

**Factors associated with HIV among First Nation living off reserves, Métis, and
Inuit persons**

by

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ABSTRACT

FACTORS ASSOCIATED WITH HIV AMONG FIRST NATION LIVING OFF RESERVES, MÉTIS, AND INUIT PERSONS

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Human immune deficiency virus (HIV) disproportionately affects the Indigenous Peoples of Canada and requires further research. For this thesis, data from the 2006 Aboriginal Peoples Survey were analyzed to better understand (1) demographic factors and comorbidities associated with a positive HIV diagnosis, and (2) social determinants of health for HIV among First Nation living off-reserve, Métis, and Inuit persons.

Multivariable logistic regression modeling was used to identify factors associated with a positive HIV diagnosis. Higher adjusted odds of HIV-positivity were associated with hepatitis B, hepatitis C, tuberculosis, asthma, and cancer, as well as among those reporting a male same-sex married or common-law partner, those in the second lowest income quartile, those who were unemployed, and those whose parent or grandparent had been a student at a residential school. Lower adjusted odds of positive HIV diagnosis were among those who had not completed high school, and those who lived with one or more other person.

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LIST OF ABBREVIATIONS

APS	Aboriginal People's Survey. Usually referring to the 2006 edition.
AOR	adjusted odds ratio
CI	confidence interval
HIV	human immunodeficiency virus
IDU	injection drug use
MSM	men who have sex with men
PHAC	Public Health Agency of Canada

CHAPTER 1: INTRODUCTION, LITERATURE REVIEW, THESIS RATIONALE, AND THESIS OBJECTIVES

INTRODUCTION

The research described in this thesis summarizes analytical work on national survey data of persons who self-report Indigenous identity or ancestry. The 2006 Aboriginal Peoples Survey comprises information about whether or not respondents had been told that they have human immunodeficiency virus (HIV), as well as demographic information, and indicators of social and economic conditions. This project studies (1) the prevalence of, and factors associated with, receiving a positive HIV diagnosis among this population and (2) social determinants of health for HIV that include measures of socioeconomic status, health services, social support, cultural continuity, and residential school experiences that are associated with a positive HIV diagnosis among this population.

In this thesis, the term Indigenous is used to include First Nations (Status and Non-Status), Métis, and Inuit persons. First Nations persons who were living on reserves in the provinces were not included in these data, and therefore findings cannot be extrapolated to these persons. We also recognize that First Nations, Métis, and Inuit persons belong to distinct populations with unique cultural, linguistic, geographic and historic characteristics [1 – 3]. However, it is argued that Indigenous populations nevertheless share common social, economic, and political experiences, in large part due to effects of imperialism and colonization [1, 3, 4, 5]. This report acknowledges these important distinctions, and presents evidence where possible about differences between First Nations, Inuit and Métis people relating to demographic characteristics and factor which impact vulnerability to, and resiliency against HIV, and the research and response initiatives necessary for these unique populations.

LITERATURE REVIEW

HIV Prevalence in Canada

The first case of HIV/AIDS reported in Canada was in March of 1982, although cases in 1979 have since been retrospectively diagnosed [6, 7]. In the 1980s, the prevalence of HIV in Canada rose steadily among the total population, and sharply among men who have sex with men [8, 9]. Through the 1990s, the prevalence rate leveled off, likely the combined result of the high initial mortality rate followed by a reduced transmission rate because of successful prevention programming [10]. Beginning in the late 1990s, there was a shift towards injection drug use (IDU) becoming a common route of exposure to the virus (35% of prevalent cases at its highest in 1996) [11]. Between 1985 and 2011, an estimated 24,300 Canadians living with HIV died [12].

The Public Health Agency of Canada (PHAC) makes epidemiological estimates of HIV prevalence and incidence every three years, using multiple methods of statistical modeling [12]. They estimated that the number of people living with HIV (including AIDS) in 2011 was 0.21% or 71,300 (95% Confidence Interval [95% CI] 58,600 – 84,000) [12]. This was an increase of 11.4% from the 2008 estimate of 0.19% 64,000 (95% CI 53,000 – 75,000) [12]. The 2008 estimates in turn represented a 14% increase from the 2005 estimate of 0.18% or 57,000 (95% CI 47,000 – 67,000) [13]. These increases are due to the rate of new infections surpassing the rate of HIV-related deaths. It is estimated that new treatments will continue to reduce HIV mortality, which some argue will necessitate increased care requirements to manage the increasing overall number of Canadians living with HIV infection [8, 12].

HIV Incidence in Canada

Annual surveillance reports include estimates of prevalence, or the number of people living with HIV, and incidence, the number of new infections in a one-year period. Incident cases among Canadians have been shown to be increasing between 2005 and 2011 [14], but the incidence rate among the population remained fairly steady in during that period. Although estimates of the number of new HIV infections are uncertain, the number of new infections in 2011 was estimated at 3,175 (95% CI 2,250 and 4,100 [14]), comparable to the estimate in 2008 (3,335; 95%CI 2,370 - 4,300 [12]), and 2005 (3,200; 95%CI 2,200 – 4,200 [13] This comprises approximately 0.01% of the total Canadian population across each of the three estimation years in 2005, 2008, and 2011.

Routes of exposure to HIV in Canada

HIV infections are also classified by exposure category. In 2008, prevalent infections were highest among men who have sex with men (MSM) (45.1% of positive HIV test reports) followed by injecting drug users (IDU), which comprised 17% of positive HIV test reports [11]. Heterosexual exposure accounted for 31% of prevalent cases, half of those represented a smaller subcategory specific to those whose likely route of HIV exposure is from an HIV-endemic country, which are concentrated in the Caribbean and sub-Saharan Africa [11]. In 2011, Men who have sex with men (MSM) again comprised almost half of the individuals living with HIV (46.7%), followed by those who acquired their infection through heterosexual contact and were not from an HIV-endemic region (17.6%), followed by those who acquired their infection through injection drug use (IDU) (16.9%) and finally those exposed through heterosexual contact that were also from an HIV-endemic region (14.9%) [15]. With respect to incident cases by exposure category, MSM continued to comprise the greatest proportion (46.6%) of new infections in 2011, approximately the same proportion as they comprised in 2008 (44.1%) [12].

In 2011, the proportion of new infections among those reporting IDU was also similar to 2008 (13.7% compared to 16.9%) [12]. The proportion of new infections attributed to the heterosexual/non-endemic and heterosexual/endemic exposure categories were about the same in 2011 compared to 2008 (20.3% vs 20.1% and 16.9% vs 16.2%, respectively) [12].

HIV among Women in Canada

At the end of 2011, there were an estimated 16,600 (13,200–20,000) women living with HIV (including AIDS) in Canada [14] or 23.2%. This is proportionally comparable to the estimated 14,740 (11,980–17,500) for 2008, which accounted for 23.3% of the national total that year [14]. There were an estimated 755 (510 to 1,000) new HIV infections among women in Canada in 2011, while the corresponding figure for 2008 was 865 (630 to 1,100) [14]. The proportion of all new infections among women was also slightly lower in 2011 compared to 2008 (23.8% versus 25.9% [14]). With respect to exposure category, a slightly lower proportion of new infections among women were attributed to IDU in 2011 compared to 2008 (23.4% versus 28.3%), whereas a slightly higher proportion was attributed to the heterosexual exposure category (endemic and non-endemic combined) (76.6% in 2011 compared to 71.7% in 2008 [14]).

Undiagnosed HIV infections in Canada

HIV and AIDS surveillance data do not include individuals who are untested and undiagnosed. In order to include both diagnosed and undiagnosed individuals, modeling techniques based on additional sources of information are necessary.

A total of 74,174 positive HIV tests have been reported to CCDIC between November 1985 when testing began and December 31, 2011 [15]. After adjusting for underreporting and duplicates, there were a cumulative total of approximately 77,620 persons diagnosed with HIV in

Canada by the end of 2011. Of these, it was further estimated that approximately 24,300 individuals have died. Therefore an estimated 53,320 (77,620 minus 24,300) Canadians were diagnosed with HIV infection in 2011 and were therefore aware of their HIV status [12]. Since there was an estimated total of 71,300 persons living with HIV in Canada in 2011, the remaining 17,980 (95%CI 14,500–21,500) persons, or 25% of prevalent cases, were unaware of their HIV infection (compared with an estimated 16,900 in 2008 [12]). This proportion matches the estimate of 26% who were unaware of their HIV status in 2008. [12] This group is hidden from health care monitoring and disease surveillance systems; they cannot take advantage of appropriate care and treatment services; and they cannot receive counseling to prevent further spread of HIV [12].

The estimated proportion of people living with HIV who were unaware of their HIV status varied by exposure category in: approximately 20% and 24% of people living with HIV infection in the MSM and IDU exposure categories, respectively, were unaware of their HIV infection, whereas there was a much higher proportion of people who were unaware of their HIV infection (34%) in the heterosexual exposure category (endemic and non-endemic combined [12]).

Indigenous Populations in Canada

In 2006, the census enumerated 1,172,790 people who self-reported Indigenous identity, representing 3.8% of the total Canadian population[16]. Of these, 59.5% of Indigenous persons self-identified as First Nations, 33.2% as Métis and 4.3% as Inuit [17]. Between 1996 and 2006, the Indigenous population grew by 45%, compared with 16% among the total Canadian population during the same time period. [13] In 2011, this population grew to 4.3% of the population, or 1,400,685. [18]

HIV Prevalence among Indigenous Populations in Canada

Before 1998, race or ethnicity data was not submitted for positive HIV test reports in Canada. Indigenous people continue to be over-represented in the HIV epidemic in Canada, highlighting the need for specific measures to address the unique aspects of certain populations and communities. An estimated 6,380 (5,160 to 7,600) Indigenous people were living with HIV (including AIDS) in Canada at the end of 2011 [12], or 0.46% of all persons who self-reported Indigenous ethnicity that year. In 2011, this comprised 8.9% of all prevalent HIV infections in Canada, which represented an increase of 17.3% from the 2008 estimate of 5,440 (4,380 to 6,500; 0.42% prevalence among Indigenous persons; comprising 8.5% of all prevalent infections in 2008[14]). According to studies focused on epidemics in British Columbia, HIV infections among Indigenous persons tend to be diagnosed at younger ages in IDUs [19, 20], and among the general population in IDUs [21] and women who are engaged in sex work [22].

HIV Incidence among Indigenous Populations in Canada

An estimated 390 (280 to 500) new HIV infections occurred in Indigenous people in 2011 (12.2% of all new infections), slightly fewer than the 420 (290 to 550) new infections in 2008 (12.6% of all new infections in 2008) [14]. The overall new infection rate among Indigenous people was 3.6 times higher than among the non-Indigenous population in 2011, unchanged from the estimate in 2008.[14]

Routes of exposure to HIV among Indigenous Populations in Canada

There is evidence that predominant routes of exposure to HIV differ amongst those who self-report Indigenous identity. Unlike the general Canadian population, injection drug use is the main category of exposure to HIV for both males and females who report Indigenous ethnicity. [6, 11 – 16, 23]

The exposure category distribution for new HIV infections in 2011 among this population was 58.1% IDU, 30.2% heterosexual, 8.5% MSM and 3.1% MSM-IDU [23]. This compares to the following distributions for this population in 2008: 63.4% IDU, 28.3% heterosexual, 6.0% MSM and 2.4% MSM-IDU [23]. There are notable differences in exposure categories between Indigenous and non-Indigenous HIV case reports. The proportion of HIV-positive test reports whose exposure can be attributed to heterosexual contact is similar between both groups, at 28.4% prevalence among Indigenous people and 31.7% among Non-Indigenous people in 2008 [11]. In contrast, among reports for individuals who indicate Indigenous ethnicity, a higher proportion of positive HIV test reports were attributed to IDU, at 60% compared with 17% among reports of other ethnicities, and a smaller proportion of exposures were attributed to MSM, at 6.5% among those who report Indigenous ethnicity compared to 39.9% among reports of other ethnicities[11].

HIV distribution by sex among Indigenous Populations in Canada

In contrast to HIV cases in the non-Indigenous population, females make up a comparatively large portion of the Indigenous HIV epidemic. Indigenous women represented 48.8% of all positive HIV test reports that indicated Indigenous ethnicity between 1998 and 2008, much higher than females who indicated other ethnicities, who comprised 20.6% of all positive HIV test reports for other ethnicities during the same period [11]

There were about the same proportions of women among Indigenous people living with HIV/AIDS as of 2011 compared to 2008 and 2005; however, there were estimated to be slightly fewer new infections occurring among Indigenous women in 2011 compared to earlier estimation periods.[20]

The exposure category distribution of reported HIV cases among females who self-report Indigenous ethnicity differs from the distribution among females who self-report other ethnicities. Between 1998 and 2012, 63.6% of positive HIV test reports were attributed to IDU, followed by heterosexual contact at 34.8% [14]. This contrasts with 24.4% IDU and 72.1% heterosexual contact among females of other ethnicities [14].

Sources of national surveillance data

Sources of national HIV surveillance data among Indigenous people are limited. The Aboriginal Peoples Survey (APS) is a cross sectional survey carried out by Statistics Canada that focuses on assessing issues related to health, language, employment, income, schooling, housing, and mobility among Indigenous peoples across Canada.[23] Many of these sections have specific variables that have been identified as factors that may influence the HIV disparities for Indigenous people. The target population includes all people living in Canada who have North American Indian, Métis or Inuit identity or ancestry, excluding people living in settlements or on-reserves. It was first conducted in 1991, and has been expanded to include over 50,000 people in each survey period since 2001. [23]

Challenges with national surveillance data relevant to Indigenous populations

Reporting on HIV and AIDS cases among Indigenous populations is challenging because information on ethnicity was not always reported by all provinces and territories. Until 2012, Ontario and Quebec did not report information on ethnicity for positive HIV tests. [25] Between 1979 and the end of 2008, information on ethnicity was reported for only 29.8% positive HIV test reports .[25] As a result, data on the incidence and prevalence of HIV among Indigenous populations in Canada is incomplete and may misrepresent the extent of the epidemic among the distinct populations who identify as Indigenous in Canada.

Comorbid illnesses experience by HIV-positive persons

With the recent advances in antiretroviral therapy, individuals are living longer with HIV and experiencing less severe morbidity associated with the disease [26 - 28]. Disease management has shifted towards mitigating the long-term health effects of HIV [29, 30]. One of these effects is an increased susceptibility to both infectious and non-infectious comorbid diseases. Well-researched is the association between HIV and hepatitis C. [33-37] Research has determined that HIV/HCV co-infectivity is especially common among IDUs[38 – 41], people with severe mental illness[39] and individuals involved in sex work.[42] There is also a well-established link between *M. tuberculosis* infection (TB) and HIV [43 - 48] HIV has been shown to increase the risk of developing TB infection, although it has not been determined whether these TB cases are new infections or a relapse (reactivation) of latent TB case [44, 51]. Other studies have found increased prevalence of respiratory illness among HIV positive individuals, such as asthma [52 - 53] and increased frequency of chronic bronchitis symptoms. [41] Previous research has found an association between HIV status and respiratory complications due to smoking. Another study indicated that HIV-infection is an independent risk factor for respiratory complications after reporting a 15% prevalence of emphysema among 114 consecutive HIV-positive patients, compared with 2% among 44 HIV-negative controls that were matched by age, sex, and smoking status [57]. It has not been determined whether HIV infection is a risk factor for developing respiratory complications, or increased rates of respiratory complications among HIV-positive persons can be attributed to the higher odds of smoking [56 - 58], drinking [59] or drug use [60], which have been shown in previous research to be associated with HIV status.

Social Determinants of Health for HIV among Indigenous persons

In 2005, Statistics Canada projected the life expectancy at birth for the total population of Canada to be 83 years for females and 79 for males by the year 2017 [61]. First Nations, Métis and Inuit were projected to live shorter lives of 78, 80, and 73 respective years for females, and 73, 74, and 64 for males[61]. The projections for First Nations and Métis people born in 2017 are comparable to estimates for the total population in 1991, when females were expected to live to 81 and males to 75 [62]. Life expectancy among the general population has exceeded 2017 projections for the Inuit for even longer, since 1961 for females (74) [63] and since 1946 for males (65 [64]). These inequalities in longevity result from a confluence of health disparities, which collectively arise from broad social, economic, political, and cultural systems that have disadvantaged Indigenous people over generations.[65 – 70]. Conditions that result from these systems, and their distribution across the population are collectively referred to as the social determinants of health. It has been argued that social determinants are linked to the disproportionate burden of HIV borne by those who identify as Indigenous [65; 71 – 73].. A 2009 study on factors associated with HIV testing among persons who self-reported Indigenous ethnicity used a multivariable model to analyze the 2001 APS. The research findings identified female gender, younger age, unemployment, contact with a family doctor or traditional healer within the past year, and “good” or “fair/poor” self-rated health with increased odds of having had an HIV test [74]. Completion of high-school education, rural residency, and less frequent alcohol and cigarette consumption was associated with decreased odds of having had an HIV test. [74]

THESIS RATIONALE

This thesis is a summary of epidemiological work conducted on the 2006 cycle of the Aboriginal Peoples Survey (APS). The 2006 APS is a voluntary post-censal survey of 29,500 persons across Canada aged 15 and over who self-report Indigenous identity or ancestry and are not living on a First Nation reserve [24]. This project comprised an exploratory analysis of the 2006 APS in an attempt to address fundamental yet unanswered questions about the HIV epidemic among persons who self-report having Indigenous ethnicity . These include: What is the prevalence of HIV among this population at a national level? How does the prevalence compare to estimates that include First Nation on-reserve individuals, and to estimates of HIV prevalence among Indigenous persons within smaller, regional epidemics? What age-, sex-, and income- adjusted factors are associated with receiving a positive HIV diagnosis among individuals who self report Indigenous ethnicity? Are comorbid illnesses, which have been found at higher rates among HIV-positive Canadians, associated with a diagnosis of HIV in this population? How do social determinants of health impact Indigenous persons who report a positive HIV diagnosis, and in what ways do they compare to and contrast with the determinants associated with HIV among the general population of Canada?

The project that this thesis summarizes sought to identify factors associated with HIV among persons who report Indigenous ethnicity in Canada. The purpose of this research, to conduct multivariable modeling of factors associated with HIV among Indigenous persons had not been previously conducted with a national level sample.

OBJECTIVES

The objectives of this research were as follows:

- 1) To determine the national prevalence of HIV in Canada for 2006 among individuals, who self report Indigenous identity or ancestry, aged 15 and older, excluding First Nation individuals living on reserves in the provinces.
- 2) To identify demographic factors associated with having a positive HIV diagnosis among this population (Chapters 2 and 3)
- 3) To identify comorbid illnesses associated with having a positive HIV diagnosis among this population (Chapter 2)
- 4) To examine social determinants of health associated with having a positive HIV among this population, and to compare these determinants to the complex factors associated with HIV among other ethnicities (Chapter 3)

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**CHAPTER 2: DEMOGRAPHIC FACTORS AND COMORBIDITIES
ASSOCIATED WITH HIV AMONG FIRST NATION LIVING OFF RESERVE,
MÉTIS, AND INUIT PERSONS**

ABSTRACT

Background The objective of this study was to identify factors associated with an HIV positive diagnosis among Canadians with Indigenous identity or ancestry. **Methods** Data were collected from the 2006 Aboriginal Peoples Survey, representing a weighted sample of 998,870 First Nation, Métis and Inuit persons. Putative comorbidities and demographic factors associated with an HIV positive diagnosis were identified. **Results** Multivariable logistic regression regression was used to identify factors associated with the outcome. A lower odds of HIV positivity was associated with self-reporting as: female (compared to male); between ages 15-19, 20-29, and 60 or older (compared to ages 30-39); living in an urban area (compared to a rural area or Inuit Nunaat); drinking alcoholic beverages one to three times a month (compared to once a week); and never having smoked (compared to currently a smoker) ($p < 0.05$). Higher adjusted odds of HIV positivity were associated with Hepatitis B, Hepatitis C, tuberculosis, asthma, chronic bronchitis, and cancer, as well as among those reporting a male same-sex married or common-law partner, and those in the second lowest income quartile (compared to the highest quartile). **Conclusion** These findings indicate a need to further investigate the prevalence and effects of comorbid illnesses among persons living with HIV who self-report Indigenous identity in Canada.

Keywords HIV; Indigenous; Comorbidities; Canada; Inuit; Métis; First Nations; Aboriginal Peoples Survey

INTRODUCTION

Indigenous Peoples bear a disproportionate burden of chronic illness in Canada [1,2]. Individuals who self-report Indigenous identity are over-represented in Canada's HIV epidemic. While Indigenous people comprised 3.8% of the Canadian population in 2008, they represented 8.5% of prevalent infections, and 12.6% of incident infections [4]. Between 1998 and 2008, 29.4% of all HIV-positive test reports that included ethnicity data reported Indigenous ethnicity [5]. The overall new infection rate among Indigenous people in Canada in 2008 was 3.6 times higher than among the non-Indigenous population [4].

Predominant routes of HIV exposure also differ among Indigenous people compared to the general Canadian population. According to 2008 surveillance data, in the non-Indigenous population, 44.1% of estimated incident HIV infections in 2008 were epidemiologically categorized as men who have sex with men (MSM), followed by heterosexual contact (36.3%), and injection drug use (IDU) exposure categories (13.7%) [4]. Of positive test results for HIV among Indigenous people in 2008, exposure was thought to be due to IDU in 66% of the cases, followed by 23% for heterosexual exposure, 9% for MSM and 2% for a combination of both MSM and IDU [6].

HIV affects a higher proportion of females in Canada who self-report Indigenous identity than among those who do not. Females made up nearly half (48.8%) of all new positive HIV test reports among Indigenous people between 1998 and 2008, while among non-Indigenous persons they accounted for only 20.6% of positive HIV test reports during the same period [6].

According to the 2006 census, the median age of individuals who identify as Indigenous was 27, compared to 40 in the non-Indigenous population [7]. Between 1996 and 2006, the Indigenous population grew by 45%, compared with 8% for the non-

Indigenous population [6]. According to available data of positive test reports, Indigenous youth are at increased odds for HIV compared to youth of other ethnicities. Individuals aged 15-29 represented 32.6% of positive HIV test reports among those who identified as Indigenous compared to 20.5% of reports among other ethnicities from 1998 to the end of 2008 [6].

Ethnicity-specific HIV/AIDS surveillance is made difficult by sparse ethnicity reporting practices among the provinces and territories. Ontario did not include ethnicity information until 2009, and Quebec does not report information on race or ethnicity [9]. Only 29.8% of new positive HIV test reports between 1998 (when ethnicity reporting began) and the end of 2008 included information on ethnicity [6]. For the total population in 2008, it was estimated that 26% of people living with HIV in Canada were not aware of their HIV-positive status [10]. As a result, data on incidence and prevalence of HIV among populations in Canada likely under-represents the extent of the epidemic. A systematic review of available HIV incidence and prevalence estimates among Indigenous peoples demonstrated that data from BC is overrepresented in Canada, accounting for 34 of the 46 included studies [10]. These studies focus on the concentrated HIV epidemic among injection drug users and female sex workers in Vancouver, subgroups which were estimated to have 17.0% and 26% HIV prevalence respectively in 2006.

The introduction of highly effective combination antiretroviral therapy (ART) for HIV treatment has dramatically decreased HIV-associated morbidity and mortality, meaning more people are living with HIV infection for a longer time [11]. Illnesses considered to be a consequence of immunodeficiency are becoming less prevalent, and now up to half of the deaths observed among ART-experienced HIV-positive patients have been

attributed to noninfectious comorbidities such as liver damage, cardiovascular disease, hypertension, and mental or physical disability [12]. Little is known about the prevalence of comorbidities among the HIV-positive Indigenous population. Epidemiological models that combine infectious and non-infectious HIV comorbidities with relevant demographic variables may help characterize the disease course with which HIV-positive people who identify as Indigenous contend. The objective of this study, therefore, was to identify demographic factors and co-morbidities associated with HIV status among self-identified First Nation living off reserve, Métis, and Inuit persons in Canada, using 2006 Census-follow-up surveillance data.

METHODS

Data sources and study population

Data were drawn from the 2006 Aboriginal Peoples Survey (APS), a voluntary, cross-sectional survey of Canadian Aboriginal people ages 15 and over. The term “Aboriginal” is used in the Survey to comprise individuals who self-reported North American Indian (hereafter referred to as First Nation), Métis, or Inuit identity or ancestry. Individuals who reported Treaty Indian or Registered Indian status as defined by the Indian Act of Canada were also included, as well as those who reported as a member of an Indian Band or First Nation [13]. This paper has employed this definition for usage of the term, “Indigenous” throughout. The 2006 Census enumerated a total of 1,172,790 people who identified themselves as an Indigenous person, with 1.7 million people reporting at least some Indigenous ancestry. For this study, three separate dichotomous variables were used to indicate self-reported identity or ancestry as First Nation, Métis and/or Inuit.

All Indigenous people in the territories were included in the 2006 APS, while individuals living on reserve in the provinces were not included [13]. From the 2006 Canadian Census, it was estimated that 40% of individuals who identify as Indigenous or have Indigenous ancestry were living on a reserve [14].

Residents of institutional dwellings (i.e. hospitals, physical and mental treatment centres, nursing homes, group homes, jails, or shelters) were not included in the 2006 APS or Census [13]. The response rate for the 2006 APS was 80.1% (87.1% among Inuit Nunaat and 79.3% among the general population of Canada) [13]. Demographic information from the 2006 Census was appended to the APS. Population weights were calculated as the inverse of the inclusion probability, and then adjusted for nonresponse and discrepancies with known Census totals. Bootstrap weights were also provided in order to adjust for sampling methodology. Detailed sampling and survey methodology may be found in the APS Concepts and Methods Guide [13].

Measures

Respondents who answered, “yes” to the question, “Have you been told by a doctor, nurse or other health professional that you have HIV?” were classified as HIV-positive. These respondents were compared to those who answered “no”. Those who answered, “Don’t Know,” “Refused,” or “Not Stated” to the question were excluded from the sample to produce a dichotomous dependent variable. The entire final weighted sample was 998,870 (rounded to the nearest 10 according to Statistics Canada guidelines).

The APS included questions regarding other comorbidities and demographic variables previously shown to be associated with HIV. Putative comorbidities included arthritis/rheumatism, asthma, cancer, chronic bronchitis, emphysema, hepatitis B and C,

high blood pressure, stroke, and tuberculosis. Demographic variables of interest were age group by decade, sex, ethnicity group (First Nations, Metis, or Inuit), residence on census day (urban, rural, or Inuit Nunaat), total income (cut into quartiles), frequency of alcohol consumption, and smoking status (former, current, or never). A proxy indicator for MSM was created from males who reported having a same-sex married or common-law partner. This variable did not capture individuals who were MSM and were not in a married or common-law relationship, but was the only data available on male same-sex activity. Information on injection drug use was not collected through APS. Missing values for total income were imputed with median values. Individuals with missing values (i.e. responses of “Don’t Know,” “Refused,” or “Not Stated”) for the dependent or independent variables were excluded from the sample. Table 2.1 contains a complete list of variables considered putative factors.

Analyses

Statistical analysis was conducted using Stata 13.0 for Windows (USA). All commands were executed with population and bootstrap weights as discussed above. Independent variables were screened at a liberal p-value of $p < 0.2$ (20%), by regressing HIV status on putative factors using univariable logistic regression. A main-effects model was constructed from the liberally significant variables. Variables from the main effects model were analyzed for confounding by comparing the coefficient from univariate regression to the coefficient when each additional explanatory variable was added in turn. A variable was determined to be a confounder if the coefficient of another independent variable changed by more than 20% when the variable was added to the model. If the added variable was not considered to be an intervening variable, it was included in the model. All tests

were two-tailed with a statistical significance level of $p < 0.05$ (5%). Variables that were not included in the model were added back into the final model to examine potential confounding. Using a manual backwards-stepwise procedure, variables that were not significant in the main-effects model were removed one at a time, beginning with the variable with the largest p-value. An adjusted Wald test statistic (F-statistic) was used to determine appropriateness of variable removal, in place of a likelihood ratio test, given that likelihood estimation assumptions are not met with complex survey data [15,16]

RESULTS

Study population

A weighted total of 30,600 individuals were dropped due to incomplete data to produce a final weighted sample of 998,870 for analysis. The study population was approximately 60% First Nation, 55% female, 73% urban, and a mean age of 39 years. Among the HIV-positive population, the distributions were 86% First Nation, 25% female, 94% urban, and a mean age of 42 years.

Overall, 0.28% reported a positive HIV diagnosis (weighted frequency of 2,840), and the mean age of diagnosis was 32.5 years (95%CI 25.7-39.2). Descriptive statistics for the survey population are detailed in Table 2.2.

Factors associated with HIV-positive status

Table 2.3 shows factors associated with a positive HIV diagnosis from the adjusted multivariable logistic regression analysis. The model includes six demographic variables, two health behaviours, and five comorbidities. Females were less likely than males to have a positive HIV diagnosis (AOR 0.17; 95% CI 0.07 – 0.41). Compared to individuals between ages 30 and 39, respondents aged 15 to 19 were at lower odds of HIV-

positivity (AOR 0.17; 95% CI 0.05 – 0.58), along with those aged 20 to 29 (AOR 0.11; 95% CI 0.03 – 0.38) and those aged 60 and over (AOR 0.04; 95% CI 0.005 - 0.37). Compared to residents living in rural areas or Inuit Nunaat, the odds of HIV positivity were higher for urban residents (AOR 4.45; 95% CI 1.91 – 10.35). The odds of reporting HIV-positivity were higher among those who reported having a male same-sex married or common-law partner (AOR 13.19; 95% CI 3.67 – 47.50), compared to those who did not. Compared to those in the highest income quartile, individuals were found at higher odds of HIV positivity if they belonged to the second quartile (AOR 13.24; 95% CI 4.45 - 39.38), or third quartile (AOR 2.87; 95% CI 0.94 – 8.75).

The odds of reporting a positive HIV diagnosis were lower among those who never smoked compared to current smokers (AOR 0.22; 95% CI 0.09 – 0.55). Compared to individuals who reported drinking once a week, individuals who drank alcohol one to three times month were at lower odds of HIV-positivity (AOR 0.08; 95% CI 0.01 – 0.59). After controlling for relevant demographic variables and health behaviours, the odds of having a positive HIV diagnosis were higher among individuals diagnosed with: hepatitis B (AOR 36.74; 95% CI 3.95 – 341.47), hepatitis C (AOR 8.62; 95% CI 2.82 – 26.35), tuberculosis (AOR 14.23; 95% CI 3.51 – 57.76), asthma (AOR 4.26; 95% CI 1.81 – 10.00), and cancer (AOR 5.00; 95% CI 1.65 - 15.12).

First Nation, Métis, and Inuit ancestry/identity variables were not significant but were included in the final model after significantly modulating coefficients for total income and education status. Chronic bronchitis was associated with having a positive HIV diagnosis at the univariate level but was confounded with smoking and therefore smoking status was retained in the model rather than bronchitis.

DISCUSSION

Data from the 2006 Aboriginal Peoples Survey included 0.28% of individuals (n=2,840) who reported having a positive HIV diagnosis. Surveillance estimates for 2005 indicated that approximately 3,500 to 4,900 people who self-identify as Indigenous were HIV-positive. This estimate increased to between 4,300 and 6,100 in 2008 [17]. These estimates excluded individuals with Indigenous ancestry, and included individuals living on-reserve in the provinces, both of which complicate comparability with this study's results. Underestimation of HIV prevalence could also result from individuals choosing not to self-report to government workers, and also from others that may not know their HIV status.

The prevalence of HIV may also have been underestimated due to lack of information from individuals who are homeless. Previous research has indicated that Canadians living with HIV who self-report Indigenous ethnicity are more likely to be homeless or living in unstable housing than HIV-positive Caucasians. [18] Among homeless people in Canada, the prevalence and incidence of HIV has been documented is higher than the general population [19, 20].

Demographic Factors

The mean age at diagnosis for HIV-positive individuals in this study was 32.5 years. Previous research has estimated that 32.4% of those diagnosed with HIV who reported Indigenous ethnicity between 1998 and 2006 were under the age of 30, compared to 21.0% among persons of other ethnicities. [21] In this study, individuals between the ages of 15 and 19 were found at significantly lower odds of being HIV-positive than individuals aged 30 to 39. Previous research has found young Indigenous people at a higher

risk for being HIV-positive compared to youth of other ethnicities [22], this was particularly true for those who use drugs [22] or have unstable housing [23]. Other surveillance data have shown that among HIV-positive test reports indicating Aboriginal ethnicity, youth ages 15 to 19 comprised 28.8% of positive HIV test reports in Canada in 1998, and 40.9% in 2008 [24]. More research will be necessary to evaluate the HIV epidemic among Indigenous youth by whether or not they live on reserve. This may explain the low odds of HIV among this age group in the current study because it excluded First Nations people who live on reserve in the provinces.

The majority of HIV cases in the study were male, which corroborates existing research on the general population of Canada [24]. Among all HIV-positive test reports in Canada, 72.2% were attributed to men between 1985 and 2006 [25]. The results also indicate the proportion of HIV among females is lower than has been found in previous studies of HIV-positive test reports among Indigenous people. Between 1998 and 2008, women represented 48.8% of all reports among Aboriginal people compared with 20.6% of reports for those of other ethnicities [26]. Studies that have shown differences in prevalence of HIV by sex between Aboriginal Canadians and those of other ethnicities have attributed the overrepresentation of Indigenous females to injection drug use [27; 28]. It is important to note that information on injection drug use was not collected in the APS.

This study suggests further investigation is needed to understand injection drug usage by sex and whether or not the individual lives on a reserve in future HIV surveillance efforts.

This study found significant differences among respondents belonging to the highest income quartile and those in the second and third income quartiles. According to

the 2006 census, Indigenous people have a lower median annual income than the total Canadian population, and Indigenous people who have HIV are more likely to live below the poverty line than non-Aboriginal HIV-positive individuals [29]. Individuals in the lowest income quartile were at higher odds HIV-positivity in the initial univariate analysis. However, after age and place of residence were included in the multivariable model, this association was no longer statistically significant. It therefore is important that the association between income and having a positive HIV diagnosis be explored further in future research.

In this study, individuals who reported living in a rural community were found to be at lower odds of being diagnosed with HIV compared to those living in an urban census metropolitan area. This finding is consistent with previous studies demonstrating higher odds of HIV among urban Indigenous populations [30], who are at an increased risk of HIV exposure through injection drug use [31]. The HIV-related stigma and discrimination has been found at an increased prevalence and intensity in small communities [32], and those who are HIV-positive experience more difficulty accessing health services [33-35] and social support [36] than in urban areas. Some individuals may have been discouraged from acquiring an HIV test in rural areas [37], or motivated to move to urban areas to avoid stigma and to access better health services [37].

HIV surveillance data on Inuit peoples are limited. Of the 690 Indigenous AIDS cases reported up to the end of 2008, 503 (72.9%) were among First Nations, 52 (7.5%) among Métis, 22 (3.2%) among Inuit, and 113 (16.4%) under the category Indigenous unspecified [38]. The low odds ratio for HIV among individuals in Nunavut areas found in this study is consistent with the relatively small proportion of documented AIDS cases

among Inuit people. Aboriginal identity and ancestry were excluded from the final model due to high collinearity with place of residence (i.e. individuals who reported living in a Nunaaat area were highly collinear with identifying as Inuit).

Previous research has indicated that MSM comprise a smaller proportion of HIV-positive individuals who are Indigenous, compared to the proportion among the general population of Canada [38]. In 2006, MSM was the third-most common exposure category behind IDU and heterosexual contact among Aboriginal men [39]. Similarly, this study found that individuals with a male same sex common-law or married partner were at significantly higher odds of having a positive HIV diagnosis. The survey did not include information about sexual behavior, thus the only data available for MSM were from men who reported a marital or common-law relationship with another man. Further, there were no questions about drug use; therefore, it was not possible to determine the association between IDU and HIV status.

The odds of having a positive HIV diagnosis was lower among individuals who had never smoked, compared to those who were current smokers. Previous research has shown that IDUs are more likely to smoke [40], which would increase their risk of contracting HIV. In our study, those who reported drinking once, or two to three times per month, were more likely to have a positive HIV diagnosis compared to those who had not had a drink in the past 12 months. Studies have shown that excessive alcohol consumption is associated with less frequent use of condoms and more frequent reporting of multiple sexual partners, both which are known risk factors for HIV [41].

Comorbidities

Hepatitis C virus (HCV) and hepatitis B virus (HBV) share routes of transmission with HIV, particularly among IDUs and MSM. These may explain the high odds ratios for having a positive HIV diagnosis among individuals in this study that were diagnosed with either hepatitis virus. This is consistent with previous research, which has found that individuals with HIV are commonly co-infected with HCV [42] and HBV [43], and this was usually due to IDU [43,44]. Co-infection of hepatitis and HIV is a growing concern among people who self report Indigenous identity and injection drug use, especially those who are younger [45] and female [46, 47].

Tuberculosis was found as a co-morbidity in this study. The high odds ratio presented here agrees with previous findings of a 20-fold increase in risk of latent tuberculosis reactivation among individuals infected with HIV [48]. In 2011, the overall rate of tuberculosis infection and disease among Canadian-born Aboriginal people was nearly six times the overall Canadian incidence rate (23.8 per 100,000 population compared with 4.7), with the highest tuberculosis incidence rate found among Inuit at 177.6 per 100,000 population [49]. HIV depresses cellular immunity and facilitates progression of tuberculosis-associated morbidity and mortality.

Research has indicated a high prevalence of respiratory symptoms and obstructive lung disease among HIV-infected people, and increased incidence of asthma among HIV-seropositive individuals receiving treatment with ART [50]. Little is known about the mechanisms by which ART affects HIV-associated pulmonary complications.

Individuals diagnosed with cancer were at significantly higher odds having a positive HIV diagnosis compared to those who had not had cancer, which is consistent with other studies associating HIV with higher cancer risk [18]. A meta-analysis of cancer incidence among

people with HIV/AIDS compared with immunosuppressed transplant recipients found that for 20 of the 28 types of cancer examined, there was a significantly increased incidence in both populations, suggesting that immune deficiency is partially responsible for the increased cancer risk [17]. More research is needed to determine if particular subtypes of cancer are more commonly found in Indigenous persons with HIV and if screening measures can be enhanced among this population.

Study Strengths and Weaknesses

This research is novel in addressing comorbidities associated with a positive diagnosis of HIV among Indigenous persons who are not living on reserves with a sample taken at the national level. Potential risk factors associated with HIV-positivity may have been missed because data were not collected on all commonly identified risk factors and also due to the small sample size, necessitating too large an effect and/or too small amount of variation to observe statistical significance for some factors. Study results may also have been impacted by type I error due to the large number of variables examined.

The Aboriginal Peoples Survey, though a large sample, comprised only Indigenous peoples living off reserve, and therefore analytical results cannot be generalized to those living on reserves. The census also does not include people without a fixed address and those living in institutions. Therefore, the results are not representative of these populations. The APS became voluntary as of the forthcoming 2011 edition, which may further limit data quality of subsequent cycles. Finally, although this study identified several clearly defined issues that were associated with a diagnosis of HIV among Indigenous peoples living off reserve, the survey did not include questions that would elucidate some highly important factors associated with HIV. Previous research has shown

that Indigenous people who inject drugs may be more likely to be infected with HIV than injection drug users who do not identify as Indigenous [39-41]; however, these studies are focused on the concentrated HIV epidemic in Vancouver and would require more research to validate generalizing the results to other Indigenous populations.

Implications and Future research

This study has highlighted a need to explore further the factors associated with a positive diagnosis of HIV among Indigenous peoples who live off reserves in Canada. These results indicate that a positive diagnosis of HIV is associated with the demographic characteristics of age, sex, and household income. Further, it is associated with the behaviors of smoking, and drinking. Finally, the results support enhanced screening of HIV-positive persons for lesser known comorbidities such as asthma and cancer, as well as hepatitis and TB.

Future national surveillance efforts must ask specific questions that identify IDUs, sex workers, and MSM to understand how these HIV risk behaviours account for HIV risk among Aboriginal people. Research aimed toward synthesizing on- and off-reserve health data would help in the effort to understand the distinct and shared challenges of these populations in managing better health outcomes for HIV-positive persons.

CONCLUSIONS

The disparity in HIV prevalence within and across First Nations, Metis, and Inuit people must be considered when assessing the HIV epidemic in Canada. This study identified comorbidities that are overrepresented amongst the Indigenous population who are not living on reserves. Individuals who reported a positive diagnosis of HIV were at a higher odds of also being affected by asthma, cancer, Hepatitis B, Hepatitis C, and

tuberculosis compared to those who did not. This is consistent with findings among non-Indigenous Canadians. An informed characterization of the HIV epidemic in Canada prompts examination into the burden of these comorbidities on HIV-positive Aboriginal populations. Results from this study also encourage research into health behaviours, such as drinking and smoking, and their association with HIV among First Nation off reserve, Métis and Inuit persons. This research was conducted in an effort to support community-led and culturally relevant prevention, care, treatment and support initiatives for Aboriginal persons living with HIV and AIDS.

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Table 2.1 List of demographic variables, health behaviours, and comorbidities evaluated for association with HIV among Indigenous people in Canada; Aboriginal Peoples Survey 2006 (n=998,870)

Demographics	Comorbidities	Health Behaviour
Aboriginal Group	Arthritis/rheumatism	Drinking frequency
First Nation	Asthma	None in past 12 months
Métis	Cancer	Less than once a month
Inuit	Chronic bronchitis	Once a month
Sex (Male/Female)	Emphysema	2 – 3 times a month
Age group	Hepatitis B	Once a week
15 – 19	Hepatitis C	2 – 3 times a week
20 – 29	High Blood pressure	4 – 6 times a week
30 – 39	Stroke	Every day
40 – 49	Tuberculosis	Smoking Status
50 – 59		Current smoker
60 and over		Former smoker
Income quartile		Never smoker
1 (lowest)		
2		
3		
4 (highest)		
Place of residence		
Urban ^a		
Rural/Inuit Nunaat		
Male same-sex partner ^b (Y/N)		

^a “Urban” indicates census metropolitan area of 100,000 or greater

^b “Partner” designates married or common-law relationship

Table 2.2 Descriptive statistics of variables associated with HIV status among Indigenous people in Canada; Aboriginal Peoples Survey 2006 (n=998,870)

	Study N (%)	HIV positive N = 2840 (0.28%)
Indigenous group		
only		
First Nation Identity or Ancestry	509,460 (51.00)	1,350 (0.37)
Métis or Inuit Identity	489,410 (49.00)	410 (0.10)
Sex		
Male	451,960 (45.25)	2,120 (0.47)
Female	546,920 (54.75)	720 (0.13)
Place of residence		
Urban ^a	725,660 (72.65)	2,670 (0.37)
Rural or Inuit Nunaat	273,210 (27.35)	170 (0.06)
Age ^b		
15 – 30	359,650 (36.01)	270 (0.07)
31 – 34	76,170 (7.63)	730 (0.96)
35 – 44	213,590 (21.38)	860 (0.40)
45 – 52	154,660 (15.48)	460 (0.30)
53+	194,810 (19.50)	510 (0.26)
Income (\$)		
0 – 9,499	272,640 (27.29)	220 (0.08)
9,500 – 11,199	39,560 (3.97)	1,320 (3.34)
11,200 – 15,499	95,420 (9.56)	440 (0.46)
15,500 – 28,999	243,200 (24.35)	520 (0.21)
29,000+	348,050 (34.85)	340 (0.10)
Cigarette Smoking		
Current	397,520 (39.80)	2,020 (0.51)
Former or Never	601,350 (60.20)	820 (0.14)
Drinking Frequency		
Not in the past 12 months	229,070 (22.93)	810 (0.35)
Once a month or less	331,550 (33.19)	730 (0.22)
2 - 4 times a month	268,680 (26.90)	810 (0.30)
2 - 7 times a week	169,580 (16.98)	490 (0.29)
Asthma		
Yes	139,500 (13.97)	1,030 (0.74)
No	859,370 (86.03)	1810 (0.21)
Hepatitis (A, B and C subtypes)		
Yes	18,550 (1.86)	890 (4.80)
No	980,320 (98.14)	1,950 (0.20)

^a“Urban” indicates census metropolitan area of 100,000 or greater

^b On the day of the census (March, 2006)

NB: Descriptive statistics for cancer, tuberculosis and having a male same-sex partner were suppressed due to low unweighted cell counts. Other variables were collapsed or re-categorized in order to meet Statistics Canada Guidelines [13].

Table 2.3 Factors associated with HIV status based on multivariable analysis

	AOR	95% CI	p
Indigenous Group			
First Nation	2.40	0.61 – 9.36	0.21
Métis	0.52	0.23 – 1.19	0.12
Inuit	0.55	0.13 – 2.42	0.43
Sex			
Male	1		
Female	0.17	0.07 – 0.41	<0.001
Place of residence			
Urban^a	4.45	1.91 – 10.35	0.001
Rural/Nunaaat(ref.)	1		
Age			
15 – 19	0.17	0.05 – 0.58	0.004
20 – 29	0.11	0.03 – 0.38	<0.001
30 – 39 (ref.)	1		
40 – 49	0.57	0.22 – 1.48	0.245
50 – 59	0.43	0.11 – 1.75	0.241
60+	0.04	0.004 – 0.37	0.004
Male same-sex partner^b	13.19	3.67– 47.50	<0.001
Income quartile			
1	0.98	0.27 – 3.61	0.978
2	13.24	4.45 – 39.38	<0.001
3	2.87	0.94 – 8.75	0.065
4 (ref.)	1		
Smoking Status			
Current smoker (ref)	1		
Former smoker	0.56	0.25 – 1.28	0.171
Never smoker	0.22	0.09 – 0.55	0.001
Drinking frequency			
Less than once a month	0.58	0.17 – 2.02	0.393
1 - 3 times a month	0.19	0.05 – 0.63	0.007
Once a week (ref.)	1		
2 or more times a week	0.43	0.12 – 1.49	0.181
Hepatitis B	36.74	3.95– 341.47	0.002
Hepatitis C	8.62	2.82 – 26.35	<0.001
Tuberculosis	14.23	3.51– 57.76	<0.001
Asthma	4.26	1.81 – 10.00	0.001
Cancer	5.00	1.65 – 15.12	0.004
Intercept	0.004	0.001 – 0.28	

^a “Urban” indicates census metropolitan area of 100,000 or greater

^b “Partner” designates married or common-law relationship

Ref = referent category; CI = confidence interval; AOR = adjusted odds ratio

CHAPTER 3: SOCIAL DETERMINANTS OF HEALTH FOR HIV AMONG FIRST NATION LIVING OFF-RESERVE, MÉTIS, AND INUIT PERSONS IN CANADA

ABSTRACT

Data from the 2006 Aboriginal Peoples Survey were analyzed to characterize social determinants of health that underlie health disparities affecting HIV-positive people who self-report Indigenous identity or ancestry. Multivariable logistic regression was used to identify determinants associated with HIV-positive status that included demographic variables, indicators of socioeconomic status, social support, health services, cultural indicators, and generational residential school attendance. There was a lower odds ($p < 0.05$) of reporting a positive HIV diagnosis among those who were: female; ages 15 to 19, 20 to 29, 40 to 49, 50 to 59, and 60 or over compared to ages 30 to 39; had completed elementary school or less, some high school, some post-secondary non-university or had completed university compared to those who had completed high school; lived with another person, or who lived with two to three people compared to those who lived alone; and who had fished in the last 12 months, compared to those who had never fished. Higher odds of positive HIV diagnosis were found among: those who did not have a job and were not looking for work compared to those who were employed; those who reported a male same-sex common law or married partner; those who indicated that someone is available to show them love and affection “some of the time” compared to those reporting “all of the time”; had consulted a nurse in the past 12 months compared to those who had not; those who rated their health as fair or poor compared to those who reported excellent or very good health; and those who had a parent or grandparent who had been a student at a residential school compared to those who did not. Identifying as First Nation, Métis, and/or Inuit was

not associated with the outcome for either model, but these variables were retained in the final model because they modulated the effect of other factors. These findings support the development of strengths-based, culturally relevant indicators that incorporate social dimensions in order to better address the health and wellbeing of Indigenous persons living with HIV.

INTRODUCTION

Indigenous people in Canada continue to be disproportionately affected in Canada's HIV epidemic [1-5]. HIV infections in Canada in 2011 occurred 3.6 times more frequently among Indigenous people than non-Indigenous people [6]. Among the total population, exposure distribution among the largest HIV risk categories was men who have sex with men (MSM), injection drug users (IDU), and heterosexual contact, at 46.6%, 13.7% and 37.2% respectively, while for Indigenous people, exposure route distribution for the same categories was 8.5%, 58%, and 30.2%.[7]

Intergenerational effects of colonization, including residential schooling and child welfare systems, have contributed to social, political, and economic inequities that generate poorer health outcomes among persons who identify as Indigenous [8 - 10]. The overrepresentation of Indigenous people in Canada's HIV epidemic can be explained by inequalities in determinants of health [10 - 14]. Determinants of health include broad social, political, economic and cultural influences that impact health outcomes based on the distribution of money, power and resources [10 - 12].

Research in the social determinants of health began with the linking of disparate health outcomes with education, income, and employment [15, 16]. The first research investigating the impact of social status on health was a study of 17,530 British male civil

servants between 1967 and 1969. [15, 16] This research identified pay employment remuneration category as the single strongest predictor of mortality due to coronary heart disease, after controlling for blood pressure, cholesterol, smoking, body mass index, blood glucose, physical activity, and height [16]. Since then, a growing body of research has been conducted to explain why those in poorer social and economic circumstances live shorter lives and have more diseases than the rich [10, 12 - 14]. Social determinants of health have proven helpful to understanding more completely the factors that shape healthy lives within and between countries. [14 - 16]

The Public Health Agency of Canada customized the World Health Organization's list of determinants of health to a Canadian model that includes: income and social status; social support networks; education and literacy; employment and working conditions; social environments; physical environments; personal health practices and coping skills; healthy child development; biology and genetic endowment; health services; gender, and culture [17].

Determinants of health have been proven effective as a conceptual framework through which to understand complex disparities between First Nations, Inuit and Métis peoples' health with the general population in Canada [12; 15; 16]. Health determinants have been used to understand more fully the factors that shape the lived experience of HIV-positive persons who identify as Indigenous [12-14; 17].

The objective of this study was to identify social determinants of health associated with a positive HIV test based on census data collected as a national survey of Canadian Indigenous persons including Inuit, Métis, and First Nations peoples living off reserves.

METHODS

Data sources and study population

The Aboriginal Peoples Survey (APS) contains data on Indigenous people aged 15 and above. The term Indigenous here refers to those who self-report at least one Indigenous ancestry or identity, that is, North American Indian, Métis or Inuit. The Census asks, “To which ethnic or cultural group(s) did your ancestors belong?” Answers to this write-in question are coded to determine whether the person has Indigenous ancestry and which Indigenous ancestry group(s) they belong to. Individuals who reported other Indigenous ancestry were excluded.

Participants were selected based on their responses to the 2006 Census, where they indicated Indigenous ethnic origin or identity. Members of an Indian band, First Nation, or status of Treaty Indian or Registered Indian as defined in the Indian Act of Canada were also included. The study population was weighted with population and bootstrap weights to account for sampling design and to stratify the APS to match the Canadian Census sample [18]. A detailed survey and sampling methodology may be found in the Concepts and Methods Guide [18]. Individuals with missing values ie. responses of “Don’t Know,” “Refused,” or “Not Stated” for the dependent or independent variables were excluded from the sample.

Measures

The dependent variable of interest was positive or negative HIV status. Individuals considered positive were those who indicated that they had been told by a health professional that they had HIV. The independent variables were demographic variables and others representing social determinants of health for HIV-infectivity. Survey questions determined a priori to be considered for inclusion in the study design were

grouped into the following broad determinant categories: demographic variables; socioeconomic determinants; social environments and support; health services; cultural continuity; and residential/industrial school experience. A complete list of variables included for consideration is detailed in Table 3.1.

Analyses

HIV status was regressed on independent variables using univariate logistic regression and variables with a liberal p-value of <0.20 were retained for further analyses. Each of these independent variables retained were further screened by examining the coefficient from the univariate regression of that variable was compared to the coefficient from a regression of the variable with one other independent variable added to the model. If the coefficient changed by at least 20% and the variable was not thought to be an intervening variable, it was included in the model as a confounding variable. Next, a main-effects model was built including the screened variables and the confounders, and excluding intervening variables. This main-effects model was reduced using a backward elimination selection process as follows. Independent variables were removed one at a time beginning with the variable with the highest p-value until all remaining were significant at the $p<0.05$ level. After the removal of each variable, an adjusted Wald test was used to determine if the reduced model better fit the data. A weighted Hosmer-Lemeshow goodness of fit test was used to determine whether the final model fit the data.

RESULTS

Study population

A final weighted sample of 998,870 people was used in the analysis after dropping 30,600 individuals due to incomplete information. The weighted survey

population was approximately 60% First Nation, 35% Métis, 10% Inuit, 55% female, and 73% urban, with a mean age of 39 years (95%CI 38.61 – 39.15). Among the HIV positive population, the distributions were 86% First Nation, 25% female, and 94% urban, with a mean age of 42 years.

Overall, 0.28% reported HIV-positive status (weighted frequency of 2840), and the mean age of diagnosis was 32.5 years (95%CI 25.67-39.24). Descriptive statistics for the survey population are detailed in Table 3.2. Two variables considered for inclusion in the main effects model were screened out at the univariate level: traditional medicine availability; and ability to speak or understand an Indigenous language. Variables indicating the respondent's region of residence; total income; received income from social assistance or welfare; and subsidized housing dropped out of the multivariate model.

Factors associated with HIV-positive status

Results from the multivariable logistic regression model detailed in table 3.3 indicated a number of social determinants of health significantly associated with lower HIV-infectivity. The odds of a positive HIV diagnosis were significantly lower among individuals who were female (adjusted odds ratio [AOR] 0.22; 95% confidence interval [95%CI] 0.087 – 0.568). Compared to individuals between ages 30 and 39, all other age groups had significantly lower odds of being HIV positive: ages 15 to 19 (AOR 0.11; 95%CI 0.024 - 0.520); 20 to 29 (AOR 0.12; 95%CI 0.025 - 0.614); ages 40 to 49 (AOR 0.40; 95%CI 0.174 - 0.917); 50 to 59 (AOR 0.28; 95%CI 0.107 - 0.725) and 60 and over (AOR 0.04; 95%CI 0.007 - 0.214). Compared to those who graduated from high school, others were less likely to be HIV positive as follows; individuals who had completed up to some elementary school (AOR 0.07; 95%CI 0.011 - 0.420), some high school (AOR 0.25;

95%CI 0.084 – 0.758) some post-secondary school that was not university (AOR 0.26; 95%CI 0.071 – 0.963), and those who had completed university (AOR 0.21; 95%CI 0.059 - 0.720). Those who had fished in the last 12 months, compared to those who had never fished, were at lower odds of being HIV positive (AOR 0.18; 95% CI 0.066 - 0.470). Compared to those who lived alone, those who lived with another person were less likely to be HIV positive (AOR 0.34; 95%CI 0.119 – 0.942), as were those who lived with two to three other people (AOR 0.12; 95%CI 0.038 – 0.352).

A number of variables were significantly associated with higher adjusted odds of being HIV positive. Those who reported being in a male same-sex common-law or married relationship were more likely to be HIV positive (AOR 43.05; 95% CI 12.602 – 147.043). Respondents who did not have a job and were not looking for work were more likely to be HIV positive compared to those who worked for pay or were self-employed (AOR 3.35; 95%CI 1.581 – 7.112). Those who indicated that someone was available to show them love and affection only “some of the time” were more likely to be HIV positive compared to those with someone available to show them love and affection “all of the time” (AOR 3.11; 95%CI 1.440 – 6.709). Those who rated their health as fair or poor compared to those who reported excellent or very good health were more likely to be HIV positive (AOR 4.53; 95%CI 1.978 – 10.386). Respondents who had consulted a nurse in the past 12 months were more likely to be HIV positive than those who had not. (AOR 2.35; 95%CI 1.224 – 4.525) Those who had a parent or grandparent who had been a student at a residential school were more likely to be HIV positive compared to those who did not (AOR 3.00; 95%CI 1.227 – 7.325).

Indigenous group was not significantly associated with HIV positivity but this categorical variable modulated the coefficients for education level from the main effects model by 20%, and so was included in the final model. A non-significant Hosmer-Lemeshow goodness of fit test indicated that the model fit the data.

DISCUSSION

There were 2840 reports of a positive HIV diagnosis, accounting for an overall prevalence of HIV of 0.28%. Surveillance estimates of HIV among individuals who identified as Indigenous on positive test reports ranged from 3500 – 4900 in 2005 and 4300 - 6100 in 2008[19]. The estimated HIV prevalence rate in 2011 among individuals who reported Indigenous ethnicity was 0.54%, compared to 0.21% among other ethnicities [7]. These estimates exclude individuals with Indigenous ancestry, and include individuals living on-reserve in the provinces, both which complicate comparability with this study's results [19]. Underestimation of HIV prevalence could also result from individuals choosing not to self-report to government workers [20], and others that may not know their HIV status [21].

The prevalence rate of HIV may also have been underestimated due to lack of information from individuals who are homeless. Previous research has indicated that Indigenous Canadians living with HIV are more likely to be homeless or living in unstable housing than HIV-positive Caucasians. [22-24] Among homeless people in Canada, the prevalence and incidence of HIV has been documented as higher compared to the general population [25].

Demographic variables

The mean age at diagnosis for HIV-positive individuals was 32.5 years, similar to findings among the non-Indigenous population at 32 years [26]. Previous research among Indigenous populations has highlighted concerns that Indigenous people tend to acquire HIV at a younger age than non-Indigenous persons [27 - 31]. However, much of this previous research was conducted within concentrated epidemics [28 – 31], and these results suggest that among the off-reserve Indigenous population at a national level, younger individuals are at lower odds of HIV. More research is needed on age distribution of Indigenous persons at the national level that includes both on – and off-reserve populations to explore this relationship further.

Although other studies have indicated that Indigenous women are particularly vulnerable to HIV infection [1 – 5, 23, 32], the current study showed that females were at reduced odds of reporting HIV positivity compared to men. Studies that have highlighted concerns for Indigenous women are usually with reference to concentrated epidemics that involve a high prevalence of high risk behavior, such as injection drug use [4] or sex work [33], and there is little research at a national level indicating that First Nation living off-reserve, Métis and Inuit women who are not injection drug users or sex workers are at increased odds of HIV compared to Indigenous men who live off-reserve and do not use injection drugs.

Information on sexual behavior was not included in the survey, however the proxy indicator of individuals who reported being in a male same sex common-law or married relationship was positively associated with being HIV positive. This is consistent with the increased odds of HIV among non-Indigenous MSM in Canada [1 - 5]. This proxy variable likely under-represents the number of MSM in this sample, as individuals who

identify as MSM but are not in a male same sex common-law or married relationship were not captured by this variable.

Socioeconomic status

Although socioeconomic status is a composite measure of income, education and employment, the interrelatedness of these three variables overlapped such that only the latter two were included in the final model. Studies that have examined the impact of income and education on health outcomes have found that less education is associated with lower income in later life [8, 14, 33-36], which in turn is positively associated with a wide variety of outcomes including type two diabetes [37 - 39], depression [40, 41], and cancer [42, 43]. Our results similarly indicate that individuals with higher education are less likely to report chronic illnesses. Persons who completed a university degree had a lower odds of a positive HIV diagnosis. The results of the current study also indicated that individuals with less than a high school education were also at lower odds of HIV. This may be a spurious finding but it warrants further research to understand this association. National data regarding education level of Indigenous peoples by HIV status have not been estimated in the literature. It is possible that individuals with lower education are less inclined to disclose a positive HIV diagnosis in fear of the public perception of HIV as being associated with stigmatized behavior such as sex work, same-sex behavior, or injection drug use [44 - 47]. More research is necessary to explore the relationship between education and HIV status among Indigenous populations.

The cross-sectional nature of this study complicates the interpretation of employment and HIV status with respect to causality. Studies among the general population of Canada have indicated that those who are unemployed are more likely to

report chronic illnesses [48 - 50], but in this study it is unclear if unemployment increases the risk of HIV or if a HIV positive diagnosis and the subsequent health consequences increases the risk of unemployment. Further research is necessary to determine the directionality of the observed association between unemployment and a positive HIV diagnosis.

Social Support

Research among HIV positive adults in North America has found a correlation between loneliness, depression and HIV positivity [51, 52]. This may explain the association between living with another person and reduced odds of HIV found in this study. It also contextualizes the association between a positive HIV test report and reporting limited contact with individuals who provide love and affection.

Health Services

Studies among the general Canadian population have indicated that HIV-positive individuals consult nurses more regularly than HIV-negative persons [53]. This association was also found in the current study where there was a positive association between a positive HIV diagnosis and consulting a nurse in the past 12 months. Previous research of HIV among Indigenous people have been concentrated in urban centres [29, 51, 52]. Indigenous persons living in remote locations and First Nations people living on reserves were found in previous research to have consulted a nurse more often than the general population due to limited health services in these regions [56, 57]. Since this survey did not gather results for on-reserve populations, these results prompt further investigation into the role of nurse practitioners in the management of HIV for individuals who self-identify as Indigenous.

Perceived health status has been included here with the guidance of other research that validates this measure for capturing more holistic perceptions of health that were not included within another variable in the multivariable model [58 – 61]. HIV positive Indigenous persons were more likely to report fair or poor health status than those who did not report HIV positivity.

Cultural Continuity

An examination of the role of traditional activities in shaping health have found that, among Indigenous people, those who had hunted or spent time on the land reported better self-rated health status than those who did not [62]. This may explain, in part, why individuals who had recently fished were at lower odds of a positive HIV diagnosis.

Residential or Industrial School

The effects of the residential school system have persisted across generations[14 ,33]. In this study, this effect is found yet again as the increased odds of reporting a positive HIV diagnosis among those with a parent or grandparent who had been a student at a federal industrial school or residential school compared to participants whose parents or grandparents did not attend one of these schools. This finding emphasizes the importance of considering the historical impacts of colonization on the health outcomes of the Indigenous Peoples of Canada, as has been widely stated in the determinants of health literature [8 – 10, 14, 33].

Strengths, Challenges and Limitations

This research is the first to investigate social determinants of health associated with a positive diagnosis of HIV among a national survey of people who self-report Indigenous ethnicity and are not living on reserve. Limitations of this study include the

small number of unweighted HIV-positive individuals, which inflate the variance around the odds ratio estimates. Potential determinants associated with HIV-positivity in other studies were not included because they were not measured by this national survey. Due to the large number of variables examined, study results may also have been impacted by type I error.

The Aboriginal Peoples Survey lacked information on First Nation individuals who are living on reserve. The survey also did not include people without a fixed address and those living in institutions. Therefore, the results are not representative of these populations.

The 2012 edition of the Aboriginal Peoples Survey cannot be compared to the results of this survey as a result of two major changes. Firstly, the 2012 APS is based on information from the National Household Survey, a voluntary survey that replaced the mandatory long-form Census in 2011.[63] This will likely limit data quality of subsequent cycles, especially for smaller subsamples [63] such those who report a positive HIV diagnosis, which could be sensitive to non-response bias. Secondly, the 2012 APS only includes individuals who report Indigenous identity, and excludes those who report Indigenous ancestry but not Indigenous identity.

CONCLUSIONS

This study has highlighted a need to explore further the social determinants associated with HIV status among First Nation off-reserve, Métis and Inuit persons. These results indicate that a positive diagnosis of HIV is associated with a combination of individual demographic variables, and socioeconomic, community, cultural, and intergenerational factors. More research is needed to disentangle the complex interactions

of these factors, to determine how they effect and are affected by HIV status among Indigenous persons. A more complete understanding of First Nations, Metis, and Inuit health among HIV-positive individuals requires an exploration of the social determinants that impact the epidemic in Canada.

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Table 3.1 List of social determinants of health evaluated for association with HIV among First Nation living off reserve, Métis and Inuit persons in Canada, Aboriginal Peoples Survey 2006 (n=998,870)

Demographics	Social Support
Indigenous Group (three separate Y/N variables)	Number of people living with respondent
First Nations	Lives alone
Métis	One other person
Inuit	Two or three other people
Sex (Male/Female)	Four or more other people
Age	Has someone who shows them love and affection
15 – 19	All of the time
20 – 29	Most of the time
30 – 39	Some of the time
40 – 49	Almost none of the time
50 – 59	
60+	
Male same-sex partner ^a	Health Services
Province/Territory of residence ^b	Past 12 months – consulted a nurse?
	Self-rated health status
	Excellent or Very Good
	Good
	Fair or Poor
Socioeconomic Status	Cultural Continuity
Income quartile	Fished in the past 12 months?
1 (lowest)	Yes
2	Never fished
3	Traditional medicines available in community (Y/N)
4 (highest)	Speak or understand an Indigenous language
Received income from social assistance/welfare?(Y/N)	Speak
Employment Status ^c	Understands only
Worked for pay/self-employed	Neither speaks nor understands
No job, looking for work	
No job, not looking for work	
Housing	Residential or Industrial school
Owns a home	Parent/Grandparent attended a federal residential or industrial school
Lives in subsidized housing	Yes
Does not live in owned or rented home	No
Highest level of school attained	Don't Know
Some elementary	
Some high school	
Completed high school	
Some post-secondary non-university	
Completed some post-secondary	
Some university	
Completed university or higher	

^a Common-law or married partner

^b On the day of the census (May 16, 2006)

^c On the week before the Aboriginal Peoples Survey (October 31, 2006)

Table 3.2 Descriptive statistics of variables associated with HIV positive status among First Nation living off-reserve, Métis and Inuit persons in Canada, 2006 (n=998,870)

	Study N (%)	HIV positive N = 2840 (0.28%)
Indigenous group		
First Nation Identity or Ancestry Only	509,460 (51.04)	2120 (0.42)
Métis or Inuit Identity/Ancestry	489,410 (49.00)	720 (0.15)
Female	546,920 (54.75)	720 (0.13)
Male	451,960 (45.25)	2120 (0.47)
Age ^a		
15 – 30	359,650 (36.01)	270 (0.07)
31 – 34	76,170 (7.63)	730 (0.96)
35 – 44	213,590 (21.38)	860 (0.40)
45 – 52	154,660 (15.48)	460 (0.30)
53+	194,810 (19.50)	510 (0.26)
Region of residence ^a		
Atlantic/Quebec	245,570 (24.59)	460 (0.19)
Ontario/Prairies	571,950 (57.26)	860 (0.15)
British Columbia	146,220 (14.64)	1420 (0.97)
Territories	35,130 (3.52)	100 (0.29)
Income (\$)		
0 – 9,499	272,640 (27.29)	220 (0.08)
9,500 – 11,199	39,560 (3.97)	1320 (3.34)
11,200 – 15,499	95,420 (9.56)	440 (0.46)
15,500 – 28,999	243,200 (24.35)	520 (0.21)
29,000+	348,050 (34.85)	340 (0.10)
Income received from social assistance or welfare	94,430 (9.45)	1160 (1.2)
No income received from social assistance or welfare	90440 (90.55)	1680 (0.19)
Employment Status		
Employed or looking for a job	649,780 (65.05)	920 (0.14)
Unemployed and not looking	349,090 (34.95)	1920 (0.55)
Housing		
Owns or rents a home	284,690 (28.50)	960 (0.34)
Lives in subsidized housing	82,740 (8.28)	860 (1.04)
Does not live in owned/rented home	631,440 (63.22)	1020 (0.16)
Education		
Less than High School	294,930 (29.53)	680 (0.23)
High School diploma	308,070 (30.84)	1350 (0.44)
Post Secondary diploma ^b	395,880 (39.63)	810 (0.20)
Number of people living with respondent		
Lives alone	115,140 (11.53)	1460 (1.27)
One other person	283,070 (28.34)	680 (0.24)
Two or three other people	426,820 (42.73)	270 (0.06)
Four or more other people	173,830 (17.40)	420 (0.24)
Consulted a nurse in last 12 months	289,030 (28.94)	1490 (0.51)
Did not consult a nurse	709,840 (71.06)	1350 (0.19)
Self-Rated Health		
Excellent or Very Good	578,860 (57.95)	650 (0.11)
Good	263,000 (26.33)	380 (0.15)
Fair or Poor	157,020 (15.72)	1810 (1.15)
Been fishing in the past 12 months	357,810 (35.82)	200 (0.06)
Not in the past 12 months or never	641,060 (64.18)	2640 (0.41)
Traditional medicines available in community	29,195 (29.23)	820 (0.28)
Traditional medicines not available or Don't Know	706,930 (70.77)	2020 (0.29)
Speaks or understands an Indigenous language		
Speaks	129,940 (13.01)	670 (0.52)

Understands only	238,170 (23.84)	430 (0.18)
Neither speaks nor understands	630,760 (63.15)	1740 (0.28)
Parent/Grandparent was a student at a federal residential school		
Yes	177130 (17.73)	990 (0.56)
No	489640 (49.02)	1360 (0.28)
Don't Know	332100 (33.25)	490 (0.15)

^a On the day of the census (As of March 30th, 2006)

^b Post-secondary includes university and other education (eg. trade/vocational school or apprenticeship)

NB: Descriptive statistics for having a male same-sex partner and for having someone available who shows them love and affection were suppressed due to low unweighted cell counts. Other variables were collapsed or re-categorized in order to meet Statistics Canada Guidelines [7].

Table 3.3 Factors associated with a positive HIV diagnosis among First Nation living off reserve, Métis and Inuit persons based on multivariable logistic regression; Aboriginal Peoples Survey 2006 (n=998,870)

	AOR	95% CI	p
Indigenous Group			
First Nation	2.59	0.638 – 10.481	0.183
Métis	0.76	0.1341 – 1.676	0.491
Inuit	0.99	0.264 – 3.739	0.993
Sex (Ref. = Male)			
Female	0.22	0.087 – 0.568	0.002
Age (Ref. = 30 – 39) ^a			
15 – 19	0.11	0.024 – 0.520	0.005
20 – 29	0.12	0.025 – 0.614	0.011
40 – 49	0.40	0.174 – 0.917	0.03
50 – 59	0.28	0.107 – 0.725	0.009
60+	0.04	0.007 – 0.214	<0.001
Male same-sex partner^b	43.05	12.602 – 147.043	<0.001
Employment Status (Ref. = Worked for pay/self-employed)			
No job, looking for work	2.22	0.386 – 12.785	0.371
No job, not looking for work	3.35	1.581 – 7.112	0.002
Highest level of school attained (Ref. = Completed high school)			
Some elementary	0.07	0.011 – 0.420	0.004
Some high school	0.25	0.084 – 0.758	0.014
Some post-secondary non-university	0.26	0.071 – 0.963	0.044
Completed some post-secondary	0.41	0.162 – 1.037	0.06
Some university	0.19	0.030 – 1.133	0.068
Completed university	0.21	0.059 – 0.720	0.013
Number of people living with respondent (Ref. = Lives alone)			
One other person	0.34	0.119 – 0.942	0.038
Two or Three other people	0.12	0.038 – 0.352	<0.001
Four or more other people	0.60	0.166 – 2.14	0.427
Has someone to show love and affection (Ref. = All of the time)			
Most of the time	0.58	0.210 – 1.621	0.301
Some of the time	3.11	1.440 – 6.709	0.004
Almost none of the time	0.47	0.114 – 1.966	0.303
Past 12 months – consulted a nurse	2.35	1.224 – 4.525	0.01
Self-rated health status (Ref. = Excellent or Very Good)			
Good	0.94	0.358 – 2.475	0.903
Fair or Poor	4.53	1.978 – 10.386	<0.001
Fished in the past 12 months? (Ref. = Never Fished)			
No	0.63	0.255 – 1.548	0.311
Yes	0.18	0.066 – 0.470	0.001
Parent/Grandparent attended a residential school (Ref. = Don't Know)			
Yes	3.00	1.227 – 7.325	0.016
No	1.94	0.729 – 5.179	0.184
Intercept	0.03	0.003 – 0.384	0.007

^a On the day of the census (As of March 30th, 2006)

^b Partner = married or common-law

AOR is the adjusted odds ratio. 95% CI is the confidence interval. Ref. is the reference group. Observations with missing data on any variable excluded. Bolded text indicates statistical significance at p < 0.05

CHAPTER 4: CONCLUSIONS

FINDINGS

The research described in this thesis investigated HIV prevalence, associated factors, comorbidities, and social determinants among a national sample of Canadians over 15 who self-reported Indigenous identity or ancestry. This research was conducted to obtain an overall national prevalence estimate for having a positive HIV diagnosis among this population, and to explore putative factors associated with HIV. This chapter outlines key findings of this research project with respect to the prevalence of having a positive HIV diagnosis, as well as demographic factors, comorbidities, and social determinants of health for HIV identified in the multivariable models.

Prevalence of having a positive HIV diagnosis

The prevalence of HIV based on self-reporting status was 0.28% among a weighted sample of 998,870 First Nation, Métis and Inuit persons. This is lower than the estimates from the Public Health Agency of Canada (PHAC), who estimated a 0.54% prevalence rate in 2011 among individuals who reported Indigenous ethnicity, and more comparable to the 0.21% reported among other ethnicities [1]. The lower prevalence might be explained by comparing the populations from which these prevalence rates were drawn. The Aboriginal Peoples Survey (APS) includes individuals who report Indigenous ancestry with no identity, whereas the PHAC estimate excludes these individuals from the population. It is possible that Indigenous people who do not self-identify as Indigenous would more closely resemble the general population with respect to HIV prevalence. Further, individuals who live on reserves in the provinces were excluded by the APS, but included in the PHAC estimates, although evidence that HIV-prevalence is high on reserves in the province has so far not been shown. Finally, the lower

prevalence could be due to underreporting in the APS. In any case, further exploration is necessary to determine why, among a national sample, the prevalence rate of HIV resembles the general population, rather than the elevated prevalence frequently cited among Indigenous populations.

Demographic Factors

A variety of demographic factors were significantly associated with HIV. Of particular interest is finding of female sex as being associated with lower odds of reporting a positive HIV test. This is in conflict with surveillance data of HIV positive case reports, in which 48.1% of reports among Indigenous persons were female [2]. Previous research has also shown that people with Indigenous ethnicity tend to be infected with HIV at a younger age than those of other ethnicities. This was not found in our study, in which the mean age of diagnosis closely resembled that of the general population. More research is necessary to determine if these differences are a result of including individuals with Indigenous ancestry only, since they are not recorded as having Indigenous ethnicity in positive case reporting.

Although surveillance research has found that MSM comprise a much smaller proportion of HIV positive case reports among Indigenous persons (6.5% compared to 39.9% among the general population [3]), in this population, reporting a male same-sex partner was highly associated with reporting a positive HIV diagnosis. It is possible the MSM comprise a greater proportion of HIV-exposure among the ancestry-only population, but this needs to be further explored.

Health behaviours were explored in this study by examining the associations between HIV with smoking and drinking. Previous research has shown that individuals who are HIV-positive experienced an increased burden of smoking-related illnesses [4], therefore our finding

that current smoking is associated HIV indicates that current public health measures with regard to smoking cessation may not be addressing this particularly vulnerable population.

Comorbidities

The association between HIV with tuberculosis, and hepatitis C, is well-researched and corresponds with this study's findings. Less established is an association between HIV and other comorbidities, such as hepatitis B, asthma, and cancer, which were all found to increase odds of reporting a positive HIV diagnosis in this population. Future work should explore the mechanism by which these comorbidities manifest, and what can be done to manage these syndemics.

Social Determinants

These findings reinforce the utility of the social determinants approach in understanding the complex factors associated with HIV among Indigenous persons. A cornerstone of determinants of health research is the effect of socioeconomic status in health, and we see from this research that those who are unemployed or have lower income are at higher odds for HIV-positivity. Likewise, it was found that completing university lowers odds of reporting a positive HIV diagnosis.

Measures of social support in this study were also associated with HIV, namely, living with others lowered odds of reporting an HIV-positive diagnosis, and reduced social contact (someone who shows love and affection) increased likelihood of reporting a positive HIV diagnosis. This emphasizes the importance of social connection and engagement among Indigenous persons who are living with HIV.

Public health efforts with respect to managing the HIV epidemic among Indigenous persons should consider the unique impact that nurse practitioners have in managing HIV-

positive persons in this population, as these results have shown that those who report a positive HIV diagnosis are more likely to have consulted a nurse.

The importance of traditional activities to Indigenous health has been demonstrated in these findings by indicating an association between having recently gone fishing, and reduced odds of reporting an HIV test. This study also highlights the impact of colonization, in finding that those whose parents or grandparents had attended a residential or industrial school were at higher odds of HIV. This underlines the complex nature of determinants of health, that they have intergenerational impacts that are not controlled by socioeconomic status alone, and suggests that effective management of HIV among Indigenous persons requires. These findings support the development of culturally-relevant health promotion that puts the unique needs and knowledges of Indigenous people at the forefront of targeted HIV interventions. An analysis of the health-care needs of the Indigenous population would be remiss without considering what is uniquely important to living healthful lives among Indigenous populations.

IMPACTS AND LIMITATIONS

These findings echo the call for improved national surveillance of Indigenous health. This study contests the often-cited increased prevalence of HIV among Indigenous people, suggesting that this may not be true when including the ancestry-only population, or excluding First Nation persons living on reserves in the provinces. Also, a number of predictors for HIV among Indigenous people, including male sex, younger age, lower education, appear not to be associated with HIV in this population, necessitating further research that takes into account ancestry and reserve status. This is the first multivariable study of HIV among Indigenous persons using a national level sample, and it is therefore difficult to compare with studies among smaller Indigenous populations. This research emphasizes that further work is necessary to

characterize the HIV-epidemic among Indigenous populations at a national level, evidenced by the disparity between these findings and those of smaller sub-populations.

Limitations of this research include the lack of information on MSM and IDU in this sample, as well as information on HIV testing. Also, the number of predictors in the multivariable model is large and therefore sensitive to type I error. Finally, the results of this study cannot be extrapolated to First Nation persons in the provinces as they were excluded from the sample.

CONCLUSION

The findings from this research validates the need for future national-level HIV surveillance on Indigenous populations. The work identifies demographic and comorbid factors associated with HIV that should inform public health, policy, and community-level responses. This research also validates a social determinants approach to understanding HIV within the Indigenous population, with indicators that are specifically relevant to First Nations, Métis, and Inuit Peoples.

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