5/ 100,000 just the year before (41,43). Lastly, the Metis community is reported to have the lowest rates of TB among all Indigenous groups, with a low rate of 2.1/ 100,000 in 2021, which is a decrease from 2.8/100,000 in 2020 (41,43). Although the rates vary, it is evident that the Indigenous community experiences TB at a disproportionately higher rate than the general population of Canada, which may once again be related to the higher prevalence of varied risk factors in this population group.

2.2 Health of the Indigenous Community

2.2.1 Conceptualization of Health

Health is generally defined as a "state of complete physical, mental, and social well-being" and not just the absence of injury or illness (44). However, in the Indigenous community, health encompasses a broader definition, which includes emotional and spiritual health (22). It not only considers the health of the individual but also the community. It denotes health as a communal responsibility, including the health system. These aspects should be adequately represented when assessing health. Although health has usually been measured through indicators including life expectancy, morbidity, and mortality, these indicators do not always represent the depth of this concept.

2.2.2 Health Status

In 2011, the life expectancy in non-Indigenous Canadian males was 81.4 years old (45). In comparison, Metis men had a life expectancy of 76.9 years, First Nations men had 72.5 years, and Inuit men had 70.0 years (45,46). Similarly, non-Indigenous Canadian women had a life expectancy of 87.3, whereas Metis women had a life expectancy of 82.3, First Nations women had 77.7, and Inuit women had 76.1 years (45).

In 2004, infant morbidity in the Indigenous community was more than 2 times higher at 17.9% than in non-Indigenous communities at 7.9% (23). Infant morbidity and mortality in the Indigenous community are affected mainly by poor dental health and asthma. Studies show that up to 70% of Indigenous children experience tooth decay and caries by the time they are three years old (23). The morbidity and mortality rates within the Indigenous community in Canada

are continuously higher than in the non-Indigenous community in Canada (23). These disparities in the health of the Indigenous community compared to the rest of the Canadian population can be attributed to the social determinants of health affecting Indigenous Health. However, this community has also shown resilience through the holistic model of health rooted in Indigenous culture, which includes spiritual and emotional health in addition to physical and mental health as part of the healing process (22). Thus, it is essential to look broadly at the determinants that reflect the realities, experiences, and holistic views of health in the Indigenous populations.

2.3 Social Determinants of Health

The WHO defines "Social Determinants of Health" (SDoH) as the non-medical conditions that can influence the health of individuals (44). As part of this definition, the WHO lists ten social determinants that it deems integral to the wellness of individuals: social gradient or status, social support, social inclusion and control, stress, nature of employment, addiction, early life, unemployment, food, and transport (23).

Similarly, the Canadian Government defines SDoH as a "broad range of personal, social, economic and environmental" variables that can influence the health of individuals and the population (GOC, 2023). The Government of Canada also developed its framework of SDoH, containing seventeen components. Most of the 17 determinants in the Canadian framework overlap with the WHO framework, but the Canadian model does not include food, transportation, stress, and addiction (23). On the other hand, the Canadian framework includes five components not found in the WHO framework: physical environment, biology and genetic endowment, health services and culture, personal health practices, and coping skills (23). There are also additional components that cater specifically to the Canadian population's cultural mosaic, such

as immigration, race, globalization, and Indigenous ancestry (46). Although both frameworks incorporate social and environmental aspects that can influence health, they do not adequately address the social factors that uniquely affect Indigenous health.

Due to varied circumstances and factors, including poor access to care and the impact of colonialism, the Indigenous community consistently experiences poor health across all indicators of health (23). The remnants of colonialism have a long-lasting impact on the health of past, present, and future generations of the Indigenous community (47). The negative impacts of colonialism are highlighted by the experience of residential schools and the marginalization of the Indigenous people and their culture (47,48). Residential schools were a tool used by European settlers to separate Indigenous children from their community and their culture. This separation resulted in physical, mental, and spiritual harm for both the children and the community involved (48,49). The residual impacts of residential schools continue to impact the health of those who were forced to attend, as well as the younger generation that experiences second-hand impacts through their community (49). As a result of this marginalization, the Indigenous community faces barriers in accessing health services and discrimination within the health care system, which adds to the burden of disease they face (47). This burden can be seen in terms of higher infectious diseases, higher maternal mortality, higher infant mortality, lower life expectancy, higher morbidity and mortality associated with smoking and alcohol consumption, malnutrition, and a heavy burden of chronic diseases (23).

2.3.1 Social Determinants of Indigenous Health Framework

The Indigenous framework on social determinants of health includes comprehensive components that address the unique lifestyle of the Indigenous community. To do so, multiple models of Indigenous health have been developed that overlap and interplay to create a holistic

image of Indigenous health. The First Nations' determinants of health, developed by the Assembly of First Nations in 2006, divide the SDoH into four categories: Individual Health, Community Health, Social and Cultural Health, and Environmental Health (23). The Integrated Life Course and Social Determinants Model of Aboriginal Health is a framework that divides SDoH into three categories: Proximal, Intermediate, and Distal, relating them to the health inequities in the Indigenous community (23,50).

Proximal determinants of health are a category of SDoH that directly affect the individual's physical, mental, emotional, and spiritual health. This category includes the individual's health behavior and practices, physical environment, education, employment and income, and food [in]security (24,50). These are the factors that would directly influence risk and lead to disease. For example, smoking is an individual health behavior that is a known risk factor for respiratory diseases. Intermediary determinants of health are a group of SDoH that affect the immediate community in which individuals reside. This category includes the available community infrastructures and resources, education and healthcare systems, cultural continuity, and environmental stewardship (24,50). For example, individuals surrounded by others in their homes or community who misuse tobacco will likely engage in primary or secondary consumption of tobacco. Distal determinants of health are the structural determinants that affect individuals on a larger scale. This category of SDoH includes socio-political and economic factors such as colonialism, racism, social exclusion, and self-determination (24,50). These are systematic factors that determine the presence of risk (e.g., how accessible tobacco is to the population); they can determine the accessibility to cessation programs (e.g., smoking cessation) or the access to preventative services and health services for chronic diseases that develop due to risk from proximal and intermediary factors.

The Integrated Life Course and Determinants of Aboriginal Health framework introduce social determinants that are more appropriate for analyzing the health and well-being of Indigenous people in Canada. However, the Indigenous community still faces many health challenges. Health data collected in Canada often lacks Indigenous identifiers or is incomplete regarding Indigenous health (22). The lack of data leads to an underestimation of diseases and health status. Additionally, programs put in place to improve health cannot appropriately account for Indigenous health and culture due to a lack of data. The existing public health interventions are not culturally appropriate for addressing the needs of the Indigenous community. Examples are seen in the high prevalence of maternal mortality within the Indigenous community. A lack of resources within the community forces pregnant Indigenous women to seek health services in urban settings that are not culturally appropriate or easily accessible, which results in higher morbidity and mortality (22). Similarly, the 2007– 2010 Canadian Community Health Survey reported higher rates of chronic conditions in First Nations (56%) and Metis (55%) compared to non-Indigenous (48%) (12).

Lastly, the remaining traces of colonialism have impacted the ways in which the Indigenous people access health care (48). Racial discrimination in the healthcare system deters people from accessing health services, and those who do access it receive inadequate care, not conducive to their health and well-being (23). This study will use a framework incorporating the social determinants of Indigenous health as a guideline for analyzing the impact of proximal, intermediary, and distal factors on pulmonary diseases in the Indigenous community.

2.3.2 Factors Associated with Pulmonary Diseases

COPD, asthma, and TB all share common risk factors that contribute to the development of pulmonary diseases, such as air pollutants, chemicals such as asbestos and radon, as well as first and second-hand smoking (51). For instance, TB requires the presence of the Mycobacterium tuberculosis bacteria as a necessary factor for the disease to develop. However, the presence of the bacteria is not sufficient to cause disease, as only 5-10% of those with the infection develop the disease (52), and for most people, other risk factors need to be present for the disease to develop. The presence of pollutants, fumes, and chemicals is conducive to the development of TB, as well as COPD and asthma, with the consumption or exposure to tobacco being the leading risk factor for all respiratory diseases (25). This makes tobacco consumption an important risk factor to explore in relation to the prevalence of COPD and asthma, especially in the Canadian Indigenous population, where a much higher prevalence of tobacco intake has been found than in the general population.

2.3.2.1 Tobacco as a Risk Factor

In Canada, the prevalence of smoking is on the decline. The 2020 Canadian Tobacco and Nicotine Survey reported 3.2 million smokers in Canada, accounting for 10% of the population (53). This is a lower prevalence compared to the 2019 survey, which reported that 12% of the population was consuming tobacco (53). However, the prevalence of smoking in the Indigenous community was 39% in 2020 compared to 20.5 % in the general population based on the most recent Canadian Community Health Survey in 2017 (8). When stratified by age groups, Indigenous individuals who are 35 years or older have a 40% prevalence rate of smoking compared to 18.62% in the non-Indigenous population. The Metis community has a smoking prevalence rate 1.7 times higher than non-Indigenous people (20). First Nations individuals

living off reserves are reported to have a prevalence rate 1.9 times higher than non-Indigenous Canadians (20). Lastly, the Inuit community has the highest smoking prevalence, at 2.4 times higher than non-Indigenous Canada (20). All three Indigenous groups report higher exposure to second-hand smoking than non-Indigenous, but the Metis community, in particular, reports 25% exposure compared to 7% in non-Indigenous populations (12).

Tobacco is the leading risk factor attributed to the development of preventable chronic diseases across the globe (54). The WHO estimates approximately 1.3 billion tobacco consumers across the globe, and 8 million deaths annually from tobacco exposure (55). Though tobacco can be consumed in many ways, including vaping, chewing, and pipes, the most common way of consumption is by smoking. Individuals who smoke can experience immediate effects such as various respiratory symptoms, including persistent coughing, wheezing, and phlegm (54). They also experience an impaired immune system, dyspnea, and overall poor health status (54). This decline in health leaves smokers more susceptible to developing latent chronic diseases, including a variety of cancers, stroke, lung diseases, heart diseases, and COPD (56). Additionally, tobacco consumption has been attributed to increasing the risk of developing TB, as well as asthma in children and sudden infant death syndrome (56). In 2017, Bird and colleagues found rates of COPD to be higher in daily smokers, with an odds ratio of 2.28 and a 95% CI [1.65 -3.14] (8).

Smoking is cited as the primary risk factor for the development of COPD and asthma (2,57–59). The risk of developing COPD in smokers outweighs all other risk factors (57). In 2010, approximately 54% of COPD mortality in men 30-69 years old was attributed to smoking, and 52% of mortality in men 70 years + was attributed to smoking (59). In women between the

ages of 30-69 years old, 24% of COPD mortality was attributed to smoking, and 19% in women 70 years+ (59).

Second-hand smoke is also a factor influencing the development of chronic diseases. Individuals exposed to smoking can be influenced to participate in the habit themselves, and second-hand exposure alone is sufficient to result in diseases such as asthma and cancer due to the constant exposure to carcinogens. Consumption of tobacco by pregnant mothers, as well as postnatal, has been strongly associated with wheezing and the development of asthma in their babies (60).

Tobacco consumption in the Indigenous community is classified into two categories: Traditional Tobacco and Tobacco Misuse (23). The first category involves the use of tobacco as part of traditional ceremonies and prayers for thousands of years, as part of the Indigenous culture and history (23), and any consumption of tobacco outside of ritualistic purposes is considered a misuse of tobacco. Despite this distinction, higher prevalence rates of smoking non-traditional tobacco are reported in the Indigenous community compared to the rest of Canada.

In the indigenous community, there is a high burden of diseases that can be attributed to tobacco consumption (61). In 2018, the general Canadian population had a smoking prevalence rate of 18% (61). In comparison, the Metis community had a smoking prevalence rate of 37%, the First Nations community had a prevalence rate of 40%, and the Inuit community had a prevalence rate of 47% (61).

The burden of disease resulting from smoking is seen more prominently in the healthcare system. Smokers are more likely to report frequent visits to their family doctor, hospitalizations, prolonged hospital stays, and use pharmaceutical services more than non-smokers (62).

Additionally, tobacco consumption is associated with increased mortality, potential years of life lost, and lower quality of life (15,62).

2.3.2.1-a The Framework Convention on Tobacco Control (FCTC)

In response to the high global tobacco consumption and its negative impacts, the WHO developed the Framework Convention on Tobacco Control as a tool for countries to use in reducing tobacco consumption (63). The framework introduces measures aimed at Monitoring tobacco use; Protecting people from tobacco smoke; Quitting tobacco; Warning about the dangers of tobacco; Enhancing tobacco advertising, promotion and advertising bans; and Raising taxes on tobacco (MPOWER) that countries can implement to curb tobacco use and reduce exposure in the population (63). These measures are implemented by 185 signatory countries, including Canada, that report progress every 5 years to the WHO. The WHO recognizes the impact that a higher prevalence of smoking has on the health of Indigenous populations and has included indicators for Indigenous communities in relevant countries such as Australia, Canada, and New Zealand (61). Though the implementation of the FCTC has resulted in a decline in tobacco consumption in Canada, the gap between Indigenous smokers and non-Indigenous smokers remains wide. The continued presence of this gap despite the implementation of the FCTC is an indication that there are driving factors unique to the Indigenous community that influence the higher prevalence of smoking. This study will assess the various factors associated with smoking as well as the association between smoking and pulmonary diseases in the Indigenous community.

2.3.2.2 Other risk factors

2.3.2.2-a COPD

Exposure to air pollutants has been found to impact the respiratory tract, leading to decreased pulmonary function, including diseases such as COPD and emphysema (3,57,59). This provides an adequate reason to draw an association between COPD and air pollution due to black carbon observed in the respiratory system (59). Socioeconomic status is another risk factor that can be attributed to the development of COPD (57). Low-income individuals are more likely to experience exposure to harmful environmental factors, such as air pollutants and indoor pollution (57). In countries in the Global South, a common risk factor among people of lower socio-economic status is exposure to biomass fuel, as it is common to use open-fire stoves (3,59). This risk factor puts women, in particular, at higher risk of developing COPD and other respiratory diseases in this part of the world (3,59). Some occupations put individuals at a higher risk of developing COPD due to the materials and chemicals that they are exposed to at work (57). Industrial workers, miners, and construction workers are a few occupations that expose individuals to harmful materials associated with developing COPD (59). An individual's diet can also play a significant role in the development of COPD. A diet lacking antioxidants can make individuals susceptible to developing COPD (59). Lastly, childhood asthma is the most common risk factor that is predictive of developing COPD (3,59). The longer an individual has experienced asthma, the more likely they are to develop chronic airway obstruction, leading to COPD (59).

2.3.2.2-b Asthma

Many risk factors are linked to the development of asthma aside from exposure to tobacco. Similar to COPD, environmental factors such as air pollutants and occupation, as well as individual factors such as genetics and obesity, play a vital role in the development of asthma

(6,58). Children who grow up in urban neighbourhoods are more likely to develop asthma than those who grow up in rural areas due to higher exposure to air pollutants (58). Urban housing is also linked with higher presence of pests, and higher concentration of indoor pollutants, all of which contribute to the disparity in morbidity between children living in urban areas compared to those in rural areas with asthma (58). Mould is another risk factor that plays a significant role in exacerbating symptoms amongst those who have asthma (64). On the other hand, occupational asthma develops due to exposure to hazardous materials in the workplace (6,58). Exposure to metals, chemicals, flour dust, Western red cedar, acid anhydrides, as well as mould in the work environment is attributed to developing adult asthma or exacerbating existing asthma in adults (58,64).

Genetics is a risk factor that plays a key role in asthma, especially since a large proportion of asthma incidence occurs in young children (6,58). Twin studies have shown that several genes have a moderate effect on the development of the disease (60). In particular, the gene ORMDL3 has been found to have a highly significant association with the development of asthma (60). Lastly, obesity is a risk factor that has a strong association with the development of asthma, as well as exacerbating the effects in individuals who already have asthma (58). Individuals with obesity exhibit increased airway inflammation that is linked to the development of asthma (58).

All of these risk factors contribute to the development of COPD and asthma in the general population, as well as the Indigenous population. Obesity in the Indigenous community is a risk factor that has been explored at great length, mainly in relation to chronic diseases such as diabetes, cardiovascular diseases, and cancers (65). However, lacking in the literature is how these risk factors affect the Indigenous community in relation to pulmonary diseases such as

COPD and asthma. Although these factors play an important role in the development of COPD and asthma, the exploration of these factors is beyond the scope of this thesis, as they are not available in the data being used.

Chapter 3: Methodology and Methods

3.1 Research Approach and Objectives

There is limited research looking at the effects of tobacco consumption on COPD and asthma within the Indigenous community. Additionally, there is a lack of adequate, culturally appropriate health programs and services that are accessible. The findings of this study contribute to understanding the relationship between tobacco consumption and the excess of pulmonary diseases in Indigenous communities across Canada. This study contributes to the literature to inform decision-making that is culturally appropriate towards tobacco control to reduce COPD and asthma.

Using a quantitative approach in health allows researchers to quantify health events and the impact of potential factors. Quantitative research tells us "how much" of a problem we have on hand. Hence, through quantitative research, we can gauge the extent of a problem or its solution, the impact it has on the population in terms of disease burden, and clinical significance. Often, tools used in quantitative research, such as surveys through mail delivery, phone calls, or online surveys, can be done at large scales to get as many respondents as possible (66). The benefits of using quantitative research are that it is objective and can be replicated and tested. The limitations facing quantitative research are the constraints to producing an in-depth understanding of the outcomes. On the other hand, qualitative research tells us how there is a problem and answers the questions "what" and "why". Qualitative research is useful in developing a deeper understanding of a topic that has not been well explored without necessarily elaborating on the scope, size, or burden. It allows researchers to explore a topic from a broader lens in order to identify key components that need deeper investigation. As such, in-depth face-

to-face interviews allow researchers to learn of new components that may not have been accounted for in predetermined surveys (66).

Based on the available data and the exploratory nature of the research objectives, this thesis uses quantitative research methods to answer the research questions. The first objective of this study is to assess the prevalence of tobacco consumption and associated characteristics overall and within specific demographic groups in the Indigenous population. The second objective looks at the magnitude of the association between tobacco consumption and pulmonary diseases, namely COPD and asthma, in the Indigenous population.

In particular, a cross-sectional design is effective and uses a large secondary data set representing First Nations living off reserve, Metis, and Inuit populations, amounting to a 76% response rate across Canada (67). In the literature review, many research studies used systematic reviews and a cross-sectional design to explore the burden of COPD and asthma in both the general population and the Indigenous population. These systematic reviews and cross-sectional studies provided insight into the variables that should be explored, such as age, sex, alcohol consumption, multimorbidity, in-home smoking, housing and overcrowding, sense of belonging, and experiences with residential schools on tobacco consumption and the presence of pulmonary disease. The literature also provided insightful information on the Integrated Life Course and Determinants of Aboriginal Health frameworks, which outline factors that should be considered when assessing Indigenous health. This information and existing frameworks supported the elaboration of the study's conceptual framework, which informs the statistical model used in this research study.

3.2 Conceptual Framework and Hypotheses

The Social Determinants of Aboriginal Health framework guided the development of the conceptual model used for this thesis. This framework breaks down social determinants of health into three categories: distal, intermediate, and proximal determinants that affect the lives of the Aboriginal people in Canada, as shown in Figure 2 below (24). The proximal determinants consist of variables directly affecting the individual, such as age, sex, and health behavior (24). Intermediary factors affect an individual's immediate surroundings, including their community's physical and social structure and the resources and infrastructure available to them (24). Lastly, the distal factors are systematic and include the collective history of the group, the socio-economic system, and the political climate (24).

This framework takes a holistic approach that incorporates all the components of health and encompasses the entire definition of health as defined by the World Health Organization (WHO). We identified key potential factors related to the different outcomes studied in our research questions, in accordance with this framework.

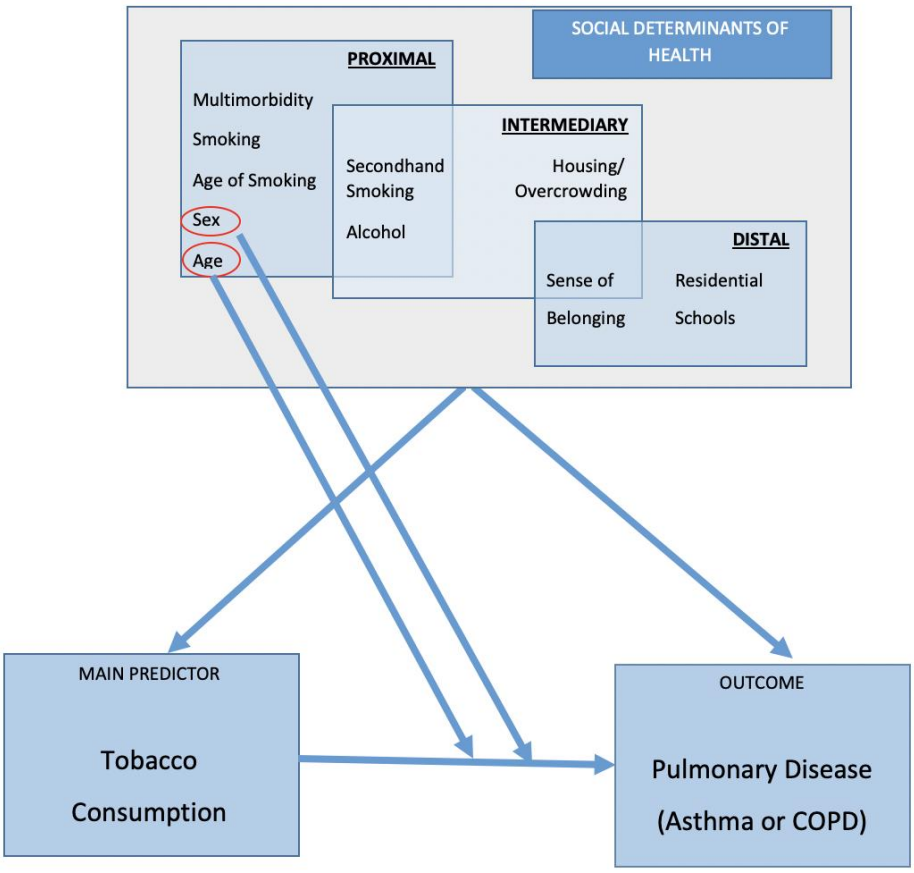

Figure 2: Conceptual framework of social determinants of Indigenous health on pulmonary diseases.

3.2.1 Objective 1

Objective 1 investigates the prevalence of tobacco consumption and associated characteristics overall and within specific demographic groups in the Indigenous population. To adequately address this question, the study explores variables from all three categories of the framework. The social determinants of health in the proximal category (e.g., age and sex) are factors that have an impact on tobacco consumption. In particular, individuals who are older and male are more likely to be smokers. In the intermediary category, factors including alcohol consumption, second-hand smoking (measured as in-home smoking), and housing/overcrowding

can influence tobacco consumption habits in individuals. The presence of in-home smoking and overcrowding can influence primary and secondary tobacco consumption. In-home smoking can influence individuals to indulge in the habit. Lastly, the distal category includes the participant's sense of belonging within their community and their experience with residential schools. Individuals who do not feel like they belong within their community are more likely to pursue risky behavior such as smoking or alcohol consumption. Additionally, individuals who have experience with residential schools may misuse tobacco as a coping mechanism for the traumatic experience. In summary, there is the expectation to see a strong correlation between tobacco consumption and age, sex, alcohol consumption, in-home smoking, and a lack of sense of belonging.

3.2.2 Objective 2

Objective 2 assesses the magnitude of the association between tobacco consumption and pulmonary diseases (asthma and COPD) in the Indigenous population. Tobacco consumption is the main predictor of COPD and asthma, as it is the most common risk factor. However, in the proximal category, age is an influential factor as younger individuals (0-15 years old) are more likely to develop asthma, whereas older individuals (35+) are more likely to develop COPD. The age at which individuals start smoking can have an impact on the development of chronic diseases such as COPD and asthma due to the latent effects of tobacco exposure.

Similarly, pre-existing conditions such as childhood asthma increase the vulnerability of the individual to develop COPD (3,59). Within the intermediary category, overcrowding is a prominent factor in the literature on the development of pulmonary diseases such as COPD and asthma. Second-hand smoking exposes individuals to carcinogens that can lead to the development of chronic conditions such as asthma, COPD, and a variety of cancers

(28,40). Lastly, the presence of distal factors such as a lack of sense of belonging or trauma from residential schools can lead to risky behavior, including but not limited to tobacco consumption, which in turn increases the risk of the diseases. Although tobacco consumption is the main predictor for this thesis, it is important to consider all these other factors and the impact they may have on the development of COPD and asthma in the Indigenous population. Based on these assumptions, there is the expectation to see an association between having COPD and older age, younger age at the start of tobacco consumption, males, more chronic conditions, lack of sense of belonging, individuals who have experience with residential schools, those living with overcrowding and presence of in-home smoking. With Asthma, there is an expectation to see an association with younger age, females, more chronic conditions, lack of sense of belonging, individuals who have experience with residential schools, those living with overcrowding, and the presence of in-home smoking.

3.3. Methods

This study used a cross-sectional design to analyze data from the Aboriginal People's Survey and address the following research questions:

(1) What is the prevalence of tobacco consumption and associated characteristics overall and within specific demographic groups in the Indigenous population?

(2) What is the magnitude of the association between tobacco consumption and pulmonary diseases, namely COPD and asthma, in the Indigenous population?

3.3.1 Data Source

The study relied on data collected through the Aboriginal People's Survey in 2017 (APS). The survey selected its sample from the 2016 national census long-forms, hence using a two-

phase sampling design. Phase one corresponds to the sample in the census, and phase two corresponds to the sample in the APS. This national survey collected information on health, transferable skills, use of Indigenous languages, and participation in the Canadian economy, among many factors. The data was retrieved from the ODESI public database and held in a password-protected file (67). This survey includes the Indigenous population, defined as First Nations living off reserves, Inuit, or Metis. The inclusion criteria for the Aboriginal People's Survey are individuals from all parts of the country who self-identified as First Nations, Metis, Inuk, or Status Indian registered in the Indian Act of Canada, and who are a minimum of 15 years old. First Nations living on reserve were excluded from participation.

3.3.2 Study Population

The APS collected data between January and August of 2017 from a sample selected from the 2016 Census long-form respondents. The target population was all individuals identifying as Indigenous, aged 15 or older. These are individuals who answered "yes" to the following questions in the 2016 Census of Population long-form questionnaire:

Q 18: "Is this person an Aboriginal person, First Nations, Metis, Or Inuk (Inuit)?" If yes, go to question 20.

Q 20: Is this person a Status Indian (Registry or Treaty Indian as defined by the Indian Act of Canada)?

Q 21: Is this person a member of a First Nation/ Indian band? If "yes", which First Nation? Indian Band?

Based on these questions, the survey included 24,220 individuals who identified as Indigenous as the target population. Past APS samples have found that approximately one-third

of individuals who do not identify as Indigenous on the Census are likely to report it on the APS. Hence, to account for that, the sampled population for the survey included an additional 8,380 non-Indigenous individuals.

The data was collected via computer-assisted personal interviews (CAPI) and computer-assisted telephone interviews (CATI). Underage individuals between 15 and 17 years old were interviewed directly after consent was obtained from their guardians. The survey was available in both English and French and for respondents in the Inuit regions, paper copies in Inuktitut and Inuinnaqtun were also available.

3.3.3 Study Variables

3.3.3.1 Objective 1

For the assessment of tobacco consumption prevalence and associated factors, the dependent variable is tobacco consumption, measured as "Yes" – a combination of "Daily Smoker", and "Occasional Smoker", or "No", which consists of "Never Smoker". The independent variables will be the age of respondents, sex, age of first tobacco consumption, alcohol consumption, multimorbidity, in-home smoking, overcrowding, sense of belonging, and experience with residential schools.

3.3.3.2 Objective 2

To analyze the association of pulmonary diseases with tobacco, the main predictor is the consumption of tobacco, measured as "Yes" – a combination of "Daily Smoker", "Occasional Smoker", or "No" measured as "Never Smoker". The outcome is the presence or absence of asthma and the presence or absence of COPD, measured as "Yes" or "No".
Age, sex, multimorbidity, age of first consumption, alcohol consumption, housing and overcrowding, experience with residential schools, sense of belonging, and in-home smoking are

included as potential confounders to better assess the adjusted impact of tobacco. Age and Sex are considered for interaction with tobacco consumption.

Table 1 provides the description and operationalization of all the variables used in the study.

Table 1: Study Variables Description

Variable	**Value**	**Variable Code in the APS**
Asthma: Do you have Asthma?	Yes No	CC_05
COPD: Do you have COPD?	Yes No	CC_25
Type of Tobacco Consumer: At the present time, do you smoke daily, occasionally, or not at all?	Daily Smoker Occasional Smoker Never Smoker	SMK_05P
In-home Smoking: including both household members and regular visitors, does anyone smoke in your home, every day or almost every day?	Yes No	SMK_20
Age at the time of response to the survey	15- 18 19-24	AGE_YRSG

	25-34 35-44 45-54 55+	
Age of first consumption: at what age did you begin to smoke cigarettes daily?	<11 years old 11-14 years old 15-18 years old 19+ years old	SMK_10P
Sex of participants	Male Female	SEX
Multimorbidity: how many chronic conditions have you been diagnosed with?	0 1 chronic condition 2 chronic conditions 3 + chronic conditions	DCCNUM
Alcohol consumption: During the past 12 months, how often did you drink alcoholic beverages?	<1 drink/ month 2-3 drinks /month 1 drink/week 2-3 drinks/week 3+ drinks/ week	ALC_10P

Housing and Overcrowding	≤1 person/ room >1 person/room	DPRSROOM
Sense of Belonging to own Aboriginal group	Strongly Agree Agree Neither Agree or Disagree Disagree or Strongly Disagree	SB_20P
Experience with Residential School: Have you or anyone in your family ever attended a residential school?	Respondent Attended Only Parent(s) OR Grandparent(s) Attended Only Other Family Members Attended Only Parent(s)/ Grandparent(s)/ Other Family Members Attended Neither Respondent nor Any Family Members Attended.	DRSATTEND

3.4 Statistical Analysis

All statistical analyses were done using the SPSS software 28.0 for Macintosh, and the cut-off value for statistical significance used is alpha = 0.05.

The variables used in this study are all categorical; hence, frequencies were generated to describe the characteristics of the study population.

3.4.1 Objective 1

The first research question quantifies the percentage of tobacco consumption overall and by characteristics in the Indigenous population. To estimate the prevalence of tobacco consumption, bivariate analysis was conducted to assess the crude association between each independent variable and tobacco consumption using the chi-square test (Table 2). A binary logistic regression model was then performed to assess the association between tobacco consumption and age, sex, age of consumption, alcohol consumption, multimorbidity, in-home smoking, overcrowding, sense of belonging, and experience with residential schools (Table 3).

3.4.2 Objective 2

The second question looks at the magnitude of the association between tobacco consumption and pulmonary diseases, namely COPD and asthma, in the Indigenous population. Descriptive statistics were generated to look at the proportion of people with COPD and asthma in the study population overall, and by age, sex, age of consumption, alcohol consumption, multimorbidity, in-home smoking, overcrowding, sense of belonging, and experience with residential schools.

A binary logistic regression model was conducted to assess the association of COPD and asthma with tobacco consumption while controlling for age, sex, age of consumption, alcohol consumption, multimorbidity, in-home smoking, overcrowding, sense of belonging, and experience with residential schools. To start with, a logistic regression model was fitted to assess the crude impact of tobacco on COPD as an outcome. Then, a multivariate regression model was conducted to evaluate the role of all the variables as confounders on the impact of tobacco on COPD. Forward selection was used to add variables to the model, looking at the coefficients in

the individual regression analyses, starting with the most significant to the least significant variable. The process was then replicated with asthma as an outcome.

3.4.3 Model Fit and Quality

For this study, the Omnibus test is one way to assess the quality of fit of the final regression models. This test provides insight into whether the model containing the predictor variables is better than the null model. A p-value <0.05 indicates that the predictors significantly improve the model compared to the null. All five logistic regression models produced Omnibus test values that have p-values <0.001, which indicate a good model fit.

Chapter 4: Results

This study included a sample of 20,849 participants who self-identified as Indigenous, 5 years or older. Table 2 summarizes the distribution of the characteristics among the participants (N= 20,849). A majority of the participants in this study were over the age of 55 (30.3%). Most participants were female (53.4%). Smokers made up 34.7% of the participants, among whom 34.8% were between the ages of 15-18 years old. More individuals (24.1%) reported having 1-3 drinks/month. Moreover, a majority of the participants were people with no chronic conditions (23.5%), a good sense of belonging in their Aboriginal group (62.5%), and those without residential school experience (34.5%). Smoking was associated with age, sex, in-home smoking, alcohol consumption, and sense of belonging.

4.1: Objective 1: The prevalence of tobacco consumption overall and within specific demographic groups in the Indigenous population, and associated characteristics

The distribution of characteristics in the study population is presented in Table 2. The logistic regression model that assesses the association between sociodemographic factors and smoking is presented in Table 3. A total of 34.7% of the participants were smokers. The highest prevalence of smoking was seen in groups of people who drank 3+ drinks/week or every day (37.9%), had three or more multiple chronic diseases (37.3%), and attended residential schools (47.5%).

The adjusted multivariate regression in Table 3 revealed significant associations between sociodemographic factors and smoking. In this sample, individuals between 25-34 years old were 2.37 times more likely to be smokers (95% C.I 2.04- 2.75). Similarly, individuals between 35-44 years old were 2.28 times more likely to be smokers (95% C.I 1.96- 2.65). Also, compared to

those with no in-home smoking experience, people who have experienced in-home smoking were 5.01 times more likely to smoke (95%, C.I 4.59- 5.47). Likewise, people who feel a sense of belonging were 2.38 times more likely to smoke than their counterparts who do not feel a sense of belonging (95% C.I 2.18- 2.60). Individuals who consume alcoholic beverages three or more times a week or drink every day had a 23% higher likelihood of smoking (95% C.I 1.07- 1.41).

Table 2: Distribution of Characteristics of the Population and percentage with Tobacco Consumption (N= 20,849)

Variables	Categories	Sample size	# of Smokers	Proportion of Smokers (%)	P-Values
All Participants		20,849	7,232	34.8	
Age					<0.001
	15-18	1777	475	26.9	
	19-24	4729	1667	35.3	
	25-34	2818	1165	41.4	
	35-44	2475	1034	41.8	
	45-54	2733	1115	40.9	
	55+	6317	1776	28.2	
Sex					0.144
	Male	9722	3,422	35.3	
	Female	11,127	3810	34.3	
Alcohol Consumption					<0.001
	0 Drinks in the past 12 months	5,260	1,722	32.8	
	<1 drink/ month	3949	1344	34.1	
	1-3 drinks /month	5021	1865	37.2	
	1 drink/week	2705	885	32.7	
	2-3 drinks/week	2443	857	35.1	
	3 drinks+/week or everyday	1344	510	37.9	
	Missing Values		49	0.68	
Multimorbidity					<0.001

	0 chronic conditions	9146	3114	34.1	
	1 chronic condition	4899	1636	33.4	
	2 chronic conditions	3206	1109	34.6	
	3+ chronic conditions	3148	1172	37.3	
	Missing Values		201	47.4	
In Home Smoking					<0.001
	Yes	3160	2076	65.7	
	No	17,641	5148	29.2	
	Missing Values		8	72.7	
Sense of Belonging					<0.001
	Strongly Agree	4788	2182	45.7	
	Agree	7561	2590	34.3	
	Neither Agree nor Disagree	1761	487	27.7	
	Disagree or Strongly Disagree	5641	1585	28.2	
	Missing Values		388	35.5	
Experience with Residential Schools					<0.001
	Respondent Attended	1169	554	47.5	
	Only Parent(s) OR Grandparent(s) Attended	2293	851	37.1	
	Only Other Family Members Attended	1121	430	38.5	
	Only Parent(s)/ Grandparent(s)/ Other Family Members Attended	3663	1653	45.2	
	Neither Respondent nor Any Family Members Attended.	7196	1884	26.2	

	Missing Values		1860	34.6	
Asthma					0.108
	Yes	2736	901	33.0	
	No	18,070	6321	35.0	
	Missing Values		10	45.5	
COPD					<0.001
	Yes	1049	457	43.6	
	No	19,725	6754	34.8	
	Missing Values		21	39.6	

Table 3: Logistic Regression Model to assess Factors Associated with Tobacco Consumption.

			Adjusted OR		
Variables	Categories within Variables	Values	95% Confidence Intervals		P- Values
			Lower	Upper	
Age	15-18	Reference Category			
	19-24	1.68	1.46	1.94	<0.001
	25-34	2.37	2.04	2.75	<0.001
	35-44	2.28	1.96	2.65	<0.001
	45-54	1.89	1.63	2.21	<0.001
	55+	0.98	0.85	1.13	0.79
Sex					
	Male	Reference Category			
	Female	0.98	0.92	1.05	0.55
Multimorbidity					
	0 chronic conditions	Reference Category			
	1 chronic condition	1.07	0.98	1.16	0.114
	2 chronic conditions	1.16	1.06	1.28	0.002
	3+ chronic conditions	1.34	1.21	1.48	<0.001
In Home Smoking					
	Yes	Reference Category			
	No	5.01	4.59	5.47	<0.001
Sense of Belonging					
	Disagree or Strongly Disagree	Reference Category			
	Neither Agree nor Disagree	1.01	0.89	1.15	0.858

	Agree	1.42	1.31	1.53	<0.001
	Strongly Agree	2.38	2.18	2.60	<0.001
Alcohol Consumption	0 Drinks in the past 12 months	Reference Category			
	<1 drink/ month	1.04	0.94	1.15	0.462
	1-3 drinks /month	1.16	1.05	1.27	0.002
	1 drink/week	1.03	0.92	1.15	0.643
	2-3 drinks/week	1.09	0.97	1.22	0.133
	3 drinks+ a week or everyday	1.23	1.07	1.41	0.004

4.2: Objective 2 The association between tobacco consumption and COPD and asthma, in the Indigenous population.

Table 4 summarizes the prevalence of Asthma and COPD. Overall, 13.2% of the study population reported having asthma, and 5.0% reported having COPD. Most of the participants with COPD were 55 years or older (11.4%) and female (6.5%). Additionally, there were more individuals who experienced in-home smoking (8.2%) with COPD. Individuals who had started smoking at 11 years old or younger made up 12.7% of people with COPD. In addition, 6.9% of smokers reported having COPD, as well as people with three or more chronic conditions (22.6%). Further, about 15% of the participants who reported having asthma were female (15.2%), with 14% between the ages of 15-18, and 15% experiencing in-home smoking. 13% of people who reported asthma were smokers, and 14% reported three or more chronic conditions.

In general, smoking, age, sex, and in-home smoking showed a strong association with COPD, as shown in Table 5. Participants who smoked had a 52% higher likelihood of having COPD than non-smokers (95% CI: 1.31-1.76). Also, participants aged 55+ years were 13 times more likely to have COPD compared to 15-18 years old (95% C.I: 7.94 -22.31). Furthermore, being female was associated with a 25% higher likelihood of having COPD compared to males

(95% C.I: 1.08-1.42). Similarly, living in a home where smoking occurs was associated with a 59% higher likelihood of having COPD (95% C.I: 1.36-1.91). The study further explored the association between COPD and age at the start of tobacco consumption (n= 7,232) through a multivariate analysis amongst smokers as seen in Table 7. The results revealed that those who started smoking prior to 11 years old were 2.5 times more likely to have COPD compared to their counterparts who started smoking at 19+ years old (95% C.I: 1.67- 3.95). Although people may start smoking at older ages, those who start at a younger age have a significant association with the development of COPD (p-value <0.001).

Table 8 presents the association between asthma and tobacco consumption while controlling for other factors. The results show that factors including sex, sense of belonging and in-home smoking were significantly associated with asthma. Smoking was not significantly associated with having asthma. Asthma impacted females more than males, with a 49% higher likelihood of having asthma observed in females compared to males (95% C.I. 1.37-1.63). Also, compared to those who did not experience in-home smoking, those who experienced in-home smoking had a prevalence of asthma 25% higher (95%C.I: 1.11- 1.41). Participants who reported a stronger sense of belonging were less likely to report having asthma.

Further investigation to assess the association between asthma and age of start of tobacco consumption, while controlling for other factors in Table 9, showed a significant association between people who started smoking at age 11 or younger and the presence of asthma. The results revealed that those who started smoking prior to 11 years old had a 50% higher prevalence of asthma compared to their counterparts who started smoking at 19+ years old (95% C.I: 1.06- 3.95).

Table 4: Distribution of Asthma and COPD overall and by respondents' characteristics

Variables	Categories	Asthma (%)	P-Value (Asthma)	COPD (%)	P-Value (COPD)
	All Participants	2,736 (13.2)		1049 (5.0)	
Age of Participant			0.003		<0.001
	15-18	257 (14.5)		19 (1.1)	
	19-24	654 (13.9)		57 (1.3)	
	25-34	362 (12.9)		48 (1.7)	
	35-44	303 (12.3)		73 (3.0)	
	45-54	303 (11.1)		137 (5.0)	
	55+	857 (13.6)		715 (11.4)	
Sex		2736 (13.2)	<0.001	1049 (5.0)	<0.001
	Male	1049 (10.8)		428 (4.4)	
	Female	1687 (15.2)		621(5.6)	
Tobacco Consumption		2732 (13.1)	0.093	1048 (5.1)	<0.001
	Daily	687 (12.3)		382 (6.9)	
	Occasional	214(12.9)		75 (4.5)	
	Not at All	1831(13.5)		591 (4.4)	
	Missing Values				
Age at Start of Tobacco Consumption (N = 7,232 Daily smokers + Occasional smokers)		652 (12.2)	0.021	359 (6.7)	<0.001
	<= 11 yrs	65 (17.2)		48 (12.7)	
	12-14	182 (12.3)		108 (7.3)	
	15-18	294 (11.7)		140 (5.6)	
	19+	111 (11.5)		63 (6.5)	
	Missing Values				
Age at Start of Tobacco Consumption (this variable is a interaction variable)		2736 (13.2)	0.011	1049 (5.0)	<0.001
	<= 11 yrs	65 (17.2)		48 (12.7)	
	12-14	182 (12.3)		108 (7.3)	
	15-18	294 (11.7)		140 (5.6)	
	19+	111 (11.5)		63 (6.5)	
	Smoker No Age	249 (13.3)		98 (5.2)	
	Non-Smoker	1831 (13.5)		591(4.4)	
Alcohol Consumption		1978 (12.8)	<0.001	638 (4.1)	<0.001
	<1 drink/ month	597 (15.1)		203 (5.2)	
	1-3 drinks /month	639 (12.7))		195 (3.9)	
	1 drink/week	311 (11.5)		87 (3.2)	
	2-3 drinks/week	270 (11.1)		70 (2.9)	

	3 drinks+ a week or everyday	161 (12.0)		83 (6.2)	
	Missing Values				
Multimorbidity		2674 (13.1)	<0.001	1016	<0.001
	0 chronic conditions	0		0	
	1 chronic condition	887 (18.1)		109 (2.2)	
	2 chronic conditions	557 (17.4)		196 (6.1)	
	3+ chronic conditions	1230 (39.1)		711 (22.6)	
	Missing Values				
In Home Smoking		2731 (13.1)	<0.001	1047 (5.0)	<0.001
	Yes	475 (15.0)		259 (8.2)	
	No	2256 (12.8)		788 (4.5)	
	Missing Values				
Sense of Belonging		2596 (13.2)	<0.001	986 (5.0)	<0.001
	Strongly Agree	548 (11.5)		297(6.2)	
	Agree	1001 (13.3)		380 (5.0)	
	Neither Agree nor Disagree	243 (13.8)		76 (4.3)	
	Disagree or Strongly Disagree	804 (14.3)		233 (4.1)	
	Missing Values				
Experience with Residential Schools		2005 (13.0)	0.009	739 (4.8)	<0.001
	Respondent Attended	159 (13.6)		108 (9.3)	
	Only Parent(s) OR Grandparent(s) Attended	331 (14.4)		99 (4.3)	
	Only Other Family Members Attended	119 (10.6)		47 (4.2)	
	Only Parent(s)/ Grandparent(s)/ Other Family Members Attended	441 (12.1)		163 (4.5)	
	Neither Respondent nor Any Family Members Attended.	955 (13.3)		322 (4.5)	
	Missing Values				

Table 5: Logistic Regression Model assessing the association of tobacco consumption and other Factors with COPD (N=20, 849)

		Adjusted OR			
Variables	Categories within Variables	Values	95% Confidence Intervals		P- Values
			Lower	Upper	
Tobacco Consumption	Non-Smoker	Reference Category			
	Smoker	1.52	1.31	1.76	<0.001
Age	15-18	Reference Category			
	19-24	1.34	0.75	2.39	0.32
	25-34	1.95	1.08	3.52	0.026
	35-44	3.41	1.94	5.98	<0.001
	45-54	5.63	3.28	9.66	<0.001
	55+	13.31	7.94	22.31	<0.001
Sex					
	Male	Reference Category			
	Female	1.24	1.08	1.42	0.002
In Home Smoking					
	Yes	Reference Category			
	No	1.61	1.36	1.91	<0.001
Sense of Belonging					
	Disagree or Strongly Disagree	Reference Category			
	Neither Agree nor Disagree	1.00	0.76	1.31	0.999
	Agree	1.04	0.88	1.24	0.632
	Strongly Agree	0.98	0.82	1.18	0.87
Alcohol Consumption	0 Drinks in the past 12 months	Reference Category			
	<1 drink/ month	0.85	0.71	1.02	0.086
	1-3 drinks /month	0.78	0.64	0.94	0.010
	1 drink/week	0.56	0.44	0.72	<0.001
	2-3 drinks/week	0.49	0.38	0.65	<0.001
	3 drinks+ a week or everyday	0.74	0.57	0.96	0.025

Table 6: Logistic Regression Model assessing the association of tobacco consumption and other Factors including SexbySmoking with COPD (N=20, 849)

		Adjusted OR			
Variables	Categories within Variables	Values	95% Confidence Intervals		P- Values
			Lower	Upper	
Tobacco Consumption	Non-Smoker	Reference Category			
	Smoker	1.29	1.03	1.61	0.027
Age	15-18	Reference Category			
	19-24	1.35	0.76	2.42	0.31
	25-34	1.96	1.08	3.54	0.025
	35-44	3.41	1.94	5.99	<0.001
	45-54	5.65	3.29	9.68	<0.001
	55+	13.31	7.94	22.31	<0.001
Sex					
	Male	Reference Category			
	Female	1.11	0.96	1.32	0.26
In Home Smoking					
	Yes	Reference Category			
	No	1.61	1.36	1.91	<0.001
Sense of Belonging					
	Disagree or Strongly Disagree	Reference Category			
	Neither Agree nor Disagree	1.00	0.76	1.31	0.999
	Agree	1.04	0.88	1.24	0.629
	Strongly Agree	0.98	0.82	1.18	0.840
Alcohol Consumption	0 Drinks in the past 12 months	Reference Category			
	<1 drink/ month	0.85	0.71	1.02	0.091
	1-3 drinks /month	0.78	0.64	0.94	0.010
	1 drink/week	0.56	0.43	0.72	<0.001
	2-3 drinks/week	0.49	0.38	0.65	<0.001
	3 drinks+ a week or everyday	0.74	0.57	0.96	0.024
SexBySmoking					
	Male	Reference Category			
	Female	1.31	0.99	1.73	0.51

Table 7: Logistic Regression Model assessing the association of age at start of tobacco consumption and other Factors with COPD among smokers (N=7,232)

		Adjusted OR			
Variables	Categories within Variables	Values	95% Confidence Intervals		P- Values
			Lower	Upper	
Age at Start of Tobacco Consumption	19+	Reference Category			
	15-18	1.09	0.79	1.52	0.572
	12-14	1.50	1.07	2.12	0.020
	11 or younger	2.57	1.67	3.93	<0.001
Age	15-18	Reference Category			
	19-24	0.76	0.27	2.17	0.611
	25-34	1.47	0.55	3.98	0.446
	35-44	3.00	1.17	7.74	0.023
	45-54	4.02	1.59	10.17	0.003
	55+	9.63	3.89	23.81	<0.001
Sex	Male	Reference Category			
	Female	1.59	1.25	2.02	0.001
In Home Smoking	Yes	Reference Category			
	No	1.59	1.26	2.01	<0.001
Sense of Belonging	Disagree or Strongly Disagree	Reference Category			
	Neither Agree nor Disagree	0.59	0.32	1.12	0.106
	Agree	1.30	0.95	1.78	0.099
	Strongly Agree	1.04	0.76	1.44	0.800
Alcohol Consumption	0 Drinks in the past 12 months	Reference Category			
	<1 drink/ month	0.66	0.46	0.93	0.018
	1-3 drinks /month	1.06	0.78	1.45	0.710
	1 drink/week	0.79	0.51	1.23	0.296
	2-3 drinks/week	0.66	0.47	1.06	0.083
	3 drinks+ a week or everyday	1.12	0.74	1.69	0.594

Table 8: Logistic Regression Model assessing the association of tobacco consumption and other Factors with Asthma (N= 10,849)

		Adjusted OR			
Variables	Categories within Variables	Values	95% Confidence Intervals		P-Values
			Lower	Upper	
Tobacco Consumption	Non-Smokers	Reference Category			
	Smokers	0.93	0.84	1.02	0.108
Age	15-18	Reference Category			
	19-24	1.03	0.87	1.22	0.770
	25-34	0.97	0.81	1.17	0.762
	35-44	0.91	0.75	1.10	0.343
	45-54	0.79	0.66	0.96	0.020
	55+	0.96	0.84	1.16	0.860
Sex					
	Male	Reference Category			
	Female	1.49	1.37	1.63	<0.001
In Home Smoking					
	Yes	Reference Category			
	No	1.25	1.11	1.41	<0.001
Sense of Belonging					
	Disagree or Strongly Disagree	Reference Category			
	Neither Agree nor Disagree	0.97	0.83	1.13	0.671
	Agree	0.92	0.83	1.02	0.128
	Strongly Agree	0.77	0.69	0.87	<0.001
Alcohol Consumption	0 Drinks in the past 12 months	Reference Category			
	<1 drink/month	1.02	0.90	1.15	0.739
	1-3 drinks /month	0.87	0.77	0.98	0.022
	1 drink/week	0.79	0.68	0.92	0.002
	2-3 drinks/week	0.77	0.66	0.90	0.001
	3 drinks+ a week or everyday	0.86	0.71	1.04	0.110

Table 9: Logistic Regression Model assessing the association of age at start of tobacco consumption and other Factors with Asthma among smokers? (N= 7.232)

		Adjusted OR			
Variables	Categories within Variables	Values	95% Confidence Intervals		P- Values
			Lower	Upper	
Age at Start of Tobacco Consumption	19+ yrs	Reference Category			
	15-18	0.99	0.78	1.27	0.970
	12-14	1.06	0.82	1.38	0.664
	<= 11 yrs	1.49	1.06	2.12	0.024
Age	15-18	Reference Category			
	19-24	1.22	0.79	1.88	0.365
	25-34	1.00	0.64	1.57	1.000
	35-44	1.02	0.65	1.59	0.941
	45-54	0.96	0.61	1.50	0.855
	55+	1.22	0.79	1.86	0.362
Sex					
	Male	Reference Category			
	Female	1.55	1.29	1.85	<0.001
In Home Smoking					
	Yes	Reference Category			
	No	1.42	1.19	1.69	<0.001
Sense of Belonging					
	Disagree or Strongly Disagree	Reference Category			
	Neither Agree nor Disagree	0.70	0.49	1.02	0.061
	Agree	0.81	0.66	1.00	0.054
	Strongly Agree	0.59	0.47	0.74	<0.001
Alcohol Consumption	0 Drinks in the past 12 months	Reference Category			
	<1 drink/ month	1.03	0.81	1.32	0.797
	1-3 drinks /month	0.85	0.67	1.09	0.206
	1 drink/week	0.99	0.74	1.35	0.982
	2-3 drinks/week	0.78	0.56	1.07	0.120
	3 drinks+ a week or everyday	0.84	0.58	1.21	0.356

4.3 Interaction of and SexBymoking

Sex was considered a variable which had the potential to be an effect modifier on the regression models for asthma and COPD. A 2-way ANOVA test was conducted to assess for interaction between sex and smoking. With regards to asthma, the interaction variable "Sex*Smoking" yielded a p-value of 0.868, which is not significant. Hence, sex in this sample does not modify the effect of smoking on asthma prevalence and was therefore not included in the regression analyses for asthma.

The 2-way ANOVA test for interaction between sex and smoking in COPD yielded a p-value of <0.001, making it necessary to include in the regression model. Table 6 showcases the results of this assessment. Female smokers had a 31% higher likelihood of having COPD compared to male smokers, but this relation was not significant (95% C.I :0.99-1.73, p-value 0.51).

Chapter 5: Discussion

This study aimed to assess the impact of tobacco consumption and other key factors on pulmonary diseases in the Indigenous population. Overall, the findings showed that 34.7% of the participants were smokers, 13.2% had asthma, and 5.0% had COPD. In general, age, sex, in-home smoking and sense of belonging were associated with smoking. COPD was associated with age, sex, in-home smoking and the age at start of tobacco consumption. Asthma was associated with sex, in-home smoking and a sense of belonging. The most striking finding in this study was that age did not have a significant association with the presence of asthma, whereas age did have an association with the presence of COPD.

5.1 : Age, In-Home Smoking, and Sense of Belonging: SDoH Associated with Smoking

The Social Determinants of Health (SDoH) framework was used in this study as a lens through which to analyze the impact of tobacco and other factors in the Indigenous population. This framework includes the proximal, intermediary and distal levels, showing direct and indirect factors that affect this population. At the proximal level, age had the most impactful relationship with smoking behavior. The 2020 Canadian Tobacco and Nicotine Survey found an increasing prevalence of smoking with increasing age (53). The higher prevalence of smoking in those aged 25-44 years found in this study could, in part, be attributable to the fact that they make up a high proportion of the workforce and face work-related factors, including work-related stressors, which could predispose them to use smoking as a coping mechanism (68). Additionally, peer pressure can play a role in younger smokers' uptake of the behavior and continuing it into their adult life (68).

At the intermediary level, this study found multimorbidity, in-home smoking and alcohol consumption also to have a significant likelihood of smoking. People who reported three or more

diseases had a higher likelihood of smoking, providing further evidence on the relationship tobacco has to the presence of chronic diseases such as asthma and COPD (68,69). Further, in-home smoking has been cited by many studies as directly or indirectly influencing an individual's exposure to smoking or smoking behaviors (70,71). In this study, individuals who were exposed to smoking in their homes were more likely to smoke themselves, which is in line with previously published studies (70,71).

The uptake of tobacco consumption among consumers of alcohol could be linked to a bidirectional relationship. Research has shown that individuals who smoke are more likely to consume alcohol, and individuals who drink are more likely to smoke (72). This was confirmed by the results of the present study, where individuals who consume alcohol either 3 times a week or every day had an increased likelihood of also smoking. This underscores the importance of targeting synchronous substance use when addressing tobacco consumption (68,72).

Unexpectedly, at the distal level, a sense of belonging displayed a contrasting trend in association with smoking. A majority of existing research shows that a lack of sense of belonging can influence individuals to pursue risky behavior, such as tobacco consumption (73). On the other hand, studies have found smoking to be a social activity. Individuals who partake in smoking may feel peer pressure to partake as a way to fit into their social networks (74). Additionally, individuals who feel a good sense of belonging make partaking in smoking an acceptable behaviour in their social group (74). It is important to note the way that the sense of belonging was measured in the APS. Individuals were asked if they strongly agree, agree, neither agree nor disagree, disagree or strongly disagree with the following statement: “ I have a deep sense of belonging to my [First Nations/ Métis/ Inuit/ Aboriginal] group. The categories being used in this variable may not be how a person feels throughout time. As this is a cross-sectional

study, the responses can only indicate how people felt at the time of data collection, but may not have felt that way at the time they picked up risky health habits such as tobacco and alcohol consumption.

5.2 Other factors associated with COPD and asthma

5.2.1 Age, Sex, Smoking, and Multimorbidity and their relationship with Asthma:

In the present study, smoking was not significantly associated with asthma. However, given the inverse and not expected direction, it is worth noting that it cannot be determined which came first in this particular sample, the smoking or the asthma. It is possible that having asthma discourages individuals from pursuing smoking in the first place, particularly considering that asthma develops in early childhood (6).

Considering the SDoH framework, age and sex were factors at the proximal level that showed an interesting relationship with asthma in this study. Previous studies have reported age as a significant factor to be considered in asthma-related research (60). This study found an increase in the likelihood of having asthma with younger age. This is consistent with other studies, which found fewer asthma cases in older adults. In fact, asthma is a disease commonly seen in children and youth (7,58). In 2011, Canadian statistics showed the proportion of asthma in children and youth was 62% higher than in adults (7). More so, the study findings showed that females had a 49% higher likelihood of having asthma than males. This is consistent with existing literature, where the rates are higher in females both in Canada and globally (7, 28). The Canadian Chronic Disease Surveillance System (CCDSS) has been tracking the prevalence of asthma and COPD in Canada over time, looking at differences in both age and gender. Over a span of 12 years, the CCDSS found a consistent trend of higher total prevalence in females compared to males (7). During the 2011-2012 fiscal year, the Canadian Chronic Disease

Surveillance System reported an asthma prevalence of 11.3% in females compared to 10.2% in males (7).

At the intermediate level, asthma had a significant association with the presence of in-home smoking. Previous published studies have shown that exposure to environmental pollutants, such as smoking, can contribute to the development of asthma (6,58) and individuals who are exposed to in-home smoking are especially vulnerable. The results of this study found that people with asthma had a 25% higher likelihood of experiencing in-home smoking. Similar to the association between smoking status and asthma, it is possible that the presence of asthma discourages others in the home from smoking or having consistent visitors who smoke.

5.2.2 :Age, Smoking, In-Home Smoking, and Multimorbidity and their relationship with COPD

As expected, smokers had a 50% higher likelihood of having COPD. This reinforces the impact tobacco consumption has on pulmonary diseases such as COPD (26,75). In addition to tobacco consumption, other proximal factors, including age, sex, and age at start of tobacco consumption, play a critical role in COPD. Increasing age of the participants was associated with an increased likelihood of having COPD, particularly amongst individuals 55+ years. This finding is consistent with COPD being a disease that typically presents itself later in life as a latent effect of exposure to pollutants such as tobacco (26). Also, being female was associated with an increased likelihood of having COPD, and this aligns with existing findings for Indigenous women (8). This gender gap can be attributed to a variety of factors, including tobacco consumption and exposure to other forms of pollution, such as secondary exposure to smoking in the home (26,76). As seen in this study, among smokers, females had a higher prevalence of COPD than males. Additionally, females are more likely to be exposed to in-home smoke as a result of cultural practices such as cooking or warming the home using products such

as wood or coal, which produce black carbon (77). Some Indigenous communities practice cultural methods of cooking and preserving game by burning wood indoors. This can expose those partaking in the practice, often women, to a higher risk (77,78). Individuals who are smokers who are also exposed to in-home burnings have a compounded risk as a result of these exposures (77,78).

Moreover, the age at which individuals begin smoking plays a critical role in COPD development. This study found that individuals who started smoking at age 11 or younger were 3 times more likely to have COPD compared to non-smokers. As COPD is a disease that develops later in life, early smoking initiation leads to longer cumulative exposure to tobacco. This compounds the effects that tobacco can have on the body, increasing the likelihood of developing diseases such as COPD (69).

Exposure to in-home smoking as an intermediary factor further increases the likelihood of having COPD than smoking (61%). This trend can be attributed to two key factors. As seen in the results, individuals exposed to in-home smoking are more likely to become smokers themselves, which increases their likelihood of primary exposure (26,75). Furthermore, those who are not influenced to smoke are being exposed to the pollutants of tobacco smoke, which can serve as a secondary exposure (26).

5.2.3 Colonialism continues to impact Indigenous health

Colonialism has an effect on the health of Indigenous people even today, through varied mechanisms. Residual effects of colonialism include racial discrimination when accessing health, the presence of intergenerational trauma, loss of cultural identity, barriers when accessing resources such as housing, substance abuse, and high rates of chronic diseases in the Indigenous community. The focus of this study was specific to chronic diseases, namely asthma and COPD,

but other factors contributing to the presence of diseases in this population are closely linked to the effects of colonialism. This study assessed the presence of smoking alongside factors such as alcohol consumption. Consistent with existing literature, there was a symbiotic relationship among smokers with increased alcohol consumption. Substance use has been shown to be a coping mechanism for intergenerational trauma (79)15/09/2025 9:56:00 AM and, as such, is contributing to the development of diverse chronic conditions.

Housing is another significant variable that emerged in this study and is potentially related to colonialism. Although an indicator for overcrowding had to be excluded due to too many missing values, another variable (in-home smoking) provided valuable insight. Individuals exposed to in-home smoking were more likely to smoke themselves and were more likely to have either COPD or Asthma. When the community is facing barriers in accessing resources such as housing, it forces people to live in overcrowded conditions, increasing exposure to in-home smoking.

The loss of cultural identity imposed on the Indigenous community by the Indian Act in 1887 meant not only forced cultural assimilation into colonial ways but also the loss of healing practices such as "Sundancing" and the use of traditional medicine. Individuals were removed from their land and their homes and forced into residential schools to cut them off from their language, their cultural practices, and the world they knew. This lack of traditional ways of healing, besides the discrimination Indigenous people face when accessing health care, means compounded health disparities. The findings in this study highlight the importance of addressing systemic factors that influence the health of Indigenous people. Implementing Indigenous-led health care that gives the community ownership of their identity can positively influence their health.

Chapter 6: Ethical Considerations

The researchers in this study have completed the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans Course on Research Ethics (TCPS 2: CORE). As the data being used is secondary data publicly available on the ODESI database, an exemption from the Lakehead University Research Ethics Review Board was requested. Nevertheless, the results of this research are expected to have an impact on the Indigenous community. Hence, consultation with community members was pursued for culturally informed advice on using the data (80). Additionally, this research upholds the core principles of Respect for Persons, concern for welfare, and Justice as they apply to Indigenous people. We acknowledge that the research must adhere to respect for Indigenous people by ensuring the knowledge generated from this research is available for the community to utilize throughout generations. To abide by concern for welfare is to address the collective nature of the Indigenous culture. This component is one of the main facets of this research, which aims to assess proximal, intermediary, and distal determinants of health through the Indigenous lens. Lastly, the principle of justice was upheld by consulting Lake University Elder Ron Linklater to gain insight and advice on Indigenous Health.

The researchers also acknowledge the First Nations Principles of OCAP. The data used in research and results from the study belong to the Indigenous community, who have a right to the management of the knowledge generated by the study and its accessibility both within and outside the Indigenous community (81).

Chapter 7: Strengths and Limitations Strengths

Strengths

Using a cross-sectional study is adequate for assessing the impact that age, sex, alcohol consumption, multimorbidity, in-home smoking, housing/overcrowding, sense of belonging, and experience with residential schools have on pulmonary diseases in conjunction with tobacco consumption. Additionally, the use of secondary data from a national survey provides a larger dataset, which is somewhat representative of the population (excluding those living on reserves) , and the survey weights provided in the public use microdata file (PUMF) contribute to better generalizable results for the Indigenous population living off reserve. Lastly, conversations with some members of the Indigenous community regarding health from an Indigenous lens helped inform this study.

Strengths: Indigenous Contribution to this Paper

On November 15, 2023, I had the opportunity to speak to Elder Ron Linklater at Lakehead University. Elder Ron provided great insight into the Indigenous perspective regarding health and "Aakozi" (Anishinaabemowin word for disease). For the Indigenous community, diseases that existed in the New World prior to colonization had existing traditional treatments. The community made use of what surrounded them, such as tree medicine or "wiikenh" (bitter root known as a treat-all plant) to treat diseases such as scurvy. When confronted with new diseases, the culture was forced to be malleable in an attempt to address them. However, when colonialists brought over new diseases, they eradicated between 8 and 9 out of 10 Indigenous people who may have had knowledge of traditional Indigenous medicine. Additionally, the banning of Indigenous practices such as "Sundancing" by Sir John A. McDonald took away a life-changing practice traditionally used for healing. As part of the impact of colonialism, Elder

Ron believes residential schools presented deadly worldviews that shifted how Indigenous people viewed each other, particularly views regarding individuals afflicted by disease. This created strife and conflict within the Indigenous communities.

Indigenous communities and cultures believe in Mother Nature as medicine and the power of "earth healing". Hence, illnesses are categorized into two groups. Cleansing illnesses are diseases such as the common cold, which run through your body, [essentially] cleansing your body. The second category is "teaching illnesses", which occur as the universe's way of redirecting a person. Illnesses such as addiction or HIV/AIDS are teaching illnesses. The experience of the AIDS epidemic in the 80s was a lesson that redirected the Indigenous communities back to their traditional ways. Colonial influences and government leadership had prevented Indigenous people dying of AIDS from being buried on Indigenous lands because the church forbade it. This experience forced the Indigenous people to turn back to the 7 grandfather teachings (humility, bravery, honesty, wisdom, truth, respect, and love).

Today, Elder Ron says, the Indigenous community views colonized people as being on a spectrum of trauma and not just high-functioning vs low-functioning, it is not a clear black-and-white experience. Many of the people who experienced residential schools later experienced health effects either directly from infectious diseases within the schools or in the form of chronic conditions that developed from the trauma. Despite all the challenges of colonialism, the Indigenous culture continues to persevere through discriminatory policy and the residual impacts of residential schools. “if you think of colonialism a sickness, it can be classified as a teaching illness”. The Indigenous community is using this experience as an opportunity to turn back to traditional ways of life and healing. Incorporating these teachings in the healthcare of Indigenous peoples can contribute to better health within this population.

Based on the Indigenous classification of diseases, asthma and COPD fall into the second category of "teaching illnesses". They are diseases that can develop in the presence of a combination of biological, sociodemographic and environmental factors, proposing important teachings that can be applied to both Indigenous and non-Indigenous populations. The dangers of consuming unhealthy substances such as alcohol and tobacco are a lesson for the global community, yet framing these teachings in a culturally relevant way can directly benefit the Indigenous population. At the same time, the impact of colonialism, structural racism, and systematic failure of the health system in relation to Indigenous peoples is a critical lesson best directed at Canada as a whole.

Limitations.

One of the limitations of this study is the inability to establish the direction of the relationship between the prevalence of diseases and the factors associated with them due to the cross-sectional nature of the design. Specifically, it was not possible to establish the etiology of asthma and whether it may be related to other causes, such as work. It was not possible to extract a direct line of causality, as this is a cross-sectional study. Also, different forms of bias may have affected this study, including participation bias, selection bias, and information bias. The sample selected for this study was identified from the 2016 Census. Participation bias may have been introduced because Indigenous individuals who chose to participate in the census (and therefore selected in the study) may differ from those who did not participate. Additionally, selection bias may have been encountered in this study due to the exclusion of Indigenous people living on reserves from the sample. Statistics Canada estimates 44.4% of First Nations were living on reserve in 2017 (82), excluding them from the survey, which can affect the odds ratio presented in this thesis, leaning them towards the null. Data from the on-reserve Indigenous population

would provide a deeper understanding of the burden of diseases in the population, as well as the cultural variables which may play a role. Data from the Canadian Community Health Surveys from 2015-2016 found a 40.3% prevalence of smoking amongst First Nations living on-reserves, higher than the 34.7% found in this study for off-reserves populations. (83). Similarly, this study found 13.2% of off-reserve population have asthma compared to 14.6% reported in on-reserve population (84). Unfortunately, data on the prevalence of COPD in on-reserve populations is currently unavailable, but the high prevalence of smoking in on-reserve populations highlights the need for such data.

The use of secondary data also posed some limitations on this study because the research was restricted by the data available in the survey. This limited the variables that can be included in the logistic regression model. In particular, it would have been beneficial to have questions regarding experiences of racism, particularly within the healthcare system, the geographical location of individuals by provinces and territories, and access to culturally relevant health care. This would have provided more insight into the distal social determinants of Indigenous health and how they influence access to healthcare or prevention services. Another limitation is the age cut-off for respondents. The Aboriginal People's Survey only surveys individuals who are 15 years or older, which means the health behaviors of those younger than 15 are not recorded. These limitations can be rectified in future Aboriginal People's Surveys by including more specific questions on structural racism and lowering the cut-off age for inclusion in the survey. Lastly, there were large amounts of unexplained missing values in key factors such as "experience with residential schools". Some of the variables provided sufficient explanations for why skipping them was permissible (e.g. when the question is not relevant based on a previous

answer). Unfortunately, this variable, which could have provided insight into the Indigenous experience, had missing values that could not be explained or accounted for in any way.

Chapter 8: Conclusion

8.1 Knowledge Contributions

There is limited research on the health of the Indigenous population in Canada. Often, literature on Indigenous populations combines Indigenous communities from Canada with the Indigenous populations from Australia, New Zealand, and the United States. Though insightful information is generated, it takes away the unique cultural identity of Indigenous people in Canada, which plays a role in the health status of this population. Quantifying the relationship between tobacco consumption and asthma, as well as tobacco consumption and COPD in the Indigenous population, can inform how to best allocate resources and implement interventions appropriate for this population. Additionally, looking at the characteristics associated with levels of tobacco use in the Indigenous community can help identify where smoking cessation programs should be targeted. Through the lens of the Social Determinants of Health of Aboriginal People Framework, culturally appropriate measures can be implemented that address asthma, COPD, and tobacco consumption from a holistic perspective by implementing smoking cessation programs that target proximal, intermediary, and distal factors.

8.2 Recommendations and conclusion:

This study found age and sex to have a significant relationship with smoking habits; women and people aged 25-44 years were more likely to partake in smoking. This highlights the need for a more targeted tobacco cessation program in this group to mitigate the impact of smoking-related adverse health effects for this group. Additionally, this study found a higher prevalence of asthma among individuals who did not smoke; hence, understanding the direction and the details that influence this relationship can be helpful in alleviating the burden of disease and tobacco consumption in the Indigenous community. Further, understanding why the trend for

asthma flips after puberty and females have higher rates after this time could provide insight into how to implement targeted interventions. These findings highlight the need for more tailored interventions to promote healthy behavior in female smokers, as well as understanding the genetic and sociocultural impacts of sex on asthma. Lastly, in-home smoking very consistently has a significant association with the likelihood of individuals smoking themselves, as well as the likelihood of individuals having asthma or COPD. This emphasizes the need for policies targeting smoke-free homes to reduce the risk of diseases, particularly for young children. Interventions for smoke-free homes can also influence the prevalence of individuals who partake in smoking as a learned behavior from those around them in the home. All measures must be developed using the Indigenous lens, and the Indigenous experiences of health, as well as the culture of the community, should be considered.

Appendix A

Ethics Approval Letter

Lakehead UNIVERSITY

Research Ethics Board
t: (807) 343-8283
research@lakeheadu.ca

February 13, 2024

Attention: Dr. Anna Pefoyo Kone, Dr. Sam Essien and Hasina Hamdan

Via Email: akonepe@lakeheadu.ca, sessien@lakeheadu.ca, hhamdan1@lakeheadu.ca

RE: Secondary use of non-identifiable data – Research Ethics Board exemption

Dear Drs. Kone and Essien, and Hasina:

Thank you for providing the Lakehead University Research Ethics Board information regarding your project titled, "The Extent of Tobacco Consumption in Indigenous Population in Association with Pulmonary Diseases." The study is a secondary analysis of publicly available anonymous data from the Aboriginal Peoples Survey 2017. It will address the following two questions: 1. What is the prevalence of tobacco consumption and associated characteristics overall and within specific demographic groups in the Indigenous population? 2. What is the magnitude of the association between tobacco consumption and pulmonary diseases, namely COPD and asthma, in the Indigenous population?

The de-identified data that you are using meets the criteria of the Tri-Council Policy Statement 2 (TCPS 2), Chapter 2, Article 2.4, exemption from Research Ethics Board review, as it involves secondary use of anonymous information and there is no opportunity of re-identification of this information through your analysis.

"REB review is not required for research that relies exclusively on secondary use of anonymous information, or anonymous human biological materials, so long as the process of data linkage or recording or dissemination of results does not generate identifiable information."
~TCPS 2, Chapter 2, Article 2.4

Also, there is no requirement for Research Ethics Board review for use of a database such as the Aboriginal Peoples Survey under TCPS 2, Chapter 9, "Secondary Use of Information or Human Biological Materials Identifiable as Originating from First Nations, Inuit and/or Métis Communities or Peoples."

If the above process related to your project changes, please contact the Research Ethics Board. On behalf of the Lakehead University Research Ethics Board, I wish you success with your research study.

Sincerely,

Dr. Claudio Pousa
Chair, Research Ethics Board

/dg

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